CHANGED PRODUCT RULE
Aviation Rulemaking Committee Final Report

December 20, 2024

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I. Executive Summary

The Changed Product Rule (CPR) Aviation Rulemaking Committee (ARC) was chartered by the Federal Aviation Administration (FAA) on April 15, 2024. The objectives specified in the ARC Charter were to consider the requirements from Section 117 of the Aircraft Certification, Safety, and Accountability Act (Pub. L. 116-260, 134 Stat. 2309, hereafter referred to as ACSAA), the recommendations from the CPR International Authorities Working Group (IAWG), and materials and public comments within Docket FAA-2023-03053 to evaluate the need for new rulemaking and development of FAA policy and guidance to ensure an adequate certification basis is established for changed products, including amendments to § 21.19 for changes requiring a new Type Certificate (TC) and the basis for such determination.[1]

The FAA selected ARC members based on their experience and expertise with the application of the CPR in the amended type certificate and supplemental type certificate processes. The ARC members, observers, and contributors consisted of broad industry representation, including manufacturers, trade associations, and subject matter experts. Staff from the FAA, other federal agencies, and foreign civil aviation authorities also participated as observers to provide technical support to the ARC members.

The ARC established two main working groups, dividing the taskings between those primarily applicable to § 21.19 Substantial change classifications, and those primarily applicable to § 21.101 Significant change classifications. Where appropriate, additional subject matter experts were invited to attend meetings and assist in working group activities.

Working group #1 of the ARC identified necessary amendments to the language of § 21.19 to align with the IAWG recommendations that would change the parameters currently used to establish the requirement for a new TC and the basis for such determinations. The ARC reviewed the IAWG's proposed objective criteria to distinguish between "significant" and "substantial"[2] changes to type design during the classification of changes to a TC, and developed recommended thresholds that could reasonably apply to those criteria when performing a substantial change classification assessment. The proposed objective criteria are based on IAWG Recommendation 1A2, which defines a new Reference Type Design (RTD) as the basis for conducting a substantial change classification assessment differently from the Baseline Product reference point used for significant change classification. The ARC emphasizes the importance of the IAWG giving due consideration to the proposal to allow an applicant to advance a product's life cycle in certain cases by gaining approval of an additional RTD on a given TC, and recognizing limited cases where products may continue to be developed even though they have exceeded the substantial change classification thresholds if an appropriate justification is provided by the applicant. These criteria and proposals include examples that should be incorporated into new and existing guidance material.

Working group #2 of the ARC identified several concepts that are recommended to be applied to the process and parameters affecting design change classifications relative to § 21.101, with the objective of developing clear definitions for important terminology that had previously not been well defined. New definitions as well as proposed updates to existing definitions and guidance are provided to improve

[1] *See* Docket No., FAA-2023-0305-0001, Input to Changed Product Rule International Authorities Working Group Recommendations, available at: https://www.regulations.gov/document/FAA-2023-0305-0001.

[2] Significant changes as defined by § 21.101 and substantial changes are those that are so extensive that a substantially complete investigation of compliance with the applicable requirements is required in accordance with § 21.19.

recommended practices for identification of areas affected by a change. The working group investigated and thoroughly developed a process to support the use of systems safety principles in recognizing the advances in technology and systems integration to identify areas affected by proposed changes and developed guidance materials to support its recommendations. Finally, a detailed and robust methodology was developed for an iterative process by which an applicant would ensure that a sufficient breadth of affected areas has been considered and are not overlooked in the process of establishing an adequate certification basis.

When the above proposals achieved a relatively mature status of development, the working groups shifted their focus to developing an enhanced set of example cases. The example cases are intended to be included in guidance and/or reference material targeting industry practitioners and representing typical significant change classification scenarios for each product category.[3] Extensive consideration was also given to the impact on subsequent design changes by either the TC holder or supplemental type certificate (STC) applicants. The ARC recognizes that awareness of past changes to a product, a clear definition of the areas affected by those changes, and the resulting impact on the Certification Basis are critical to ensuring the continued safety of the product. Due consideration is necessary for the level of detail that must be available to the public. Therefore, the ARC recommended additional tasking to further develop recommendations for Type Certificate Data Sheet (TCDS) content, with a focus on harmonizing that information across international certification authorities to level the playing field across the industry. The ARC drafted all of its recommendations with a goal of ensuring, to the greatest extent possible, compatibility with the certification systems of other civil aviation authorities (CAAs) for the purpose of supporting international harmonization and coordination with the CPR IAWG.

II. Chairs' Comments

The CPR principles are designed to enhance aviation safety by ensuring to the greatest extent possible that the latest airworthiness requirements are applied when making changes to aeronautical products. Since its last major update, aerospace technology has evolved very substantially through extensive integration of systems that were traditionally independent, and through advancement of materials and processes yielding improvements in weight, strength, manufacturability, safety, and longevity that have far outpaced the evolution of airworthiness regulatory standards. Similarly, compliance methodology has necessarily evolved commensurate with the advances of technology and systems integration. Compounding these advances within the traditional product spectrum is the emergence of new product types and configurations, as well as operational scenarios (e.g., electric vertical take-off and landing (eVTOL) aircraft, air taxi operations, uncrewed or remote-piloted airborne systems, supersonic aircraft, alternative energy sources, additive manufacturing capabilities and advanced materials). Guidance made available to the industry at the time that the latest CPR rules were promulgated could not foresee this level and pace of growth and evolution.

The aerospace industry invests heavily in research and development with the intention of fostering continuous improvements in safety and advancements in operational performance, efficiency, economics, and customer comfort to establish a competitive advantage within the marketplace. The flying public

[3] In some cases, the examples require further development and the ARC has requested additional taskings to facilitate this work (e.g., follow-on work is required to develop appropriate examples for Transport Category aircraft). *See* Section VII. of the ARC report.

demands to be able to trust aerospace manufacturers, product modifiers, and certification authorities to achieve the safest, most reliable, and most efficient aeronautical products possible, and industry is committed first and foremost to achieving that trust.

FAA, in collaboration with other leading global aviation safety authorities, chartered the IAWG to conduct a review of CPR requirements and processes, and make recommendations for improvements. In support of this objective, aviation manufacturers collaborated under the leadership of the General Aviation Manufacturers Association (GAMA) and the Aerospace Industries Association (AIA) to develop industry recommendations. Through evaluation of survey inputs collected from around the industry, it became clear that there is a need to expand and modernize the CPR guidance material. In particular, the examples of significant changes and for identification of affected areas which are essential for industry to achieve consistent and predictable project classification determinations when planning for the evolution of aeronautical products. CPR guidance is due for significant improvements to better accommodate the technological advancements and compliance methodologies, and to be more adaptable to continued evolution and increased pace and growth in the future. Manufacturers are interested in shaping that improvement of the CPR to ensure that existing products can continue to be safely operated and improved where appropriate and future changed products can continue to be developed, and type certificated. Industry is committed via this ARC to supporting the FAA and their IAWG partners in making recommendations to improve the requirements and guidance for development and certification of changed and future aviation products.

Contained within this report are 14 detailed recommendations that have been developed primarily by the industry participants of the CPR ARC and are hereby submitted for consideration by the FAA and partner authorities on the IAWG. The ARC considers that it is critical that the FAA take into consideration the interaction and integration of all ARC recommendations with all of the IAWG actions, which goes beyond the limited subset of IAWG recommendations specifically identified in the ARC's charter. The ARC provides several recommendations that are targeted at improving guidance materials for application of existing § 21.101 regulatory requirements, and strongly recommends that these be implemented in upcoming revisions to existing guidance material to ensure current projects (and personnel involved in overseeing these projects) benefit from these improvements and clarifications.

Section VII of the CPR ARC recommendation report identifies several topic areas that warrant more development and therefore, in accordance with task 4.e of the charter, the industry members of the ARC respectfully request that the FAA Co-Chair designate additional tasking to the ARC, in the interest of expanding on or more fully developing concepts that have emerged during the work of the ARC, but could not be fully matured, or that are over and above the original tasking, but are felt to be critical to a successful and holistic evolution of Changed Product Rule principles.

The CPR ARC is comprised of highly experienced industry CPR practitioners and experts from Original Equipment Manufacturers (OEM) and STC holders from around the world, representing all types and categories of Aeronautical Products. Additionally, it included subject matter experts from both the FAA (Part 21, product experts, and human factors) and several foreign authorities (from the IAWG). To serve as the industry co-Chair on this committee of highly esteemed industry experts has been a rewarding and humbling endeavor, and to do so alongside those experts, the FAA co-Chair, additional FAA members, and the IAWG observers, has been an honor of the highest order. We are trusted to put forth recommendations

that ultimately will transform aviation safety for air travelers worldwide, and this committee has worked tirelessly to achieve that objective.

III. Background

Airworthiness standards (often referred to as airworthiness regulations or airworthiness requirements) are continually amended to improve safety. Typically, changes to type certificates (TC) are required to meet the amendments of the airworthiness requirements in effect on the date of application for the change and its affected areas. However, there are some exceptions where the proposed design changes, and any areas affected by the changes, can be certified to earlier regulatory amendments. For a change to a TC that is considered substantial, the entire product is required to meet the applicable airworthiness requirements in effect on the date of the application. The process for determining the applicable airworthiness requirements and amendments is governed by §§ 21.19 and 21.101 of Title 14 of the Code of Federal Regulations (CFR), commonly referred to as the Changed Product Rule. The CPR principles are to "enhance safety by incorporating the latest airworthiness requirements to the type certification basis for the changed product, to the greatest extent practicable."[4]

Section 21.19 describes the circumstances in which an applicant for a change to a TC must apply for a new TC. Section 21.19 requires an applicant to apply for a new TC for a changed product if the FAA finds that the change in design, power, thrust, or weight is so extensive that a substantially complete investigation of compliance with the applicable airworthiness requirements is necessary.

Section 21.101(a) requires a change to a TC, and the area(s) affected by the change, to comply with the airworthiness requirements in effect on the date of application unless the change meets the criteria for the exceptions identified in § 21.101(b) and (c). The intent of § 21.101 is to enhance safety by incorporating the latest airworthiness requirements into the type certification basis for the changed product to the greatest extent practicable.

Application of the Changed Product Rule is guided by Advisory Circular 21.101-1B, *Establishing the Certification Basis of Changed Aeronautical Products*, and is subject to FAA Order 8110.48A, *How to Establish the Certification Basis for Changed Aeronautical Products*.

IV. Overview of ARC Charter

The CPR ARC evaluated the need for new rulemaking as well as FAA policy and guidance development to ensure an adequate certification basis is established for changed products. The ARC Charter referenced ACSAA requirements and recommendations from the IAWG. The ARC investigated the use of systems safety principles towards the identification of areas affected by proposed changes, examined how systems safety principles may play a role in changed product outcomes, and further developed the applicable guidance materials. The CPR ARC's recommendations also considered compatibility with the certification systems of other CAAs to support international harmonization efforts.

The ARC was tasked with:

a. Identifying necessary amendments to § 21.19 and related guidance that the ARC finds appropriate to ensure an adequate certification basis is established for changed products, such as requiring a

[4] Reference FAA Order 8110.48A.

new TC. CPR IAWG recommendations and usage of the reference type design definition should be incorporated as much as possible.

b. Evaluating draft objective criteria developed by the CPR IAWG (Recommendation 1A1) for determining if a proposed design change would result in a substantial change under § 21.19 and require a new TC application. This should include performing an impact assessment for proposed objective criteria using prior certification projects or new potential projects (amended TCs) and proposing revisions to objective criteria as necessary.
c. Identifying additional guidance as necessary, including practical examples of proposed design changes for inclusion within advisory material to support the implementation of the classification criteria for substantial/significant changes; guidance material will include improving the definitions associated with the three criteria for the significant change classification and evaluation of design changes at the product level.
d. Developing guidance material for affected areas to include incorporating the use of systems safety principles (Recommendation 1BG3); ensure that guidance addresses the need for proposed changes to an aircraft to be evaluated from an integrated whole-aircraft system perspective (i.e., examination of the integration of proposed changes with existing systems and the associated impacts); ensure guidance also includes considerations for the need to weigh certain airworthiness requirements within the CPR process, such as those pertaining to flight deck and human factors effects, and safety critical information.
e. Submitting a recommendation report within six months from the first meeting after the effective date of the charter. The recommendation report should document both majority and dissenting positions on the findings and the rationale for each position. Any disagreements should be documented, including the rationale for each position and the reasons for disagreement. The FAA co-chair may task the ARC with subsequent recommendation reports with deadlines prior to the ARC's sunset date.

V. Objective Criteria for Substantial Changes

As part of its work, the ARC considered the existing regulatory structure and evaluated the draft objective criteria developed by the CPR IAWG. As a result of this analysis, the ARC proposes several revisions to the regulatory text and objective criteria. The ARC acknowledges the IAWG position that § 21.19 evaluations should always be tied to a Reference Type Design (RTD), whereas the assessments required by § 21.101 should use the baseline product.[5] However, the ARC is generally not in favor of the implementation of an RTD that is different from the baseline product. The consensus among ARC participants remains that the primary focus of the criteria should be the required level of investigation of compliance. Nonetheless, the ARC has formulated Recommendations REC1 through REC4 presuming the adoption of the IAWG recommendation for the RTD.

The ARC also notes that, in some instances, AC21.101-1B lacks specific guidance, which has resulted in an inconsistent application of the rules, or even failing to consider § 21.19 for design changes. To ensure the requirements of § 21.19 are consistently considered as part of any major product change, the ARC recommends including a sequence diagram in the guidance material that is like the decision record currently contained in Appendix B of FAA Order 8110.48A. The ARC also recommends updating the

[5] *See* REC2 for more details.

guidance material to include examples that focus on a more holistic approach to determine when a product change will require a substantially complete investigation of compliance.

A. ARC Evaluation of the Draft Objective Criteria in the IAWG Report

The ARC began its work by considering the existing regulatory structure and evaluating the draft objective criteria developed by the CPR IAWG.[6] This evaluation was required by the CPR ARC Charter[7] for the purpose of determining whether and when a proposed design change would result in a substantial change under § 21.19 and require a new TC application. The ARC also performed impact assessments for proposed objective criteria using prior certification projects or potential new projects as examples (e.g., amended TCs). Based on these assessments, the ARC makes the following observations:

1. Single Quantitative Criteria Feedback

The ARC acknowledges that an approach using a single criterion, such as thrust or weight, is simpler and potentially more consistent, but it is not a true measure of a substantially complete investigation of compliance and may result in unintended consequences (e.g., limits on design innovations that are safety upgrades, changes to design with limited thrust). The singular objective criterion approach is prescriptive by definition, making it difficult to maintain as technology changes and advances. Moreover, the ARC does not believe that a singular objective criterion approach aligns with the trend toward using the high-level safety intent.

Design changes themselves are the key driver for the required level of investigation. The ARC considers design changes to be the highest priority from an industry perspective, with thrust and weight being significantly lower priorities. Thrust changes can be a singular (isolated) design objective, in which case the resulting impact on the aircraft would not result in a substantially complete investigation of compliance. Weight changes are typically the result of other design changes and not the primary design objective.

The ARC's view seems to be shared by the IAWG in its 2022 report. The IAWG observed that:

> "while specifying cut-off numbers/thresholds (for weight and thrust – see above) provides predictability for the industry and ensures standardization in the decisions, it may be a source of unfairness between applicants as it relates to design growth potential that may or may not be anticipated (design provisions) at time of initial design. Therefore, thresholds may be associated with actual design modifications of much different amplitude. The primary criteria that should prevail should always be the extent of the design change and the associated compliance re-investigation and the numbers are just an indication based on benchmarking."

The IAWG further noted that the existing singular criterion examples provided in current guidance are "…neither fully adequate nor complete." A detailed review of the high-level product change examples shows that some have been historically unrealistic (e.g., subsonic to supersonic), while others may usually be effective and appropriate, but are not always adequate to show a substantially complete investigation of compliance.

[6] https://www.faa.gov/sites/faa.gov/files/IAWG_CPR_recommendations.pdf.
[7] CPR ARC Charter Task 4.b.

2. Multi-Dimensional Approach

The IAWG reviewed a proposal that included a multi-dimensional approach with a scoring system for each dimension. This approach seems complex and potentially too prescriptive for the desired flexibility. As an alternative, the IAWG suggested a multi-level threshold approach for a certain number of changed key characteristics to drive a substantial change. This type of evaluation is more effective at identifying product-level changes that are likely to result in a substantially complete investigation of compliance of the product that would warrant a new TC.

The ARC reviewed each of the proposed criteria and documented its determination on how well they work, either as a singular assessment or as part of a threshold based multi-dimensional approach. The evaluation summaries are below.

B. ARC Analysis of IAWG Report - Single Criterion for Substantial Change Classification

The ARC considered the IAWG's report on the single criteria for substantial change classification. The ARC's detailed analysis, impact assessment, and conclusion for each criterion is more fully explained in the following section. Based on its analysis, the ARC concluded that aircraft design changes need to be evaluated at the product level from an integrated whole aircraft system perspective. Multi-dimensional design-based criteria are more accurate as a means to identify changes that require a substantially complete investigation of compliance when the changes are not obvious design cases based on a singular change. These conclusions are supported by the ARC's findings that:

- Most of the criteria do not lead to a substantial level of compliance investigation alone.
- Some of the criteria could lead to a substantial level of compliance investigation because they would likely be associated with other changes at the product level.
- In all cases, the multi-criteria approach proposed by the ARC removes the uncertainty and confirms whether the overall product change leads to a substantial level of compliance investigation.

1. Changes to the Aircraft's Main Physical Configuration or Overall Construction

Analysis: This criterion is consistent with the current examples in AC 21.101-1B for substantial changes, such as changing from high to low wing, altering the empennage configuration, or converting from a full metallic airframe to a full composite airframe. As such, it can effectively characterize a substantial level of compliance investigation in most cases.[8] The ARC believes this criterion effectively covers high changes of configuration, and that any lower levels of configuration change will be covered by Criterion 3.

Impact assessment: A review of previous projects across all product categories shows that Original Equipment Manufacturers (OEMs) typically treat main physical configuration changes the same as brand-new products. This results in the OEMs applying for new TCs without undertaking a substantial change analysis.

Conclusion: The proposed criterion would be acceptable to classify a change as substantial in most cases. However, the use of the multi-criteria approach proposed by the ARC at REC1 will help reinforce or

[8] An exception may be the last example, if not calling for further system changes.

invalidate the conclusion by providing insight on the other criteria impacted by the change, thereby either confirming or invalidating the need to conduct a substantially complete investigation of compliance.

2. *Certificating Into Another Aircraft Category or to Another Level Within the Same Aircraft Category*

Analysis: Certifying into another aircraft category (e.g., from Part 23 to Part 25 or vice versa) requires a complete investigation of compliance and a new TC under § 21.19. However, certifying into another level within the same aircraft category does not (e.g., from Part 23 Level 1 to Part 23 Level 4).

Impact assessment: The ARC confirmed that all known projects involving a transition to another aircraft category required new TCs, while certification to another level within the same aircraft category was typically done under the same TC. The ARC notes that this was the practice both before and after the adoption of Amendment 64. For example, prior to Amendment 64, the Cessna CJ-series and the Beechcraft King Air/1900 were updated from Normal to Commuter category under the same TC. Similarly, after Amendment 64 was adopted, a Cessna Sky Courier was certified at Part 23 Level 1 and Level 4 under the same TC.

Conclusion: This criterion is acceptable to classify a change as substantial when transitioning from one product category to another. However, changing Levels for Part 23 aircraft should not, in and of itself, be characterized as requiring a substantially complete reinvestigation of compliance, unless the change is combined with other criteria under the multi-criteria approach (See REC1).

3. *Airframe and Structural Changes*

Analysis: As stated in the IAWG report, this criterion may significantly change the aerodynamic characteristics of the aircraft and structural loads distribution. This also may happen for other equivalent categories of airframe changes without leading to a substantially complete investigation of compliance when the airframe changes are not calling for further design changes.

Impact assessment: Review of past projects confirms that such level of design change did not lead to substantial classification and new type certification exercises (e.g., typically derivative of existing products – Airbus A321, Cessna 210 to P210, Piper Cherokee to Arrow).

Conclusion: The proposed criterion alone would not lead to classifying a change as substantial. However, the multi-criteria approach would help identify other criteria that would be implicated in the change, thereby confirming the need for a substantially complete investigation of compliance.

4. *Change to the Aircraft Systems*

Analysis: This criterion is consistent with some of the examples of systems significant changes provided in the current AC 21.101-1B (e.g., reduction of the number of flight crew, changing flight control system to fly by wire). As such, it could lead to a full investigation of compliance **for the aircraft systems.** However, it would not lead to a substantially complete investigation of compliance **at the product level**.

Impact assessment: Numerous projects related to the significant systems change examples in AC 21.101-1B have been certified over the last 20 years for all product categories. None of these projects led to an

investigation of compliance beyond the systems part, unless coupled with other product level changes that triggered a new type certification exercise.

Conclusion: A change to aircraft systems, on its own, would not lead to a substantial change classification, as it would not typically require a substantially complete investigation of compliance. The multi-criteria approach proposed by the ARC illustrates how a change to aircraft systems, when combined with other criteria, would require a substantially complete investigation of compliance, and therefore lead to a substantial change classification (See REC1).

5. *Change to the Number and Location of Engines*

Analysis: This criterion is consistent with one of the current examples of Substantial Changes for Parts 23 and 25 in AC 21.101-1B and can effectively characterize a substantial level of compliance investigation. The ARC presumes the same result would likely occur when changing the location of engines on a rotorcraft. However, changing the number of engines is only an example of a significant change for rotorcraft in AC 21.101-1B. Therefore, it can be assumed that a slight change in a high number of engines for an eVTOL may not necessarily lead to a substantially complete investigation of compliance either.

Impact assessment: The ARC's review of projects involving changes to the number and location of engines (e.g., aft -mounted (fuselage or tail) to wing-mounted or similar) shows that they are handled as a new Type Certification exercise for Part 23 and 25 projects;[9] but they can be handled as a non-substantial change for projects under Parts 27 and 29. The ARC also notes that in several other theoretical cases, this criteria alone would not result in a substantial change. For example, for eVTOL and similar, the number of propulsive units may not yield a significant impact. This is because once the configuration exceeds four propulsive units, a change in the number of units may have a lower impact on the level of compliance investigation required. Similarly, for conventional products, changing the number of engines at a single location or smaller locational changes would not result in a substantially complete investigation of compliance alone (e.g., Jetstar with 2 engines v. 4 engines).

Conclusion: The proposed criterion would lead to a substantial classification in most cases. However, there are some exceptions that could exist,[10] and these would be highlighted using the multi-criteria approach proposed by the ARC. These exceptions can be found in the analysis of past projects for the multi-criteria approach (See REC1).

6. *Power (Principles of Propulsion)*

Analysis: This criterion needs to be differentiated depending on the product category. For engines and propellers, it does effectively characterize a substantial level of compliance investigation, but for Part 23 and Part 25 products, the impact on the compliance investigation will be much lower (e.g., changing the number of blades on a propeller or changing from a reciprocating to a turbine engine).

[9] Specific examples include PA-24 v. PA-30, AA-5 v. GA-7, Beech Bonanza v. Twin Bonanza and Baron, and DA-40/DA-42 v. DA-62. The ARC also notes that the Airbus A330 and A340 were developed as one common product but shared a large part of the investigation of compliance.

[10] A330 v. A340 matches only the main physical configuration criteria, as both products share the same airframe and the same system architectures. The Bell 206L4 was modified via STC to add a second engine and the Bell 212 was modified via STC to reduce the number of engines from 2 to 1.

For Part 27 and Part 29 products, this criterion could cover changes such as a change in the type of powerplant (e.g., reciprocating engine to turbine or turbine engine to electric). The criterion is aligned with existing examples of significant changes for rotorcraft contained in AC 21.101-1B (e.g., change from piston to turbine engine). Overall, changes meeting this criterion would not, on their own, require a substantially complete investigation of compliance.

Impact assessment: AC 21.101-1B provides examples of significant but not substantial changes, such as changing from a reciprocating engine to a turbine engine. Using a different type of power to drive a propeller has generally not resulted in a substantial classification. Indeed, there are numerous examples of TCs and STCs for turbine installations on Part 23, 27, and 29 aircraft that started as piston powered aircraft. However, changing the *means of propulsion* (e.g., from propeller to jet) will typically result in a substantial determination.[11] It is important to note, however, that as technology continues to advance, turbofans will become larger and blades will be added to propellers, making the degree of change from propeller to jet much less than what was originally considered.

Conclusion: The proposed criterion would most probably be acceptable to classify an engine or propeller change as substantial. However, it alone cannot characterize a substantial level of compliance investigation for other product categories. The ARC acknowledges the uncertainty surrounding certain propulsion types, such as aircraft using a hydrogen power source which could have far-reaching impacts on the overall product and compliance investigation. However, the ARC reiterates that these types of cases would be adequately captured by the multi-criteria approach proposed by the ARC. For aircraft, the source of power behind the means of propulsion is not typically adequate as a singular criterion for substantial determination. Changing the means of propulsion (e.g., propeller to jet) has historically resulted in substantial determination due to the other changes required as part of the propulsion change but, depending on design factors, this may not always warrant a substantially complete investigation of compliance. This can also be determined effectively via the multi-criteria approach.

7. Change in Thrust or Weight

Analysis: The ARC acknowledges that using the percentage of change in thrust or weight to determine whether a change is substantial is a very convenient way to comply with § 21.19. However, thrust or weight changes alone will not usually lead to a substantial level of compliance investigation. When considered independently of other design changes, thrust or weight changes will only lead to a compliance investigation with respect to performance, certain handling qualities and loads, and a possible partial investigation of structural strength. Moreover, *any* product will require further design changes if thrust or weight changes exceed a given level based on the reason for the thrust/weight change, such as a different payload or range, or simply because further design changes are necessary for compliance demonstration. This will of course trigger further compliance investigation.

The level of change at which a substantially complete investigation of compliance becomes necessary depends primarily on each product's characteristics. No single value can be identified that would work for all products of the same category.

[11] One specific example where this determination may not be warranted is with the 328 Turboprop to the 328 Jet due to the level of other changes.

Impact assessment: The list of Part 23 projects already certified highlights the large variability of thrust increase that was achieved on projects classified not substantial. Examples include:

- Piper Cub thrust change in the J-3 to the final variant of PA-18 increased by over 400%. The aircraft was transitioned through a second TC but is still very recognizable as a Piper Cub aircraft. In the same TC the J-3 increased in thrust by 188%.
- Grumman AA-5A Cheetah updates include a 73% increase in HP (thrust) via an STC with no other changes to the airframe.
- Changes to Part 23 piston aircraft that add turbocharging capability are common. These can easily increase the thrust available at altitude by more than 100% with little if any change to the remainder of the aircraft.

The list of Part 25 projects already certified highlights the large variability in thrust/weight increase that was achieved on projects classified not substantial, such as:

- Airbus Single Aisle aircraft weight/thrust increased approximately 30% without any airframe or system change beyond the fuselage lengthening to accommodate increased payload.
- Cessna 560XL weight/thrust was increased up to 87% (versus initial TC) with a fuselage length and a wingspan increased by around 20%.

None of the above cases led to a substantial level of compliance investigation.

Although it is difficult to assess the maximum thrust/weight change each of these two products could accept before requiring a substantial level of compliance investigation, the respective level of increase achieved so far (87% v. 30%) clearly shows that both products will not reach this level for a similar level of thrust/weight increase.

For Part 27 and 29 projects, and due to the high sensitivity of rotorcraft to weight, changes to increase the maximum take-off weight have typically been less than the intended significant threshold identified in AC 21.101-1B. Thus, the threshold for the multi-criteria approach will differ for these types of products.

Conclusion: As stated above, it is difficult to determine the maximum thrust/weight change each product would need to meet to trigger a substantial level of compliance investigation. However, the huge scatter in the level of weight or thrust change achieved so far demonstrates that this limit will largely differ from one product to the other. Therefore, the criterion does not, in and of itself, classify a change as substantial, and relying on it for this purpose may potentially result in negative outcomes, including:

- creating an unfair playing field (if the proposed limit is too low),
- being detrimental to safety if the proposed limit is too high (e.g., 200%), thereby offering a possibility to further develop a product as an amended TC, although the level of compliance demonstration needed is substantial, or
- precluding derivative products from bringing practical safety enhancements where new TCs may not be viable.

The multi-criteria approach proposed by the ARC supports the appropriate identification of when a thrust/weight change should trigger a substantially complete investigation of compliance by identifying the related design changes.

8. Proportionality

The IAWG report highlights the need for a regulatory approach that addresses proportionality for different product types in a risk-based manner. The ARC concurs, noting that its agreement is based on an evaluation of the historical product evolution, which shows that different products have varying thresholds for changes that result in substantially complete investigation of compliance.

Based on the current Part 23 regulatory approach, passenger count is used to determine different levels of risk. For example, Level 3 includes aircraft with crew and 9 passengers or less (instead of the older 6000 lb. limit); while Level 4 includes aircraft with crew and up to 19 passengers. The passenger count concept could be included in advisory material as part of a proportional risk-based means to differentiate the levels.

The ARC notes that the IAWG considered a weight threshold that has historically been used as part of the § 21.101 evaluations. However, the ARC considers passenger count to be the preferred risk-based approach and has developed its proposed multi-criteria methodology to focus on aircraft products with more than 9 passengers. The use of passenger count in Parts 23 and 27 could also be included in guidance material, avoiding the need to amend the CFR directly to incorporate this approach.[12]

Historically for Part 23, new type certificates appear to have been driven by a limited number of factors. For example, two-place trainer aircraft have evolved from four-place products of similar configuration and have typically resulted in company requests for a new TC. In many cases, the application for a new TC appears to have been more of a company business decision as opposed to a decision based on regulatory guidance. To allow for the anticipated level of innovation in Parts 23 and 27, a proportionality line needs to be established for aircraft products with 9 passengers or less. At this level, the existing guidance, with some improvements in the high-level design examples, is adequate.

Engine and propeller products also have criteria in the current guidance. The ARC considers the guidance for engines to be adequate but notes that a few additional examples would be helpful to address identified inconsistencies with propellers. For example, a modification to the pitch change method for a propeller that already has pitch change capability has typically been deemed a significant change. It would be helpful to clarify why adding to existing criteria that changes from fixed pitch to controllable pitch would be substantial.

9. Supplemental Type Certificates (STCs)

The evaluation of STCs requires specific attention to their individual requirements. When installing multiple STCs on products that are not co-dependent (i.e., each STC can be installed on its own), the installer is responsible for ensuring compatibility as prescribed in AC20-188. This is a stand-alone determination because the certification basis of the STC is not dependent on any other STC. In contrast, when STCs are co-dependent (i.e., can only be installed in combination with one or more separate STC(s)), the

[12] Level 3 in Part 23 has the same passenger count limit as the Part 27 passenger limit. *See* https://www.ecfr.gov/current/title-14/chapter-I/subchapter-C/part-23; and https://www.ecfr.gov/current/title-14/chapter-I/subchapter-C/part-27.

combination of the STCs must be evaluated as *one change* in order to determine the resulting certification basis in accordance with § 21.19 and § 21.101. The ARC emphasizes that only considering changes to individual STCs that cannot exist independently is not an appropriate means to reduce the overall change impact from a CPR perspective.

VI. ARC Recommendations - Intent, Rationale, and Approach

The following section contains detailed information on each recommendation, including the ARC's intent, supporting rationale, research, examples, and suggested regulatory approach. Proposed regulatory text is also included as appropriate. In some cases, examples are included in an appendix, and this is noted in the recommendation text.

The ARC strongly emphasizes that while the scope of the ARC Charter primarily involves processes to determine applicable airworthiness requirements for a proposed design change, the necessity to apply for a new type certificate for design changes meeting the proposed new objective criteria thresholds will have implications on non-airworthiness certification requirements for which an aircraft would be required to demonstrate compliance – such as those specified under Parts 34, 36, 38, etc. These factors alone may negatively impact an applicant's ability to advance the safety or utility of a product, simply because they could not meet the new type stringencies prescribed in the other bodies of requirements. We therefore recommend extensive coordination with relevant policy teams within the FAA to ensure appropriate consideration of these implications for those recommendations related to the determination of substantial change.

Recommendations for Reference Type Design

Recommendations REC1 through REC4 presume adoption of the IAWG Recommendations for RTD.[13]

REC1 The FAA should develop a multi-factor objective method for the existing criteria to determine whether a change should be classified as "substantial."

INTENT: To create guidance specific to the application of § 21.19 outlining a multi-factor objective method for determining whether a change should be classified as "substantial" (i.e., constituting a substantially complete investigation of compliance).

RATIONALE: The ARC believes there is insufficient objective guidance information specific to the application of § 21.19. The examples provided in AC 21.101-1B are inadequate and incomplete and have resulted in inconsistent decisions on whether to require a new TC.

As noted in the ARC's evaluation of the IAWG report, the ARC concluded that using the proposed criteria in a multi-criteria approach would better characterize a substantially complete investigation of compliance. Accordingly, the ARC based this recommendation on the IAWG's objective criteria list, with the aim of characterizing a substantially complete investigation of compliance and defining specific and easily manageable criteria.

APPROACH: The ARC recommends the FAA adopt the multi-criteria approach described below. This approach is supported by the information provided in Appendix A of this report, which includes both the system criteria examples and the impact assessment of the thresholds for each of the quantitative criteria used for the multi-criteria approach[14] This recommendation has implications on non-airworthiness certification requirements an aircraft must demonstrate compliance against, such as those specified under

[13] IAWG Report Recommendation 1A2.

[14] The Quantitative Criteria for each product category are captured in Appendix A, section B, and includes the justification for the proposed thresholds.

Parts 34, 36, and 38. The relevant policy teams within the FAA should ensure these factors are appropriately considered in implementation.

A change (or accumulation of changes) at the product level would be classified substantial when a specified number[15] of the following Product Key Characteristics are triggered.

1. Changes to an aircraft's main physical configuration (e.g., low to high wing or empennage), addition of aero lifting new surfaces (e.g., canards), different fuselage cross section (e.g., double deck vs single deck), different wing planform (e.g., blended wing), number and location of engines and rotors (e.g., tail mounted to wing mounted engines), or overall construction (e.g., going from a metallic to a full composite airframe).

2. Any of the following airframe or structural changes:
    - fuselage circumference changes (>AA%)
    - fuselage length change (>BB%)
    - exposed wing area change (>CC%)
    - horizontal tail plane area change (>DD%)
    - vertical tail plane area change (>EE%)
    - wing sweep change (>FF%)
    - airframe-level change (e.g., fuselage integrated wing carry-thru structure vs. wing carry-thru external to fuselage), airframe structure provisions for a change in engine number and position.

3. Accumulation of changes across aircraft systems that execute critical product level functions extensively impacting either:
    - the overall product's architecture (driving extensive architectural changes) and integration across multiple systems, or
    - critical aspects of the flight crew human-machine interface at a product level.

4. A change in engine or rotors using different principles of propulsion or operation, or in the case of propeller changes (at the propeller product level), in the number of blades or principles of pitch change operation.

5. A change in thrust (power) and/or maximum take-off weight (mass) of more than GG%.

The ARC notes that certificating into another aircraft category from (e.g., Part 23 to Part 25 or Part 27 to Part 29 aircraft and vice versa) would require a complete investigation of compliance to the appropriate certification basis within the new product category and would require a new TC under § 21.19, independent of the above criteria.

This generic recommendation should be customized per product category to better fit with the identification of a substantially complete investigation of compliance. This customization requires adapting the specific criteria, while also considering the quantitative figure associated with some of the criteria, and the number of criteria to be met to declare a change as substantial.

[15] The number will vary by product category and would be specified in the applicable guidance material.

To assist users in executing this approach, the ARC recommends the FAA introduce the following guidance material:

A. Conditions for Substantial Classification of Design Changes for Part 23 Airplanes

A change (or accumulation of changes) at the product level would be classified substantial when at least 3 of the following Product Key Characteristics are affected:

1. Changes to an aircraft's main physical configuration (e.g., low to high wing or empennage), addition of aero lifting new surfaces (e.g., canards), different fuselage cross section (e.g., double deck vs single deck), different wing planform (e.g., blended wing), number and location of engines, or overall construction (e.g., going from a metallic to a full composite airframe).

2. Any of the following airframe and structural changes:
   - fuselage width changes (>20%)
   - fuselage length change (>40%)
   - wing area change (>30%)
   - horizontal tail plane area change (>30%)
   - vertical tail plane area change (>30%)
   - wing sweep change (>5°)
   - airframe-level change (e.g., fuselage integrated wing carry-thru structure vs. wing carry-thru external to fuselage, airframe structure provisions for a change in engine number and position)

3. Accumulation of changes across aircraft systems that execute critical product level functions extensively impacting either:
   - the overall product's architecture (driving extensive architectural changes) and integration across multiple systems, or
   - critical aspects of the flight crew human-machine interface at a product level

4. A change in engine using different principles of propulsion or operation (e.g., replacing a turbo-propeller with a turbofan, or changing the source of propulsive power).

5. A change in thrust and/or maximum take-off weight (mass) of more than 45%.

Certifying into another aircraft category from Part 23 to Part 25 would require a complete investigation of compliance to the appropriate certification basis within the new product category and would require a new TC under 21.19.

The ARC recommends the above criteria should not apply to Normal category aircraft with 9 passenger seats or less or to section 23.2005, Level 1-3 products until a more detailed impact assessment is completed.

One common occurrence found throughout the examples in Part 23 aircraft regarding the proposed application of the objective criteria is installation of high-powered engines through the STC process. The ARC found multiple STCs that increase horsepower between 73% and 188% above the original type design. These STCs could trigger the requirement for a substantial change depending on how the TC has evolved (i.e., relative to the Reference Type Design). In some cases, the change in horsepower provides improved climb performance to improve safety for clearance of obstacles and high-altitude operations. Changes that

improve safety margins, such as improved performance, reliability, or other safety enhancements for the product should be eligible for consideration of the relief offered in the proposed rule language for § 21.19(b).[16]

B. Conditions for Substantial Classification of Design Changes for Transport Category Airplanes (Part 25)

A change (or accumulation of changes) at the product level would be classified substantial when at least 3 of the following Product Key Characteristics are affected:

1. Changes to an aircraft's main physical configuration (e.g., low to high wing or empennage), addition of aero lifting new surfaces (e.g., canards), different fuselage cross section (e.g., double deck vs single deck), different wing planform (e.g., blended wing), number of engines at different locations and location of engines (e.g., tail to wing or similar), or overall construction (e.g., going from a full metallic to a full composite airframe).

2. Any of the following airframe and structural changes:
   - fuselage circumference changes (>20%)
   - fuselage length change (>40%)
   - exposed wing area change (>30%)
   - horizontal tail plane area change (>30%)
   - vertical tail plane area change (>30%)
   - wing sweep change (>5°)
   - airframe-level change (e.g., fuselage integrated wing carry-thru structure vs. wing carry-thru external to fuselage, large airframe structure provisions for a change in engines number and position).

3. Accumulation of changes across aircraft systems that execute critical product level functions extensively impacting either:
   - the overall product's architecture (driving extensive architectural changes) and integration across multiple systems, or
   - critical aspects of the flight crew human-machine interface at a product level.

4. Power: Generally, a change in engine using different principles of propulsion or operation.

5. Thrust / Weight: Generally, a change in thrust and/or maximum take-off weight (mass) of more than 45%.

The ARC notes that certifying into another aircraft category from Part 25 to Part 23 would require a complete investigation of compliance to the appropriate certification basis within the new product category and would require a new TC under § 21.19, independent of the above criteria.

[16] *See* REC4 The relief described in the proposed rule language at § 21.19 is applicable to all product types, not just Part 23 powerplant STCs.

C. Conditions for Substantial Classification of Design Changes for Rotorcraft (Parts 27 & 29)

A change (or accumulation of changes) at the product level would be classified substantial when at least 3 of the following Product Key Characteristics are affected:

1. Changes to an aircraft's main physical configuration (e.g., number and location of engines and rotors) or overall construction (e.g., going from a full metallic to a full composite airframe).

2. Any of the following airframe and structural changes:
   - fuselage circumference changes (>20%)
   - fuselage length change (>20%)
   - main rotor diameter / main rotor blade surface area increase (>35%)
   - airframe level change to incorporate an additional rotor system

3. Accumulation of changes across Aircraft systems that execute critical product level functions extensively impacting either:
   - the overall product's architecture (driving extensive architectural changes) and integration across multiple systems, or
   - critical aspects of the flight crew human-machine interface at a product level

4. A change in engine using completely different principles of propulsion or operation.

5. A change in power and/or maximum take-off weight (mass) of more than 35%.

The ARC notes that certifying into another aircraft category from Part 27 to Part 29 aircraft (and vice versa) would require a complete investigation of compliance to the appropriate certification basis within the new product category and would require a new TC under § 21.19, independent of the above criteria.

D. Conditions for Substantial Classification of Design Changes for Engines (Part 33)

Engines are designed to a precise set of specifications flowing from the airplane manufacturer. Where possible, they are certified to the most extreme envisioned limits for variables, such as thrust and operating limits. Any subsequent changes in design are restricted to the physical limitations of that set of requirements, and while some may be classified as major, none reach the level of substantial. Substantial changes in design are sufficiently described in AC 21.101-1B and would most likely result in new model designation(s) and a complete reinvestigation of Part 33.

E. Examples of Systems Changes That Would Trigger the Systems' Input into the Substantial Change Objective Criteria and Examples of Systems Changes That Would NOT Trigger the Systems' Input into the Substantial Change Objective Criteria.

The ARC developed several examples that can be used for illustration purposes to demonstrate Systems Changes that would and would not trigger the systems input to substantial change objective criteria. Detailed information about the examples can be found in Appendix A, Section A, below.

REC2 The FAA should update its regulations, policy, and guidance material to better define Reference Type Design and Baseline Product. The update should explain the difference between the two terms and the usage of each in the CPR process.

INTENT: To clarify the definition for Reference Type Design (RTD) and Baseline Product (BP) including defining their use, and the process for amending both.

RATIONALE: Current policy and guidance material are silent, confusing, or conflicting regarding the point of comparison for determining whether a proposed changed product constitutes a substantial change. This leads to inconsistent and sometimes inadequate application of the § 21.19 requirement for a new type certificate and the accompanying "substantially complete investigation of compliance" with an updated certification basis. Similarly, the ARC recommends that a clear definition of the BP be created, including its usage for determination of significance per § 21.101 and differentiation from RTD.

The ARC acknowledges the IAWG's intent to introduce the concept of the RTD. However, the ARC is generally not in favor of the implementation of an RTD that is different from the baseline product. The ARC disagrees with some aspects of how it has been proposed to be defined and used. The ARC feels the current IAWG approach will disincentivize manufacturers from introducing changes that would require a complete investigation of compliance, and thus hinder product development. This Recommendation provides an alternate approach for the use of RTD which the ARC feels meets the intent of the IAWG while still reflecting the manner in which product families are developed. This will incentivize applicants to more frequently fully substantiate derivative product configurations that they intend to further develop to the latest safety objectives by allowing such configurations to become the RTD for subsequent changes.

Updating the regulatory, policy, and guidance material to define RTD will help assure consistent and adequate application of the regulatory requirement for a new type certificate and the accompanying substantially complete investigation of compliance to an updated certification basis. The ARC recommends that the definition for RTD include the provision for additional RTD configurations and define a process for adding RTD configurations. The ARC notes that developing a process to add an RTD configuration is consistent with IAWG Recommendation 1A2.[17] The ARC cautions, however, that the IAWG recommendation of not allowing reversions or exceptions disincentivizes TC holders from advancing the certification basis and conducting complete investigations of compliance before reaching the threshold for substantial change. The ARC recommends instead that the FAA establish a process to add a new RTD configuration for a changed product that is not a substantial change, *and* allows for reversions/exceptions from the latest amendments where the safety objective of the latest amendments is achieved. The ARC notes that Part 21[18] allows the use of earlier amendments, in non-substantial changes, if compliance with the latest amendments would not contribute materially to the level of safety. The ARC believes this will encourage TC holders to advance the certification basis more often, and more frequently conduct complete investigations

[17]As noted in the IAWG report, a *reference type design configuration may be established to a later basis if the applicant demonstrates compliance with all the airworthiness requirements applicable to the category of the product in effect on the date of the application for the whole aircraft without any reversion (exception) granted.* *Changed Product Rule Recommendations*

[18] https://www.ecfr.gov/current/title-14/chapter-I/subchapter-C/part-21/subpart-D

of compliance. This will promote safety because of the increased frequency of complete investigations of compliance without sacrificing the safety objectives of the latest amendments.

APPROACH: The FAA should add the following definition to § 21.1(b) to avoid confusion and promote a common understanding of RTD in the new regulatory framework.

Reference Type Design is a design configuration:

- for which compliance with a certification basis, acceptable to the FAA for the purpose of establishing an RTD configuration, has been established and a complete showing is made for the entire product, and

- against which changed products must be assessed for determining whether compliance with the provisions of 14 CFR 21.19 "Changes requiring a new type certificate" would be required.

The FAA should also update its policy and guidance material to define RTD in the context of § 21.19, to include additional RTD configurations, and define the process for adding them. Specifically, the policy and guidance material should:

- include the design configurations for which a new TC is issued, and

- describe the design configurations of a changed product for which an investigation of compliance for the entire product has been conducted to a certification basis that the FAA finds acceptable for establishing an additional RTD configuration.

A certification basis acceptable to the FAA for establishing an additional RTD configuration is one which is consistent with the requirements of a new type certificate, except that it may contain some airworthiness requirements at an amendment earlier than those in effect on the effective date of application for approval of the proposed RTD configuration, provided the applicant shows the design meets the safety objectives of the latest amendments. Consistent with the requirements for a new TC, equivalent level of safety findings and exemptions would be allowed, and special conditions may also be required and maintained.

As this recommendation has implications on non-airworthiness certification requirements an aircraft would have to demonstrate compliance against – such as those specified under Parts 34, 36, 38, etc., part of this recommendation relies on the relevant policy teams within the FAA to coordinate to ensure appropriate consideration of these implications are accounted for in implementation.

Defining the Use of RTD

RTD is the basis of comparison against which a proposed changed product must be assessed to determine if the resulting changed product constitutes a substantial change. When making this determination, the RTD configuration must be identified. This assessment should be required for all major changes that affect the objective criteria involved in determining whether a changed product constitutes a substantial change.

Defining the Process to Identify Multiple RTDs Within a Product Family on the Same TC, and to Add an RTD Configuration to a TC at a Later Time

The FAA should update policy and guidance material to include language to explain that multiple RTDs may exist within a product family on the same TC, and also explain the process to add an RTD configuration to a TC.

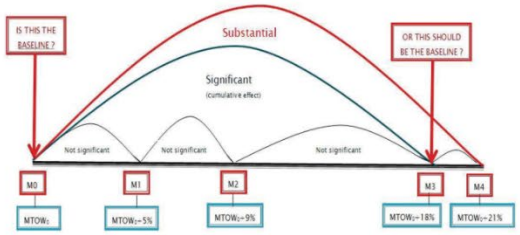
The Reference Type Design (RTD) concept proposed by the IAWG appears to assume that product development is linear – i.e., that all derivative aircraft are developed from a single starting point (which would be the currently defined RTD, M0 in the Figure REC2-1 below).

Figure REC2-1

Proposal 2:

Proposal 1A2 – Establish Reference Type Design Configuration Definition	The IAWG recommends the following definition to be established for the reference type design configuration: Reference Type Design Configuration: The configuration to be identified when completing the § 21.19 evaluation is the type design configuration of the initial type certification. A reference type design configuration may be established to a later basis if the applicant demonstrates compliance with all the airworthiness requirements applicable to the category of the product in effect on the date of the application for the whole aircraft without any reversion (exception) granted. (See Appendix 2, Cases 3 and 4 for examples).	Recommend to Adopt - Policy/Guidance Updates

Appendix 2:



The scenario outlined here assumes a sequential evolution of a single type design. Industry practices requires consideration of a wider range of derivative products.

In reality, manufacturers may establish more than one "original" product, meaning that product development is done as separate "branches," where each branch originates from its own unique original product. As such, more than one RTD may exist. As an example, an applicant may create $M0_A$ and $M0_B$ (Figure REC2-2). If changes are applied to $M0_A$, then $M0_A$ is the RTD for those changes, regardless of the fact that $M0_B$ exists. In Figure REC2-2 the Applicant has fully substantiated M3A to the current airworthiness requirements at the time of application and, in line with this recommendation, M3A is established as the RTD for subsequent change. Thus, changes M3A1 and M3A2 are assessed from M3A as the RTD and subsequent changes to changes to configuration M3 would be measured from RTD $M0_B$. As such, evaluations of changes under the substantial criteria require the use of the RTD that is applicable to the branch on which the current change is being applied. Similarly (subsequent to a determination that a design change is not substantial), each change to a product on a particular branch is evaluated to be significant or not against an appropriate BP on the same branch.

Figure REC2-2

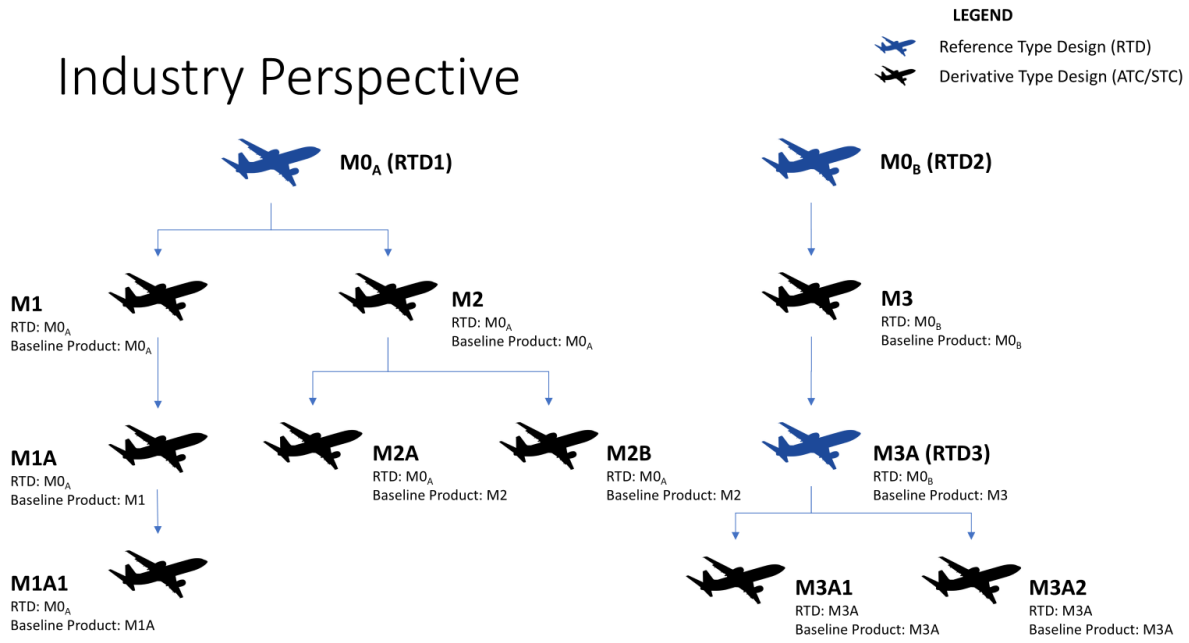
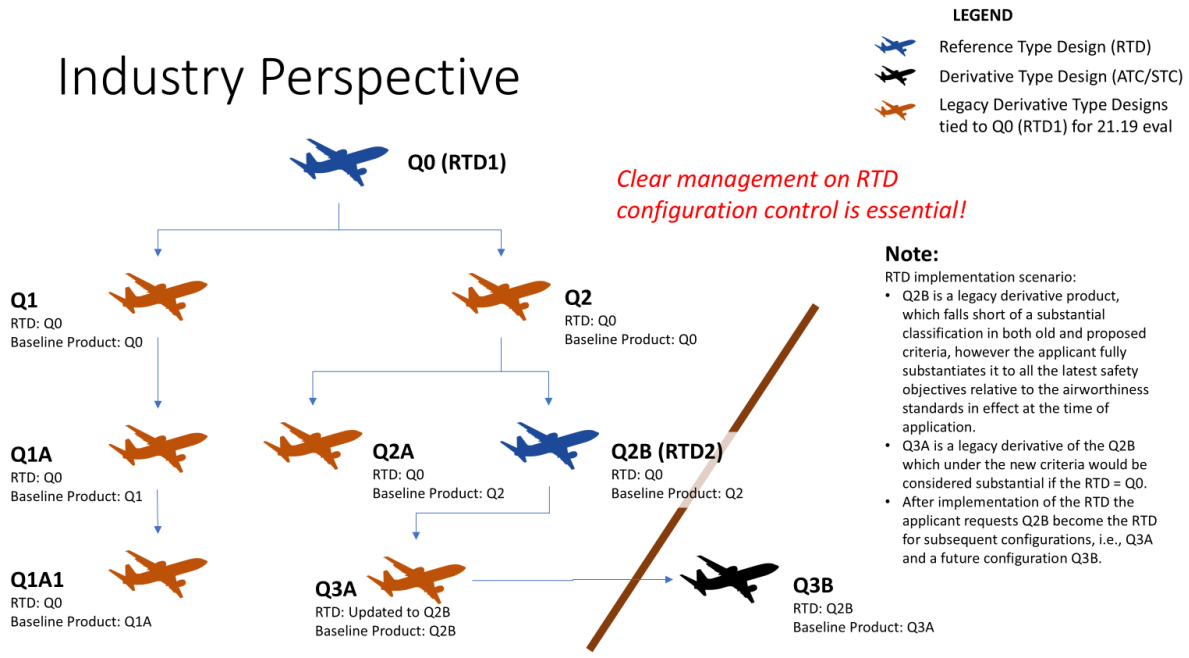


Figure REC2-3 depicts how a legacy product might apply the concept of RTD to extend the viability of the TC to a new generation of products where a configuration (Q2B) has been fully substantiated to the latest safety objectives and later derives changed products (Q3A and Q3B) for which the accumulated change from Q0 would be considered substantial but for which the accumulated change from Q2B is not substantial. The type certificate holder requests configuration Q2B be added as an additional RTD for subsequent changes including configurations Q3A and Q3B. This enables continued viability of this type certificate.

When an OEM develops more than one branch for product development (changes made to different “original” models), the onus is on the applicant to identify each RTD that would be used for substantial change evaluations for all models derived on each individual branch. The authorities would be asked to recognize this potential multiple RTD concept in the development of guidance material related to RTD. This concept is particularly important to industry, as the use of a single RTD for all product development has a high risk of being an economic barrier to future product development.

Figure REC2-3



The ARC also wishes to develop a means to designate new or additional RTDs, as it may be an after-the-fact decision to branch off or derive new models from a unique model as a starting point. As this proposed new RTD may itself not have resulted from a complete investigation of compliance, additional work may be required to justify this model as a new RTD.

The ARC feels strongly that RTD implementation should proceed only after an additional tasking with sufficient time to develop the concept of identifying a new RTD and the justification required to do so.

<u>Defining Baseline Product and its Usage</u>

The ARC concurs with the recently provided IAWG definition of Baseline Product proposed for inclusion in AC 21.101-1C, repeated here for convenience:

> *"The baseline for a changed product is an aeronautical product with a specific, defined, approved configuration, which the applicant proposes to change. If a type design change is proposed for multiple product configurations, multiple baseline definitions may be required. If the baseline product definition is predicated on prerequisite type design changes, these should be defined. The applicant should identify the specific product configuration that will be modified."*

The ARC wishes to clarify that the identification of the BP and evaluation of significance is ONLY carried out after the proposed change is compared to the RTD for the purpose of determining whether the change is substantial, and the change was found to be not substantial. The RTD and BP have independent definitions and are used for the determination of substantial and significant changes respectively.

For the purpose of evaluating significance, cumulative change needs to be evaluated. Cumulative change is evaluated by looking at the affected area of the currently proposed configuration and comparing it back to the point the last significant change to that affected area was certified (or the certification basis for that

affected area was at or otherwise updated to the latest amendments); or to the RTD if no previous significant changes (or the certification basis was not updated to the latest amendments). As such, for the purpose of evaluating significant changes, credit is given for already having considered cumulative change up to the point of the previous significant change or last time the latest amendments were used.

To demonstrate cumulative change, consider the following scenario using Figure REC2-2 above:

1) From $M0_A$ to M1, a fuselage plug is added to accommodate one additional row of seating with a 9% MTOW increase with no change in the certification basis

2) From M1 to M1A, cockpit displays are updated with no change in the certification basis

3) From M1A to M1A1, an additional 10% weight increase is introduced

Although M1A can be used as the Baseline Product for M1A1, the evaluation for cumulative change when considering the MTOW increase would go back to the last time the affected areas (e.g., loads and structure, handling qualities) had their certification basis updated, or to $M0_A$ if no changes to the certification basis for the affected areas had occurred. Since there were no changes to loads /structure from M1 to M1A, and no change in certification basis at M1, the point for consideration of cumulative effect of weight increases would have to be the original model, $M0_A$. In other words, a 19% MTOW increase would be evaluated for the certification of M1A1 for significance.

REC3 The FAA should amend 14 CFR § 21.19 to incorporate the ARC's recommendations for Objective Criteria and Reference Type Design.

INTENT: To expand the regulatory text in 14 CFR § 21.19 to:

- introduce objective criteria to be considered when assessing a proposed design change for project classification as a substantial change; and
- codify the proposed Reference Type Design language (REC 2) and clarify where exceptions are necessary.

RATIONALE: The current regulation language does not effectively communicate the intent behind the IAWG-recommended changes, particularly the new Reference Type Design (RTD) concept and its potential impact on current programs/projects or near- and medium-term planned product changes. The ARC recommends revising the regulatory language to ensure that the shift introduced by the new terminology is clear and understandable to users, particularly with respect to the "Baseline Product" approach. The ARC further recommends flexibility in the implementation of the rule changes to avoid unnecessary burdens on industry associated with designating a new set of objective criteria for evaluating proposed design changes. The ARC considers the following objectives to be paramount in this regard.

The first objective for the proposed rule change is to introduce the term "reference type design" with the appropriate policy and guidance documents to further explain its meaning. Historically, § 21.19 has been interpreted to apply in a similar way as § 21.101, whereby an applicant evaluates a proposed change against the "baseline product" configuration. However, the IAWG report clarified that the original intent of § 21.19 was to compare changes against the "original" configuration **or** a later configuration that has undergone a "complete investigation of compliance" of the entire product. Accordingly, the ARC proposes to use the term RTD to provide a method of describing the new reference point and distinguish between the "baseline product" or "original" configurations. Moreover, replacing terms like "design, power, thrust, or weight" with RTD, minimizes the focus on specific design aspects within the rule language and allows for a more flexible definition for the critical objective criteria to be defined in guidance.

The second objective for the proposed rule change is to provide exceptions for situations where a new TC is not required, even if the change could be considered "extensive." This is to avoid adverse consequences for the existing fleet with the new interpretation of the reference point. The exceptions include:

- Paragraph (b)(1) would allow changes that support safety improvements, whether they are necessary to resolve an unsafe condition, or the type certificate holder can show a product safety improvement can be made available to all operators. This would eliminate the burden of showing a substantially complete investigation of compliance for the entire product for changes that can be shown to improve fleet safety. This is particularly valuable to fleets that may be found to have already exceeded objective criteria thresholds upon implementation of the IAWG and ARC recommendations, and thus could theoretically not withstand any further design changes without requiring a new TC, but for which new technology or features would be a benefit to safety without making extensive additional changes to the design.

- Paragraph (b)(2) recognizes that changes to an existing product may be necessary to maintain or advance compliance with environmental requirements for Emissions (Part 34), Aircraft Noise (Part

36), and Fuel Efficiency (Part 38). In particular, Part 38 has established a requirement for current production Transport Category airplanes to demonstrate compliance to a prescribed set of fuel efficiency stringencies before January 1, 2028, and thus will require new compliance evaluations, but should not constitute a requirement to pursue a new TC.

- Paragraph (b)(3) allows for existing products that are already near or beyond the objective criteria that constitute a substantial change to undergo modifications that produce aircraft for special uses such as (but not limited to) firefighting aircraft, specialized cargo carrying aircraft, aircraft supporting government research programs or national security missions, special medical evacuation capabilities, etc.

- Paragraph (b)(4) would provide a transition period following the final rule which would allow existing design approval holders adequate time[19] to submit applications for planned activities already in development for their existing certificates, and prepare to update their reference type designs where future planned design changes warrant. Design approval holders may be incentivized to update a certification basis for a certificate intended to be in production for an extended period, which would lead to an improvement in product safety. This also prevents conflict for any active projects from having to be cancelled or converted to a new TC project, which could have a detrimental impact to these design approval holders, including the possibility of canceling projects.

- Paragraph (b)(5) is intended to be used to provide product updates necessary to meet International Civil Aviation Organization (ICAO) or FAA mandates for new required equipment without requiring a new TC for those legacy products that have already surpassed the threshold for requiring a new TC. This would include mandates required by special retroactive requirements,[20] Part 26, parts obsolescence, or as required by amendments to the operating rules. This should also allow design changes, to products that are near or have already surpassed the "extensive" threshold, within the limited relief as detailed in the grandfathering proposal in REC4. The criteria for meeting this exception would be detailed in the new policy for § 21.19. A complete investigation of compliance for the entire product is not expected to be required for these two conditions.

The third objective for the proposed rule change is to provide clarification that the application of § 21.19 is expected to occur only after a proposed change has been classified as major, per § 21.93. This alleviates confusion about when to conduct this assessment. Since minor changes can have no appreciable effect, they will not impact the objective criteria to be proposed for determining when a change is "so extensive."

Due to the complexity across product categories, compounded by variation within each category, the ARC is not proposing to include the objective criteria, or their thresholds, within the rule language. There is no one-size-fits-all criterion that can be applied across all TCs, and the ARC's analysis shows that a single criterion alone is not sufficient to describe the complexity of a design change. To meet an "extensive" threshold, the objective criteria must be reached, and each product type includes differing criteria. Moreover, changes in technology can have a sizeable effect on the relative impact of any single criterion. Therefore, the ARC

[19] The proposed time aligns with the strategic planning cycle for a majority of the ARC membership.
[20] 14 CFR §§ 25.2, 27.2, and 29.2.

recommends the FAA publish new guidance that provides a definition of RTD and the objective criteria associated with each product type. This guidance would be more easily revised as new technology is introduced that would impact the criteria or their related thresholds.

APPROACH: The ARC recommends the following regulatory text amendments to 14 CFR § 21.19:

> 21.19, Changes requiring a new type certificate.
>
> (a) Except as provided in paragraph (b) of this section, each person who proposes a major change to a product must apply for a new type certificate if the FAA finds that the difference in the resulting product compared to the applicable reference type design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.
>
> (b) An applicant for the following changes is not required to apply for a new type certificate:
>
> (1) Design changes under § 21.99,
>
> (2) Design changes required to maintain compliance under Parts 34, 36, or 38,
>
> (3) Derivative aircraft or modifications supporting special use (e.g., Conversions to oversize cargo freighter, firefighting, Military Commercial Derivative, Medical Evacuation aircraft),
>
> (4) Changes to Type Certificates, via Amended or Supplemental Type Certificates, for which initial application is submitted prior to [insert date that is 5 years following date that the final rule becomes active], or
>
> (5) Other changes found to be acceptable to the FAA.

The proposed regulatory amendments should be accompanied by clear definitions in the related guidance material. The ARC also recommends adding definitions for Baseline Product and RTD configuration to 14 CFR § 21.1(b) Applicability and definitions (See REC2). **The ARC also requests an additional tasking to evaluate alternative approaches for the transition of legacy products to the new § 21.19 rule language and to assess the effects of the transition on products certified with international authorities.**

As this recommendation has implications on non-airworthiness certification requirements an aircraft would have to demonstrate compliance with, such as those specified under Parts 34, 36, 38, etc., part of this recommendation relies on the relevant policy teams within the FAA to coordinate to ensure appropriate consideration of these implications are accounted for in implementation.

REC4 The FAA should provide regulatory relief for previously approved and in-work products with the change in application of § 21.19.

INTENT: To establish a process for:

1. "Value-Limited" regulatory relief for products already near or over the threshold for substantial change as of the implementation of these recommendations, and completion of projects whose application was submitted before the end of the period afforded by proposed § 21.19(b)(4) (i.e., the transition period) to continue a 'value-limited' level of product improvements without requiring complete investigation of compliance to an updated certification basis, and

2. previously approved products which are already over the threshold of substantial change as of the implementation of these recommendations, and completion of projects whose application was submitted before the end of the transition period, to be designated as an additional "Reference Type Design" configuration.

This proposal is intended to apply grandfathering relief to existing products and products at a configuration that includes changes for which application was submitted before the end of the transition period. The ARC clarifies that the transition period is time-based while the "grandfathering" afforded by this proposal is not. This grandfathering proposal is intended to be value-based.

RATIONALE: With the implementation of the ARC's recommendations, the interpretation and application of substantial change will be very different from the standard practice that has been in place for decades. Many previously approved products will be very near or over the threshold for substantial change as of the implementation of these recommendations, and completion of projects whose application was submitted before the end of the transition period. The ARC recognizes that TC holders of products near or over the threshold for substantial, who do **not** already have projects in development, the ability to take any advantage of the time period is hampered by the financial and time commitments necessary to advance a project from concept to application. The ARC recognizes that, without the proposed regulatory relief, the investment of capital in development of derivative products under the previous interpretation and application of § 21.19 will be of no future value. The ARC recommends enduring, value-limited regulatory relief for TC holders to avoid an undue financial burden.

APPROACH: <u>Continued limited level of product improvement</u> - Allow for continued major changes up to 10% increase in each of the analog characteristics (e.g., thrust, weight, wing area, H-tail area, V-tail area, fuselage length, fuselage circumference) and non-significant changes to the discrete characteristics[21] involved in triggering a substantial change classification, for products which are already over the threshold of substantial change as of the implementation of these recommendations, and completion of any projects whose application was submitted before the end of the transition period afforded by proposed § 21.19(b)(4), or products that are within 10%[22] of a level of an analog characteristic that would trigger the

[21] The ARC emphasizes the importance of maintaining the distinction between a major change and a significant change. A change can be major, but not significant as measured from the baseline product.
[22] The ARC chose 10% as that has been the historical threshold used to distinguish between significant and non-significant changes.

criteria resulting in a substantial change classification as of the completion of any projects whose application was submitted before the end of the transition period afforded by the proposed § 21.19(b)(4).

Designating an Additional RTD Configuration (in the context of grandfathering) - Allow the addition of RTD configurations that are over the threshold for substantial recommendations, and completion of projects whose application was submitted before the end of the transition period afforded by proposed § 21.19(b)(4). As with the ARC's desire to develop a means to retroactively designate an RTD configuration (See REC2), additional work will be required to justify the grandfathered configuration as a new RTD.

The ARC feels strongly that RTD implementation should proceed only after an additional tasking with sufficient time to develop the concept of identifying a new RTD and a more explicit means to identify a grandfathering principle, and the justification required to do so.

Recommendations for Criteria & Definitions

The ARC developed various recommendations to revise and clarify criteria and definitions.

REC5 The FAA should revise the significant change criteria definitions in its regulatory text and guidance material.

INTENT: To revise the significant change criteria definitions in 14 CFR § 21.101(b)(1) and AC21.101-1B Section 3.6 to align with the ARC's recommendations.

RATIONALE: The current definitions consist primarily of inferential examples, resulting in broad and inconsistent interpretations. In many cases, there is merely a list of examples with no definition at all. Revised definitions are necessary to promote greater clarity and consistency in the evaluations of significance across different projects, applicants, and CAAs. This is especially true considering that AC21.101-1B relies on these defined terms as the basis for determining significance (e.g., Assumptions for Certification). Clear definitions that are easy to understand are essential to the evaluations.

APPROACH: The ARC recommends the following revised definitions:

- General Configuration: *"General configuration refers to the basic product layout and arrangement of major items to support the intended product use. A significant type design change to the general configuration is one that distinguishes the resulting product from the baseline product, such as changes to: the overall shape or layout; external items having aerodynamic effects (e.g., wings, empennage, engines, rotors); number or location of exits or cargo doors; type of landing gear; and changes to the crew interface (e.g., analogue to digital flight deck). For examples, see Appendix A of this AC.*

- Principles of Construction: *A significant type design change to the principles of construction is one that introduces a distinct change to the materials and manufacturing processes that make up the structural configuration of the baseline product and may thus affect its operating characteristics or structural performance at the product-level. This concept includes the types of materials (e.g., metallic, composite, ceramic) as well as special manufacturing processes (e.g., additive manufacturing). For examples, see Appendix A of this AC.*

- Assumptions Used for Certification: *The Assumptions Used for Certification of a baseline type design refer to the key design and operational characteristics (see new Product Level Change definition proposed for Appendix J) for which the certification basis was found to be adequate, as well as the associated compliance approach that would apply.*[23]

The Assumptions Used for Certification are invalidated in one or both of the following scenarios:

1. *The change to type design requires consideration of new or different types of hazards at the product-level from those certified on the baseline product, thus requiring an updated certification basis.*

[23] A change to the acceptable means and methods of compliance that would dictate a different compliance approach does not invalidate the assumptions used for certification, but rather it is the extent of change that would drive the assumptions for certification to be invalidated.

2. *The product's key design and operational characteristics have changed to such an extent that the compliance approach used for the baseline product cannot be re-used or extrapolated for the changed product.*

The proposed definition would be illustrated by consideration of a few examples as follows:

"A distinct set of Assumptions Used for Certification would be necessary in the following examples (new or different hazards requiring new or different requirements, and the existing compliance approach cannot be re-used or extrapolated):

- *A change in the minimum flight crew;*
- *Change from a fully mechanical primary flight control system to a digital FBW system;*
- *Initial installation of a new APU essential for aircraft flight operation;*

For these and other examples with associated explanatory notes, see Appendix A of this AC.

The Assumptions Used for Certification would not be invalidated in the following examples (no new or different hazards requiring new or different requirements, and the existing compliance approach can be re-used or extrapolated):

- *Increase in the number of passengers of a magnitude such that the existing evacuation testing results could be extrapolated;*
- *Increase in maximum take-off weight, for an aircraft, of a magnitude such that the existing compliance approach for flight performance, flying qualities, air and ground loads, structural strength, fatigue spectra, aeroelasticity, etc. could be re-used;*
- *Increase in maximum engine thrust or power, for an aircraft, of a magnitude such that the existing compliance approach for flight performance, flying qualities, air and ground loads, structural strength, fatigue spectra, aeroelasticity, etc. could be re-used.*

For these and other examples with associated explanatory notes, see Appendix A of this AC.

REC6 The FAA should update AC21.101-1B Appendix A examples to reflect the new definitions for significant changes.

INTENT: To revise AC21.101-1B Appendix A to align with the ARC's recommendations.

RATIONALE: The definitions of the three criteria for a significant change and the definition of a product level change have been clarified.[24] The examples in Appendix D of this report were updated to match the new definitions. The ARC considers it essential for the examples to be incorporated in AC21.101-1B to reinforce and clarify the meaning of the new definitions.

APPROACH: The ARC was advised during its deliberations that AC21.101-1B is currently being revised, and a new Revision C is slated to be released for public comment in the coming weeks. Since the AC revision is pending, the ARC considered it prudent to table its discussion and await the opportunity to provide feedback during the public comment period. The ARC does, however, note the following:

- The revised examples[25] developed by the ARC should be incorporated into a separate section of the AC that affords greater flexibility to make changes and respond to issues in an agile manner that better supports industry.
- The ARC encourages the FAA to coordinate with the IAWG to ensure the ARC's examples align with the IAWG recommendations.

[24] Per Charter Tasks 4(c)-2 and Topic 4(c)-3 t.
[25] *See* AC21.101-1B - Part 23 Tables and AC21.101-1B - Parts 27 & 29 Tables. The ARC requests an additional tasking to complete the examples for Part 25.

REC7 The FAA should revise the definition of "Product Level Change."

INTENT: To clarify the definition of "Product Level Change"[26] (Ref. AC 21.101-1B App. J) that is meaningful in the context of significant changes.

RATIONALE: The current definition of Product Level Change is found in AC 21.101-1B Appendix J.[27] This definition is confusing because it refers to the "models of the product" (without defining the meaning) and offers examples that differ from the criteria used for significant evaluations. For example, the definition of Product Level Change refers to range, payload, speed, and design philosophy. However, significant changes are evaluated based on principles of construction, general configuration, and assumptions used for certification. Improving the definition will harmonize the concepts considered for significant change classifications.

The ARC notes that the IAWG is proposing to add the term "product level" into the regulations as recommended in 1BR4. The ARC concurs with this recommendation as it supports the ARC's efforts to define product level change and clarify its meaning with respect to the baseline product.[28]

APPROACH: The ARC proposes the following definition for Product Level Change:

> **J.10** ~~Product Level Change. A change or combination of changes that makes the product distinct from other models of the product (e.g., range, payload, speed, design philosophy). Product level change is defined at the aircraft, aircraft engine, or propeller level of change.~~
>
> **J.10 Product Level Change.**
>
> *Any change is a change to the product and its effects are assessed at the product level. Some changes affect the key operational and design characteristics and depending on the magnitude of the change, a major change could be classified as major, not-significant, significant or substantial. Only a change affecting the key operational and design characteristics which makes the product distinct from its baseline configuration (or reference type design as applicable) is considered a "product level change" and therefore would be classified as either significant or substantial.*

A change to the product must be assessed *at the product level*, but only changes that affect the key design and operational characteristics are product level changes. The effect on the key design and operational characteristics is determined by the magnitude of the change from the baseline product, including any

[26] Substantial changes are also inherently Product Level Changes. This section is clarifying the meaning of Product Level Change in the context of significant changes.
[27] A change or combination of changes that makes the product distinct from other models of the product (e.g., range, payload, speed, design philosophy). Product level change is defined at the aircraft, aircraft engine, or propeller level of change.
[28] *See also* NPA 2024-04 (where EASA proposed a revision to 21.A.101 rule and corresponding guidance NPA 2024-04 - Regular update of Commission Regulation (EU) No 748/2012 and the associated acceptable means of compliance and guidance material (RMT.0031 Subtask 3) | EASA.

previously accumulated change(s). Only product level changes need to be evaluated for significance in accordance with § 21.101(b).[29]

Key Design and Operational Characteristics can generally be described as high-level design descriptors, such as passenger capacity, type and number of engines, maximum take-off weight, operating speeds, kinds of operation (e.g., VFR, IFR, day, night, icing), overall human-machine interface architecture, maximum operating altitude, and minimum and maximum operating temperatures. These characteristics taken together define the intended usage of the aeronautical product and the context in which it operates.

Product Key Design and Operational Characteristics include the following:

- **Key Operational Characteristics**:
    - Kinds of Operation (e.g., VFR, IFR, day, night, icing)
    - Operating Limitations
        - MTOW
        - MPSC
        - Operating envelope (Altitude / speed / OAT)
        - Power / Thrust
    - Aircraft Flight Performance and Handling Qualities
    - Flight Crew Requirements (e.g., Minimum Crew)
    - Maintenance Concept

- **Key Design Characteristics**:
    - Product category/sub-category
    - Main physical characteristics
        - Fuselage size
        - Wing shape, size, and location
        - Tail shape, size, and location
        - Number and location of engines or rotors
    - Architecture (functional/physical) and technology of systems ensuring the:
        - Controllability/maneuverability
        - Overall human-machine interface architecture
        - Structural integrity
        - Propulsion type
        - Occupant safety/survivability
    - Structural material and processes

[29] *See* REC5.

Recommendations for Affected Areas

The ARC developed various recommendations to improve the management of affected areas. Recommendations REC8 through REC12 are interdependent and address various aspects of affected areas. The Recommendations are fully aligned with the goals of the ARC Charter and are intended to be incorporated into and aligned with AC21.101-1B § 3.9 and Appendix C. As more fully explained below, the ARC requests an additional tasking to develop AC 21.101-1B and ensure the recommendations are integrated in an optimized manner. This will ensure the overall consistency and effectiveness of these recommendations.

The ARC provides the following insights on the objectives of Recommendations REC8 - REC12. Specifically, the Recommendations are intended to:

- Ensure that the guidance material details the iterative and continuous update methodology for Affected Areas assessments, including FD/HFE/SCI requirements (REC8),
- Provide the identification of the certain airworthiness requirements (including FD/HFE/SCI and other safety critical aircraft level requirements) for which the scope of the affected areas should be reviewed in consistency with the scope of the requirements (REC9),
- Define and create a framework for affected areas (REC10)
- Provide a methodology to adapt with proportionality the scope of the affected areas to the scope of the certain airworthiness requirements (REC11), and
- Develop a method to review the completeness of the affected areas in front of the safety analysis principles (REC12).

REC8 The FAA should develop guidance detailing the iterative and continuous update methodology for Affected Areas assessment, including FD/HFE/SCI requirements.

INTENT: To develop a step-by-step methodology to guide the boundaries of the identification of the Affected Areas and applicable requirements.

RATIONALE: Affected Areas identification is described mainly at Step 6 of the CPR process, but it actually starts earlier at Step 1. It is necessary to describe this progression across the different steps of the CPR process. The boundaries should be defined as an iterative process and adjusted based on:

- the completeness check, using system safety principles, or
- the consistency check, with the applicable requirements/scope of applicability.

APPROACH:
Update AC21.101-1B § 3.2.2 with the following additional text:

- 3.2.2.3 The identification of the proposed change, the baseline product that is being changed, and an early high-level assessment of the affected product key design and operational characteristics is necessary for the classification of the change and for the determination of the certification basis. This first identification will support the classification steps (Step 2 and Step 5). A more detailed identification of the areas affected

by the change will be necessary for the determination of the applicable certification basis requirements at Step 6.

- 3.2.3 Use High Level Descriptors - To identify and describe the proposed changes to any aeronautical product, use a high-level description of the design change that characterizes the intent of, or the reason for, the change. No complex technical details are necessary at this stage, the description of the change shall nonetheless allow a good understanding of the effect of the change on the product key design and operational characteristics. It is therefore expected that an initial identification of the change includes information such as changes to the product category, the affected key operational characteristics (kinds of operation, operating limitations, performance, flight crew requirements, etc.), and the affected key design characteristics (physical, architecture, materials, etc.). For example, a proposal to increase maximum passenger-carrying capacity may require an addition of a fuselage plug, and as such, a "fuselage plug" becomes one possible high-level description of this design change. Similarly, a thrust increase, a new or complete interior, an avionics system upgrade, or a passenger-to-cargo conversion are all high-level descriptions that characterize typical changes to the aircraft, each driven by a specific goal, objective, or purpose.

Update AC21.101-1B § 3.9 with the following text:

- 3.9 Step 6. Prepare your Proposed Certification Basis List.

- Following the identification of the product key design and operational characteristics affected by the change at Step 1, Step 6 consists in detailing the identification of the Affected Areas, according to the changed product development maturity level, to an extent that allows a proper definition of the applicable certification basis requirements. The certification requirements address all physical and functional areas of the product from the aircraft-level down to the lower-level components' technical characteristics, accounting for change to, or effects on operational and other key characteristics.

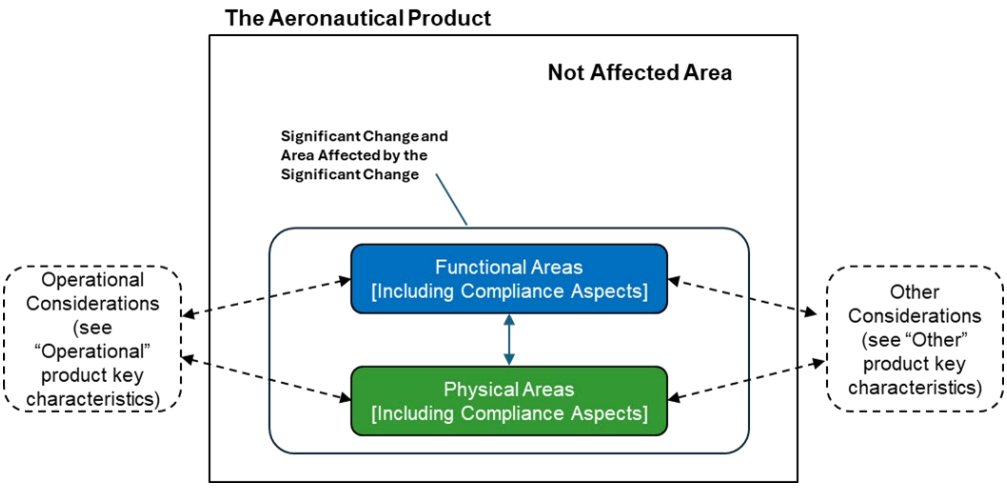
- As part of preparing your proposed certification basis list, you must identify all the areas, at aircraft, systems, components, equipment, or appliances level, of the product that are affected by the design change and the corresponding regulatory standards associated with these areas. For each group, you must assess the physical, functional and operational effects of the change on any areas (at aircraft, systems, components, equipment, or appliances level) of the product. The characteristics affected by the change are not only physical changes, but also functional, operational or other changes brought about by the physical changes.

- The intent is to encompass all aspects where there is a need for re-evaluation, that is, where the substantiation presented for the product you are changing should be reviewed,

updated or rewritten. Appendix H of this AC contains two examples of how to document a proposed certification basis list.

- 3.9.1 An area affected by the change is a technical characteristic that is physically, functionally, operationally, or otherwise modified by the change (or combination of changes), thereby invalidating the compliance demonstration to the baseline certification basis or for which additional/bridging analysis is required to show the validity of the existing compliance demonstration. Figure 3-3 of this AC illustrates concepts of physical, functional, operational and other changes to an Affected Area. Appendix C of this AC contains a method used to define the change and areas affected by the change. This appendix is meant to assist you when you propose a large, complex design change. For a type design change, it is important that you properly assess the effects of such change on any areas (at aircraft, systems, components, equipment, or appliances level) of the product because areas that have not been physically changed may still be considered part of the Affected Area. If a new compliance finding is required, regardless of its amendment level, it is an Affected Area.

Figure 3-3. Affected Areas versus Not Affected Areas



- 3.9.2 An area not affected by a change can remain at the existing certification basis, provided you present to the FAA acceptable justification that the area is not affected.

- 3.9.3 For sample questions to assist in determining Affected Areas, see paragraph D.1 of Appendix D of this AC.

- 3.9.4 Detailed Affected Areas identification:
  - 3.9.4.1 The identification of the Affected Areas shall consider a whole product perspective (physical and functional areas, operational and other characteristics) and be based on a product decomposition allowing a top-down and bottom-up assessment of the effects of the change.

- From the initial identification of the affected key design and operational characteristics at Step 1 and the allocation to the related/unrelated groups at Step 4, the detailed identification of the Affected Areas should include:

  - 3.9.4.2 Physical Areas. Main physical changes (e.g., new engine installation) and any other impacted areas modified to accommodate the main physical change (e.g., electrical, structural or HW adaptation). It can include zonal modifications (e.g., new DFZ, or new FFLZ). These physical changes are usually subject to the configuration management principles. The physical areas encompass all the items of the product breakdown structure (from the top-level aircraft to the bottom elementary parts through all intermediate level assemblies) affected by the change.

  - 3.9.4.3 Functional Areas. Main functional changes (e.g., new AP upper modes) and any other impacted areas or characteristics or performance modified at the product-level to accommodate the main functional change (e.g., alerting functions). It can include changes to the functional architecture (e.g., monitoring function). The functional areas encompass all the items of the functional breakdown structure (from the top-level aircraft functions to the bottom equipment Software functions through all intermediate level systems functions) affected by the change.

  - 3.9.4.4 Physical and Functional Areas (above) could be affected by the change to the TC. If the objective is a change to operational capability, it must include all physical and functional changes that enable the intended operational capability. If the objective of the change is a physical or functional change, it must consider the impact to end user operations. In both cases, if the compliance substantiation of the Baseline Product is invalidated by the change, the invalidated compliance aspects must be reassessed in the identification of the physical and functional areas. Examples of changes to operational capability include:
    - Flight envelope and operating limitations, flight performance and handling qualities
    - Minimum Crew (SP/DP) and Kinds of Operation (NVIS, IFR/VFR, Day/Night, Icing, HEC, ...)
    - Operational concept and flight crew requirements

  - 3.9.4.5 The Physical and Functional Areas (above) must also take into consideration other (transverse) characteristics of the physical, functional, or operational characteristics that must be assessed to show compliance with the applicable requirements of the TC basis:
    - Flight Deck, Human Factors Effects, and Safety Critical Information
    - System Safety/Reliability characteristics
    - Development Assurance (SW, AEH, System)
    - Zonal safety and fire protection

        - Cabin safety and evacuation
        - Loads (flight, ground, ...)
        - Static and fatigue strength
        - Environment:
            - Thermal aspects (Hot and Cold)
            - Dynamic and vibration aspects
            - Lightning (direct and indirect)
            - EMI/EMC, HIRF
            - Icing
            - Snow
            - Noise
            - Fuel venting/emissions
        - Maintenance schedule and means
        - Any certification assumption (e.g., flight spectrum)

- 3.9.5 Completeness check of the Affected Areas identification
    - 3.9.5.1 The consistency of the scope of the Affected Areas with the scope of the allocated requirements can be checked with the interpretative material provided in the corresponding AC.

    - 3.9.5.2 Case of certain airworthiness requirements. By nature, these requirements address product level hazards and as such their full safety intent is achieved when applied at product level. These requirements are related to the following areas:
        - FD/HFE/SCI areas:
        - Human Factors (e.g., ergonomics, crew interface, workload) [e.g., 2x.1302, 2x.1309]
        - Flight Crew Alerting [e.g., 2x.1322]
        - Safety (e.g., equipment, systems, and installations) [e.g., 2x.1309].

    - 3.9.5.3 Other characteristics that need consideration for impacts on the system of systems:
        - Development assurance
        - Security considerations
        - Environmental conditions
        - Certification Maintenance Requirements
        - Electrical Wiring Interconnection System
        - Crashworthiness
        - Structural fatigue
        - Fire protection

    Applying the requirements related to the above listed areas at product level may not be practical, and adaptation of the scope of the affected areas to the scope of applicability of

these specified airworthiness requirements should be performed with proportionality considering the required level of effort and the expected safety benefits.[30]

- 3.9.5.4 Consistency with the safety assessment principles. The systematic decomposition of functions and systems used by safety analysis could be a useful tool to make sure that all related functional and physical affected areas were properly captured. Figure 3-4 shows how the identification of the affected areas, and associated requirements, could be refined thanks to the identification of the impacted systems through the Aircraft and Systems FHA and SSA (when existing).

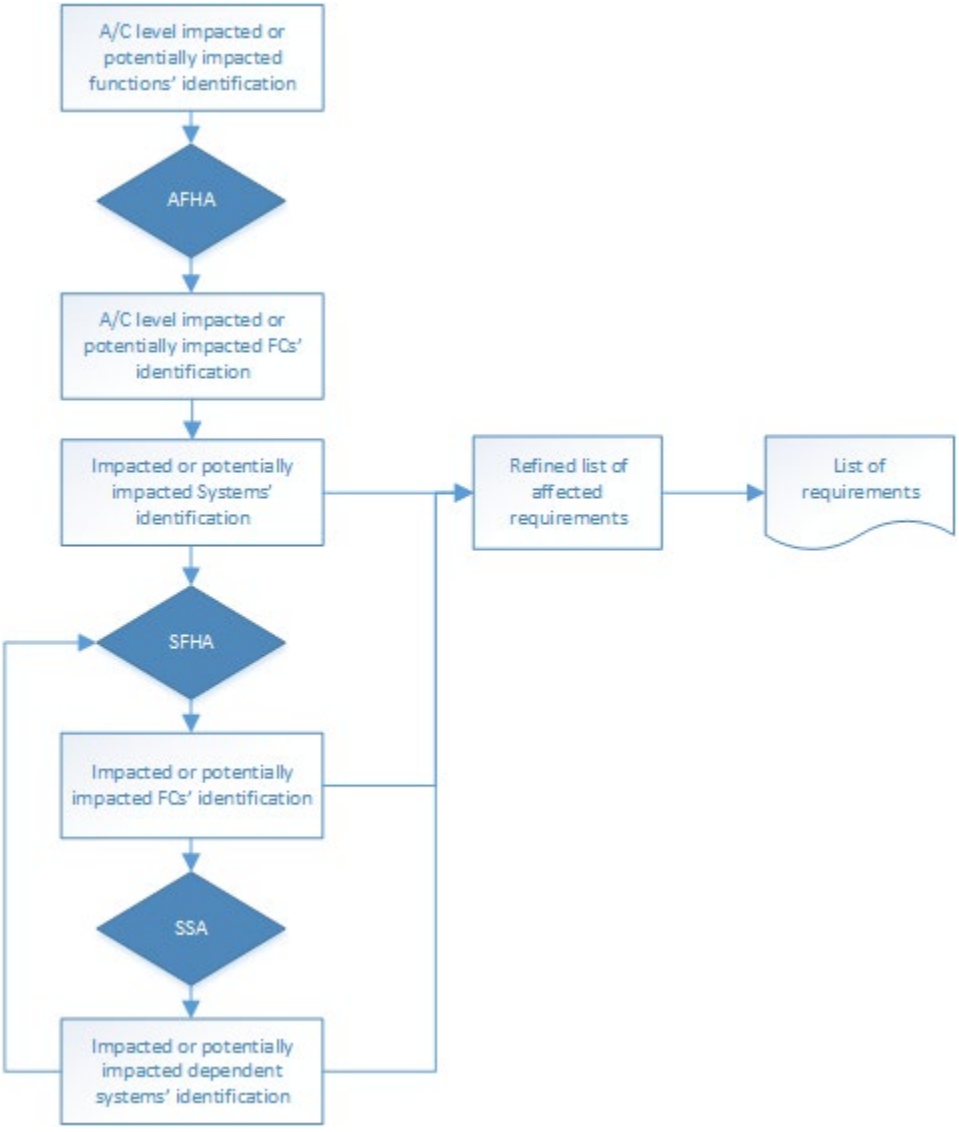


Figure 3-4

[30] *See* REC 11.

- 3.9.6 Once the detailed Affected Areas are identified, the corresponding certification requirements shall be allocated, including any cross-referenced requirements. Appendix C shows how this allocation of requirements to Affected Areas could be documented. All areas affected by the proposed design change must comply with the latest requirements unless you show that demonstrating compliance with the latest amendment of a requirement would not contribute materially to the level of safety or would be impractical. Step 7 below provides further explanation.

- 3.9.7 Final Affected Areas identification and combined list of requirements.

- 3.9.8 Consider the following aspects of the Affected Areas assessment process
  - 3.9.8.1 Links with the changed product development maturity
    - The certification requirements for all physical and functional areas addressing the complete aircraft characteristics (all physical, functional, operational and other (transverse) from the aircraft-level down to the lower-level components technical characteristics, the complete and detailed identification of the effects can only be achieved after reaching a good maturity of the design. Therefore, the Affected Areas assessment will follow the steps of the development process resulting in a stepwise approach for the definition of the proposed certification basis list.

    - The Affected Areas assessment process is sequential and iterative (see Appendix C).

- 3.9.9 The applicant should document the change and areas affected by the change using high level descriptors along with the applicable requirements and their associated amendment levels. The applicant proposes this as a change to the certification basis that the FAA will consider for documentation in the type certificate data sheet (TCDS) or STC if they are different from that recorded for the baseline product in the TCDS.

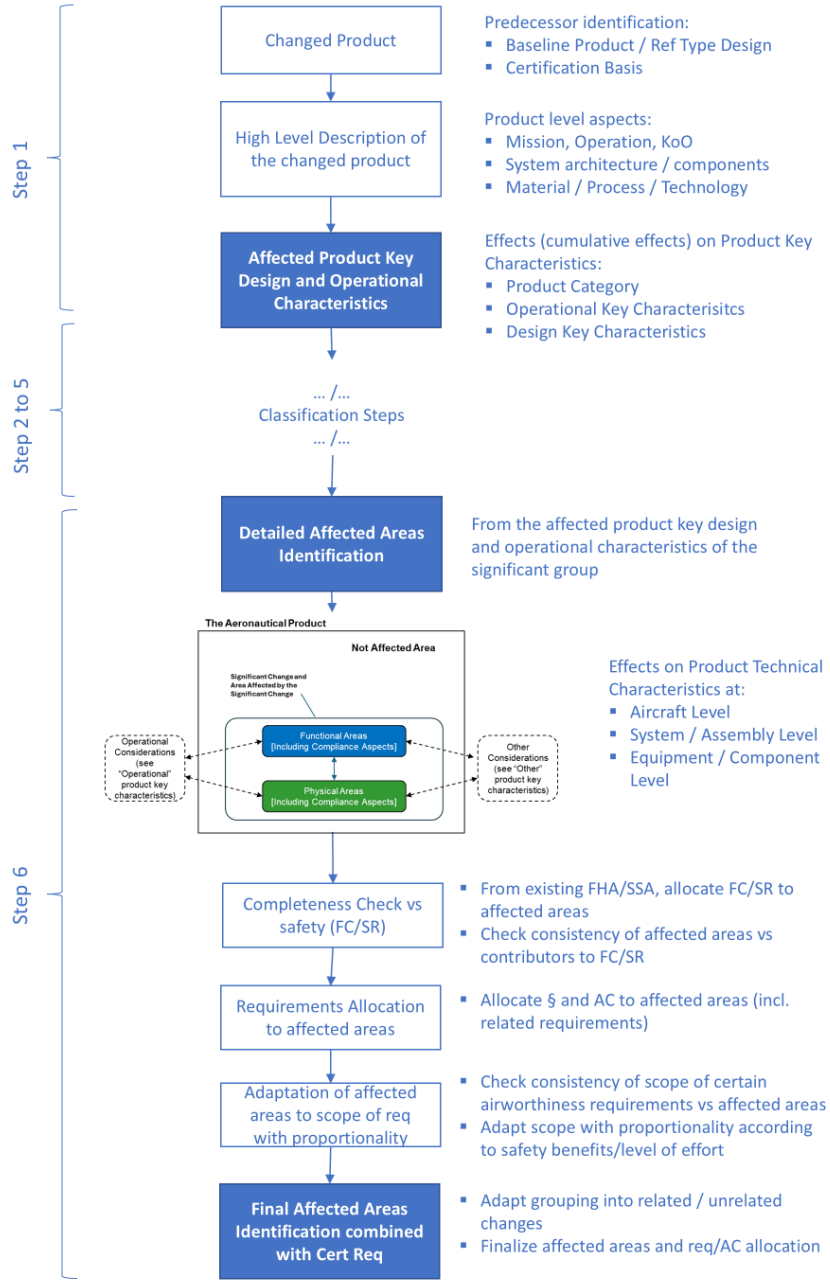
Update AC21.101-1B Appendix C, Section C.1 as follows:

C.1 Overview.

C.1.1 When a product is changed, some areas may change physically, while others may change functionally, and those areas need to appropriately encompass operational or other (transverse) affected characteristics. The FAA refers to this combination as changed and Affected Areas. For example, an extension to the wing of a fixed-wing aircraft would physically change the wing tip and likely other wing structure. Some areas of the airframe may have sufficient strength for the increase in load and would change functionally, i.e. they would carry greater load, but they would not change physically. The change will likely affect handling qualities or performance which require assessment of compliance. These areas have associated airworthiness requirements, which become Part of the certification basis for the change.

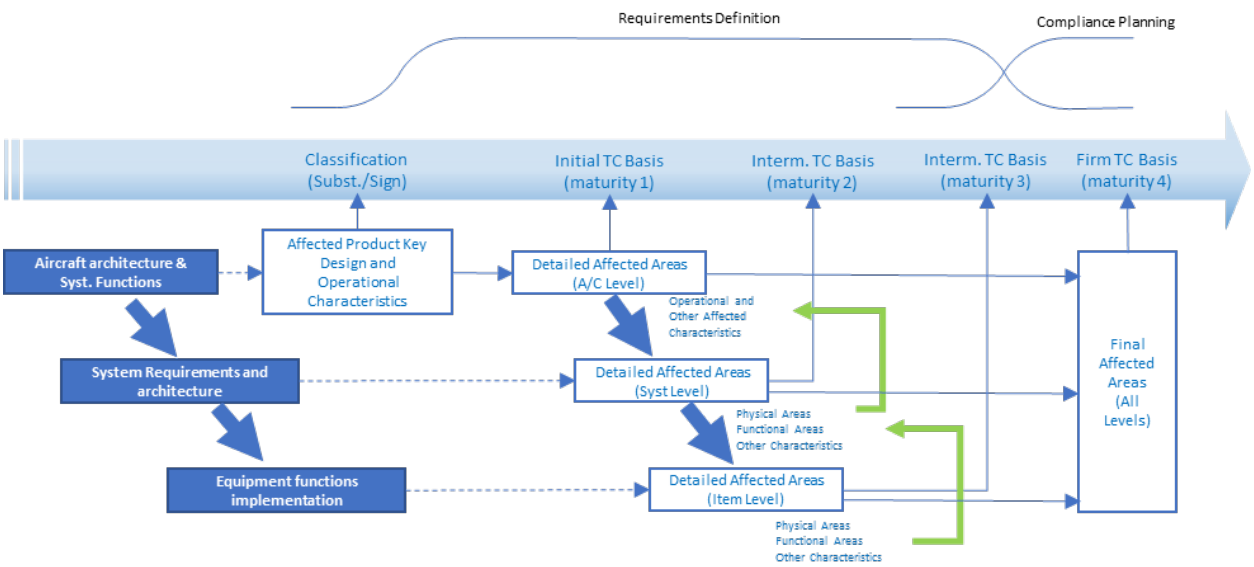
C.1.2 Figure C-1 below provides an overview of one method that applicants may use to determine in a stepwise approach the changed and Affected Areas (from initial to detailed and final Affected Areas) and the applicable airworthiness requirements.

Figure C-1. Method to Determine the Changed and Affected Areas



C.1.3 The identification of the Affected Areas starts early in the certification project with the high-level description of the change (or combination of changes) and the identification of their effects (and cumulative effects) on the product key design and operational characteristics. This initial change identification supports the classification steps of the CPR process. From this initial change identification, a detailed Affected Areas identification starts for the group(s) classified Significant. In a top-down/bottom-up stepwise approach, the detailed Affected Areas identification will assess, according to the certification project maturity, at each level of the product (from aircraft to item level) the effects of the change on the functional and physical areas accounting for operational and other (transverse) considerations. Each level being connected to the other, the identification of the Affected Areas at one level could reveal a need to reconsider the upper level, and vice versa. The allocation of the airworthiness requirements can occur at each step of the identification of the detailed Affected Areas allowing to mature the definition of the certification basis step by step as shown in the figure below. This evaluation method supports the evaluation of an adequate certification basis for each Affected Area, at each system level from the equipment-level to the aircraft-level.

Figure C-2 Decomposition Method to Determine Affected Areas



C.1.4 The top-down/bottom-up process described above can start at system level, in case the main change is a physical change (e.g., or directly at the aircraft level).

The steps below include a simple winglet example. The ARC recommends an additional tasking to develop a more relevant example for Appendix C of AC 21.1.1-1B that has implications for FD/HFE/SCI.

Update AC21.101-1B Appendix C, Section C.2 thru C.9 as follows:

C.2 Affected Product Key Design and Operational Characteristics

C2.1 Steps.

- Step 1: Identify predecessor configuration (baseline product and reference type design) and certification basis
- Step 2: Provide high level description of the change
- Step 3: Identify the Product's Key Design and Operational Characteristics affected by the change

C2.2 Example.

Applicant A has applied for the certification of new large fixed-wing aircraft Model X-2 to Type X, consisting of adding a winglet to the Model X-1 and a change to the leading-edge slats for a performance increase. Model X-1 was approved in compliance with FAR 25 Amdt. x to y. See Table C-1 below for an example of how to chart the affected Product's Key Design and Operational Characteristics

Table C-1. Example of Associating a Physical Change with the Applicable Airworthiness Requirements

Product's Key Characteristics		Proposed Change
Key Operational Characteristics	Kinds of Operation (e.g., VFR, IFR, day, night, icing)	No change
	Operating Limitations - MTOW - MPSC - Operating envelope (Altitude/speed/OAT) - Power/Thrust	No change
	Aircraft Flight Performance	Low speed performance and handling qualities
	Flight Crew Requirements	No change
	Maintenance Concept	No change
Key Design Characteristics:	Product Category/Sub-category	No change
	Main physical characteristics - Fuselage size	

	- Wing shape, size, and location - Tail shape, size, and location - Number and location of engines or rotors	Winglet
	Architecture (Functional/Physical) and technology of systems ensuring the: - Controllability/Maneuverability - Overall human-machine interface architecture - Structural Integrity - Propulsion type - Occupant Safety/Survivability	Load distribution/wing PSE
	Structural material and processes	No change

C.3 Detailed Affected Areas

C.3.1 Changes with Operational Considerations.

C.3.1 Steps.

- Step 1. Make a list of changes at the aircraft level due to operational considerations. List these as "Functional" changes.
- Step 2. List the corresponding airworthiness requirements applicable to these changes.
- Step 3. List the amendment level recorded on the existing certification basis of the baseline product and the amendments on the date of application.
- Step 4. Reconsider iteratively the operational affected characteristics once the physical, functional area listings have been completed at the next lower level (e.g., system, equipment, item) including the consideration of other characteristics and adjust the Functional areas accordingly.

C.3.2 Example.

Adding a winglet increases aircraft performance in climb and level flight and affects flight characteristics. See Table C-2 below for an example of how to chart a physical change and the associated certification requirements.

Table C-2. Example of Associating a Functional Change with the Applicable Airworthiness Requirements

Functional Change	Applicable Regulations*	Amendment of Existing Certification Basis	Amendment to Application Date
Aircraft Performance	25.xxx	25-aaa	25-ddd
	25.yyy	25-bbb	25-eee
Flight Characteristics	25.zzz	25-ccc	25-fff

* These would be airworthiness requirements related to aircraft performance/flight characteristics aspects only.

C.4 Physical Changes.

C.4.1 Steps.

- Step 1. Make a list of the physical changes.
- Step 2. List the corresponding certification requirements applicable to the physical changes.
- Step 3. List the amendment level recorded on the existing certification basis of the baseline product and the amendments on the date of application.
- Step 4. Reconsider iteratively the identification of the physical affected areas once the affected areas (physical and functional areas considering changed and affected operational and other characteristics) are identified at a lower level (e.g., system, equipment, item).

C.4.2 Example.

The change is adding a winglet to a fixed-wing aircraft and a change to the leading-edge slats for a performance increase. As part of the change, an electrically driven slat actuator is modified by changing the mounting structure of the actuator used to connect the actuator to the slat. The actuator structure is changed. The electrical system in the actuator is not affected. The applicant would list certification requirements applicable to the actuator. The applicant would not list the certification specifications applicable to the electrical system of the actuator. See Table C-3 below for an example of how to chart a physical change and the associated certification requirements.

Table C-3. Example of Associating a Physical Change with the Applicable Airworthiness Requirements

Physical Change	Applicable Regulations*	Amendment of Existing Certification Basis	Amendment to Application Date
Structural change to slat actuator	25.xxx	25-aaa	25-ddd
	25.yyy	25-bbb	25-eee
	25.zzz	25-ccc	25-fff

* These would be airworthiness requirements related to structural aspects only.

C.5 Functional Changes.

C.5.1 Steps.

- Step 1. Make a list of the functional changes.
- Step 2. List the corresponding airworthiness requirements applicable to the functional changes.
- Step 3. List the amendment level recorded on the existing certification basis of the baseline product and the amendments on the date of application.
- Step 4. Reconsider iteratively the identification of the functional affected areas once the affected areas (physical and functional areas considering changed and affected operational and other characteristics) are identified at a lower level (system, equipment, item).

C.5.2 Example.

Adding a winglet will affect the aircraft flight characteristics and adaptation of the aircraft stability augmentation system and automatic pilot control laws is required. See Table C-4 below for an example of how to chart a physical change and the associated certification requirements.

Table C-4. Example of Associating a Functional Change with the Applicable Airworthiness Requirements

Functional Change	Applicable Regulations*	Amendment of Existing Certification Basis	Amendment to Application Date
SAS / Autopilot control laws	25.xxx	25-aaa	25-ddd
	25.yyy	25-bbb	25-eee
	25.zzz	25-ccc	25-fff

* These would be airworthiness requirements related to autopilot/stability functional aspects only.

C.6 Changes with other (transverse) considerations.

C.6.1 Steps.

- Step 1. Describe each change.
- Step 2. Describe the effects of the change (e.g., structural, performance, electrical, etc.).
- Step 3. List the areas, systems, parts, and appliances that are affected by those effects as appropriate in either the physical or functional listing.
- Step 4. List the certification requirements associated with the effects for each area, system, part, or appliance.
- Step 5. List the amendment level recorded on the existing certification basis of the baseline product and the amendments on the date of application.
- Step 6. Reconsider iteratively the identification of the physical and functional affected areas once the affected areas (physical and functional areas and changed or affected other characteristics) are identified at a lower level (e.g., system, equipment, item).

C.6.2 Example.

The change is adding a winglet to a fixed-wing aircraft and a change to the leading-edge slats for a performance increase. The wing root bending moment has increased. The loads in the wing box are increased but the wing box has sufficient structural margins to carry the higher loads. Thus, the wing box is not physically changed but its function has changed because it carries greater loads. See Table C-5 below for an example of how to chart a functional change, its effects, and the Affected Areas (steps 1 through 3 above). See Table C-6 below for an example of how to chart an area affected by a functional change and the associated certification requirements (steps 4 and 5 above).

Table C-5. Example of a Functional Change, Affected Areas, and Associated Effects

Description of Change	Effects	Affected Areas
Installation of winglet	Increased loads in wing structure	Wing spars
		Wing skins
	Effect 2*	Area 1
		Area 2
	Effect 3*	Area 3

* There may be other effects as well.

Table C-6. Example of Associating Affected Areas with the Applicable Airworthiness Requirements

Impacted Area	Applicable Regulations*	Amendment of Existing Certification Basis	Amendment on Application Date
Wing spar	25.xxx	25-aaa	25-ddd
	25.yyy	25-bbb	25-eee
	25.zzz	25-ccc	25-fff

* These would be structural airworthiness requirements only. There could be other airworthiness requirements applicable to the wing box, but since the effect is structural, only the structural airworthiness requirements are applicable.

C.7 Completeness Check vs Safety analysis.

C.7.1 Steps.

- Step 1. Identify the Failure Conditions Associated to the Functional Areas (from existing or new AFHA/ System FHA).
- Step 2. Identify all system and equipment contributing to the Failure Conditions (from existing or new Preliminary System Safety Assessment (PSSA))
- Step 3. Check if all systems and equipment identified are already included in the physical or functional areas
- Step 4. If not, consider extending the scope of the affected area to these systems and equipment when relevant (i.e., the systems and equipment are physically and functionally unchanged but affected).

C.7.2 Example.

The function “stability augmentation” affected by the winglet adding has the following failure conditions “Loss of right wing flap control at high speed.”

Table C-7. Example of Identifying Additional Affected Areas

Function	Failure Condition	Related Systems	Affected Areas	Rationale
Stability Augmentation	Loss of control	Auto-pilot syst (incl. actuators) Air Data syst Electrical Generation Syst	Auto-pilot (incl actuators)	Air Data and Electrical Generation system is neither functionally or physically affected by the change

C.8 Consistency of requirements scope and affected areas.

C.8.1 Steps.

- Step 1. List all requirements applicable to the functional and physical areas considering operational and other key product characteristics.
- Step 2. Identify if certain airworthiness requirements are part of the list of applicable requirements
- Step 3. For these requirements only, evaluate the level of effort and the effectiveness in complying with the latest amendment at Product Level
- Step 4. Consider extending the scope of the affected areas when complying with the latest amendment is Resource Effective

C.8.2 Example.

Adding the winglet required new fatigue substantiation according to §571 which applies by definition to all primary structural elements. Expanding the scope of the affected areas to other areas than the wing spar is assessed for this certain airworthiness requirement considering the existing certification.

Table C-8. Example of review of the scope of affected areas with scope of applicability of the requirement

Airworthiness Requirement	Scope	New Hazard mitigated by the Amendment on application date	Safety Benefit	Proportional Change Impact	Project Level Practicality of Compliance	Proposed affected areas
25.571	All PSE	Damage Tolerance	MED	HIGH	Not Practical	Wing Spar

C.9 Combine the Lists.

C.9.1 The FAA typically presents the certification basis for a product by certification requirements and not by area. The next step is to combine these two lists. However, since only a portion of the product is being changed, the changed and Affected Areas of the new certification basis need to be identified. The unchanged areas are not required to comply with the certification requirements in effect at the date of application. (See point 21.A.101(b)(2)).

C.9.2 When the change is quite extensive, applicants will save time by listing all the certification requirements applicable to the category of product they are certifying. They can use Table C-9 below in the next step where they will identify any other exceptions that they would like the FAA to consider.

C.9.3 Example. If we use the examples above for the combined list for the actuator structural changes and the wing box functional change, then the certification basis would be listed as shown in Table C-9 below.

Table C-9. Example of a Combined List of Physical and Functional Changes with Applicable Airworthiness Requirements

Airworthiness Requirement	Amendment Levels		Changed and Affected Area
	Amendment of Existing Certification Basis	Amendment on Application Date	
25.xxx*	25-aaa	25-ddd	- Wing spar
25.yyy*	25-bbb	25-eee	- Leading-edge actuator
25.zzz*	25-ccc	25-fff	- Wing loads

* These represent structural airworthiness requirements

REC9 The FAA should update AC21.101-1B guidance to identify certain airworthiness requirements (incl. Flight Deck, Human Factors Effects, and Safety Critical Information) for which the scope of the affected areas should be reviewed.

INTENT: To provide guidance for and specific emphasis on certain airworthiness requirements within the CPR process, such as those pertaining to flight deck (FD) and human factors effects (HFE), and safety critical information (SCI), but more generally to any safety critical aircraft level requirements.

RATIONALE: In the systems hierarchy, an item or system-level change may prompt the assessment of such FD, HFE, and SCI requirements that are applied at the aircraft-level. The inclusion of such potential FD/HFE/SCI requirements is likely to expand the scope of Affected Areas beyond the scope of change, and impact compliance with other airworthiness requirements. In other words, these requirements have the following characteristics:

- full mitigation of a critical hazard at the aircraft level
- safety intent which is not limited to a given system or installation, i.e. safety benefit is expected when applied to the full scope (e.g., aircraft, PSEs)

Potential FD/HFE/SCI areas include:

- Human Factors (e.g., ergonomics, crew interface, workload [e.g., 25.1302, 2X.1309, etc.])
- Flight Crew Alerting [e.g., 2X.1322]
- Safety (e.g., equipment, systems, and installations) [e.g., 2X.1309, etc.]

Potential other safety critical areas that need consideration for impacts on the system of systems include:

- Development Assurance (e.g., 2x.1309)
- Security considerations
- Environmental conditions (e.g., 2x.1309)
- Certification Maintenance Requirements (e.g., 2x.1309)
- Electrical Wiring Interconnection System (e.g., Part 25 Sub-part H)
- Crashworthiness (e.g., 2x.561, 562, 785, 952)
- Structural Fatigue (e.g., 2x.571, 2x.573)
- Fire Protection (e.g., 2x.853, 855, 861, 863, etc.)

The FAA has historically treated HFE[31] and SCI[32] requirements separately and recently initiated an NPRM[33] to formally define SCI and implement disclosure requirements for Part 25 applicants. The SCI NPRM is expected to be completed in Q4 2025.

[31] https://www.faa.gov/aircraft/air_cert/design_approvals/human_factors/hf-air/cfr
[32] https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1041149
[33] https://www.federalregister.gov/documents/2024/01/25/2024-01485/disclosure-of-safety-critical-information

The ARC considers it prudent to defer to the SCI NPRM to define SCI and the associated airworthiness requirements. This will avoid the confusion and inconsistency that may arise from the ARC's efforts to scope SCI as a parallel activity. Accordingly, the ARC offers no recommendation on SCI requirements other than to note that similar initiative and formality are also needed to develop FD/HFE requirements (though not necessarily via an NPRM). Once formal associations for FD/HFE/SCI are complete and published, additional consideration may be given to their utilization in the CPR process for all applicants, including Parts 23, 25, 27, 29, 33, and 35.

However, in the meantime, the ARC considers that identification of the other safety critical aircraft level requirements (other than FD/HFE/SCI) could help the applicant to anticipate the applicability of some requirements beyond the scope of the affected areas. REC11 proposes a method to adapt with proportionality the scope of the affected areas to the scope of these certain airworthiness requirements.

APPROACH: Although the assignment of associated SCI requirements is deferred, the ARC does recommend changes to AC 21.101-1B Appendix D to ensure the guidance accounts for certain airworthiness requirements (incl. FD/HFE/SCI and other safety critical aircraft level requirements) to determine the Affected Areas. Proposed changes are denoted in the colored text below (blue text indicates proposed additions and red text indicates proposed deletions). Introductory contextual clarification is also added. It also proposed to add an item D.3 dedicated to the clear identification of the certain airworthiness requirements (incl. FD/HFE/SCI and other safety critical aircraft level requirements).

APPENDIX D. OTHER GUIDANCE FOR AFFECTED AREAS

An "area" is a scalable scope of assessment that is completed at various systems levels, i.e., at the detailed item, software, or equipment-level, up the hierarchical tier to a systems-level, system-of-systems-level (SoS) that involves two or more systems, or aircraft-level. It is important to identify the scope of an area to assess it as affected or not for certification.

D.1 Sample Questions in Determining Affected Areas.

Based on a proposed significant product level change to the baseline product, below are sample questions to assist in identifying other areas that may be affected by the change. The sample questions are generalized so as to apply to an area that is identified at the detailed item-level up to the aircraft-level. If the answer to any of these questions is yes, then the area is considered affected.

1. Are the product level design and operational characteristics affected by the change?
2. Is another area impacted as a consequence of the proposed significant product level change?
3. Is another area required to change to accommodate the proposed significant product level change?
4. Is there an ~~functional~~ effect (i.e., functional, physical, operational, other) on the unchanged area by a change to the system or system function of which it is a part?

5. Does the unchanged area need to comply with ~~a~~ system- or product-level requirements (e.g., Flight Deck, Human Factors Effects, Safety Critical Information) that ~~is~~ are part of the change?
6. Is the existing compliance for the area invalidated? Is new or additional analysis required to show the validity of the existing compliance demonstration?

D.3 Certain Airworthiness Requirements

The following requirements are considered safety critical aircraft level requirements. When they are triggered in the affected area assessment, the scope of the affected areas should be checked with proportionality (see Appendix E) to the scope of applicability of the requirements.

Example - Large Aircraft: [34]

Aircraft Level Topic	Requirements	Amdt	Hazard	Scope	Comments
Development Assurance	*25.1309*	*x*	*Design error mitigation*	*Complex and critical system and equipment*	

The ARC reiterates that this recommendation is to ensure appropriate proportionality in the certification basis of the change scope and Affected Areas relative to certain airworthiness requirements (incl. FD/HFE/SCI and other safety critical aircraft level requirements), in particular for aircraft-level certification items. The ARC notes that additional taskings should be issued for this recommendation:

- once the SCI NPRM is complete to formally define FD/HFE/SCI and implement disclosure requirements for Part 25 applicants, and
- to finalize the complete identification of the other safety critical aircraft level requirements

[34] The table illustrates how the FAA should depict the list of requirements it considers safety critical product level requirements for each product type. Similar tables should be developed for small aircraft, large rotorcraft, small rotorcraft, engines, and propellers.

REC10 The FAA should define and create a framework for "Affected Areas."

INTENT: Affected Areas is a key term used in CPR for the determination of the scope of the change and the associated applicable requirements.

RATIONALE: Current Appendix J to AC21.101-1B does not provide a definition of the term "Affected Areas," although it is widely discussed in Section 3.9 and Appendix C.[35] The current AC21.101-1B guidance emphasizes consideration of the *physical* and *functional* domains to determine the Affected Areas with inconsistent references to also consider *performance* and *product-level characteristics* that reside within the *functional* domain. CPR ARC Task 4(d) states that the guidance should also consider FD/HFE/SCI requirements, all of which may also reside either within the functional domain or as a separate domain. The ARC recommends that the advisory circular be updated for consistency and to include all contributors that determine the Affected Area regardless of domain.[36]

APPROACH:

- Update AC21.101-1B Appendix J with the following text:
    - ***Affected Areas****: Technical characteristics of the product that are physically, functionally, operationally, or otherwise modified by a change, thereby requiring additional compliance demonstration or bridging analysis to validate the original compliance demonstration of the Baseline Product.*
    - ***Physical Areas****: Main physical changes (e.g., new engine installation) and any other impacted areas modified to accommodate the main physical change (e.g., electrical, structural or hardware adaptation). It can include zonal modifications (e.g., new Designated Fire Zones or new Flammable Fluid Leakage Zone). These physical changes are usually subject to the configuration management principles. The physical areas encompass all the items of the product breakdown structure (from the top-level aircraft to the bottom elementary parts through all intermediate level assemblies) affected by the change.*
    - ***Functional Areas****: Main functional changes (e.g., new autopilot upper modes) and any other impacted areas or characteristics or performance modified at the product-level to accommodate the main functional change (e.g., alerting functions). It can include changes to the functional architecture (e.g., monitoring functions). The functional areas encompass all the items of the functional breakdown structure (from the top-level aircraft functions to the lower-*

[35] Definition in section 3.9.1: "An area affected by the change is any system, component, part, or appliance of the aeronautical product that you *physically* and *functionally* change."
Context on the definition in
Section 3.9.1: "...areas that have not been *physically* changed may still be considered part of the Affected Area. If a new compliance finding is required, regardless of its amendment level, it is an Affected Area."
Section 3.9.4: Consideration is given to "*physical aspects*" and "*performance/functional characteristics*"
[36] Guidance to determine changed and Affected Areas in Appendix C, with emphasis on *physical and functional changes*; and guidance to determine Affected Areas in Appendix D, with emphasis on *functional effects and product-level characteristics*.

level equipment functions through all intermediate level systems functions) affected by the change.

Example: Complete Flight Deck Upgrade

- High level descriptors: complete upgrade of flight instruments from federated to a highly integrated glass cockpit allowing single pilot VFR day/night and IFR flight (previously Dual Pilot IFR)

- Initial Affected Areas (high level):
    - Physical areas:
        - structure: instrument panel, control panels
        - equipment: Primary Flight Display (PFD)/Multifunction Display (MFD) back-up instruments
    - Functional areas:
        - Display of flight, navigation, powerplant and other vehicle parameters
        - Provide aural and visual alerting
        - Provide monitoring and automatic reconfiguration of critical parameters

    - Operational characteristics:
        - Kinds of Operation: VFR/IFR
        - Minimum crew
        - Crew workload

    - Other characteristics:
        - human factors (ergonomics, crew error, workload)
        - System safety (Functional Analysis, Failure Conditions, Safety Assumptions/Requirements, Fault Trees, Common Modes)
        - Maintenance – Certification Maintenance Requirements (CMR)
        - Indirect Effects of Lightning (IEL)
        - EMI/EMC, HIRF, Electrical Wiring Interconnection Systems (EWIS)
        - Security
        - Occupant protection (Head Injury Criteria (HIC), crashworthiness)

REC11 The FAA should develop guidance to address the scope and proportionality of the affected areas to account for certain airworthiness requirements.

INTENT: To develop guidance on scoping Affected Areas in relation to certain airworthiness requirements. Specifically, the airworthiness requirements that apply at the system-of-systems level or aircraft level for changes, and Affected Areas of limited scope with proportionality.

RATIONALE: When a change is made to a complex system with highly integrated functions, it is necessary to assess the certification impacts (i.e., certification basis and compliance) at each applicable hierarchy level. This includes everything from the product-level (e.g., aircraft, engine, or propeller) down to the item and equipment-level, and then back up to the product-level, to determine and validate the scope of Affected Areas. Historically, the resulting scope of Affected Areas has been guided by the proportional scope of change that initiates the assessment. However, consideration of certain airworthiness requirements (e.g., FD, HFE, and others) in the CPR process is likely to broaden the scope of Affected Areas at the product or system-of-systems (SoS) level. The SoS-level involves two or more systems to account for increasing system integration, greater complexity, and a wider analysis scope. A system may be bounded for the purpose of study at any process or subsystem level, and related systems that are normally analyzed individually may be studied as a group, and the group is often called a SoS.[37]

As stated above in REC9, the FAA issued SCI NPRM to incorporate the SCI statutory definition into the regulations. The ARC notes that there are several definitions of FD and HFE that need to be harmonized. The definitions are likely to involve requirements that are often addressed at the SoS-level, so they need to be finalized and published to determine criteria for their applicability. This recommendation is intended to address more general SoS-level requirements and provide guidance on the scope of their applicability to adjust the scope of Affected Areas.[38]

APPROACH: The decomposition approach is an expansion of Step 6 in AC21.101-1B to determine the scope of Affected Areas. If the decomposition yields traceable impacts to certain airworthiness requirements at the SoS-level, then the broader scope of the SoS requirements is likely to expand the Affected Area to the higher SoS-level. In such case, proportional scoping of the SoS-level requirements to the changed area may be accomplished considering the following:

- The AC states that "related changes are those that cannot exist without another, are co-dependent, or a pre-requisite of another." The decomposition outputs may support the proposed arrangement of change groupings and delineation of sub-areas. A Significant change grouping does not preclude subsidiary sub-areas to propose exceptions for SoS-level requirements.
- If the revised sub-area set(s) is not eligible for the Not Significant exception, evaluate the area for the Not Affected exception in Step 6. Refer to AC 21.101-1B, Appendix D, section D.2 for an example.
- If the revised sub-area set(s) is not eligible for the Not Affected Exception, evaluate the area for the Does Not Contribute Materially to the Level of Safety (DNCMLS) and Impractical Exception in Step 7.

[37] *See* Blanchard, B. S., & Fabrycky, W. J. (2010). Systems Engineering and Analysis. Prentice Hall.
[38] *See* REC11.

The ARC notes that IAWG recommendation 1BR1a proposes to eliminate the Impractical Exception, and IAWG recommendation 1BR1b proposes to combine the Impractical and DNCMLS Exceptions. The ARC proposes an alternative "Level of Effort" evaluation method to grant exceptions. The ARC considers such a method to be necessary to achieve a measure of proportionality for changes where there is no safety benefit, or the effort required outweighs the safety benefit. The Level of Effort evaluation method is based on the GAMA Impracticality Evaluation Method[39] as depicted in the table below. **The ARC requests an additional tasking from the FAA to further develop this approach and refine the details of this recommendation based on comments provided by the IAWG[40] on the GAMA proposal.** Once finalized, the Level of Effort evaluation method should also be incorporated as an appendix in AC21.101-1B.

Step #	GAMA Impracticality Evaluation Method	Adapted
1	Table 1 – Safety Benefit of the Amended Regulation	Evaluate the safety benefit of the new amendment of the FD/HFE/SCI requirement
2	Table 2 – Incremental Effectiveness of Compliance	Evaluate the safety benefit of closing the gap of the design
3	Table 3a – Proportional Change Impact (impact on compliance demonstration)	Evaluate the redemonstration effort
4	Table 3b – Proportional Change Impact (impact on the changed product)	Evaluate the redesign effort
5	Table 4 – Project Level Practicality of Compliance	Adapt the scope of the Affected Area to the scope of applicability of the requirement

[39] Changed Product Rule Industry White Paper: "Impractical" and "Does Not Contribute Materially to the Level of Safety" Exceptions In 21.101. This paper is submitted in response to IAWG Proposal 1BR1a/b in the International Authorities Working Group (IAWG) report on Changed Product Rule (CPR) published in December 2022.
[40] IAWG CPR Team Response to Changed Product Rule Industry Task Force White Paper "IAWG Recommendation 1A1 - Objective Criteria for 21.19", dated March 5th, 2024.

REC12 The FAA should develop guidance for scoping and checking the completeness of the Affected Areas and provide practical examples.

INTENT: To identify all the affected or potentially Affected Areas and the associated certification requirements, specifically, all the areas for which system safety requirements of 25.1309, 29.1309,27.1309, 23.1309, 23.2510 need to be complied with and all the associated requirements (e.g., 25.981(a)(2)(3)).

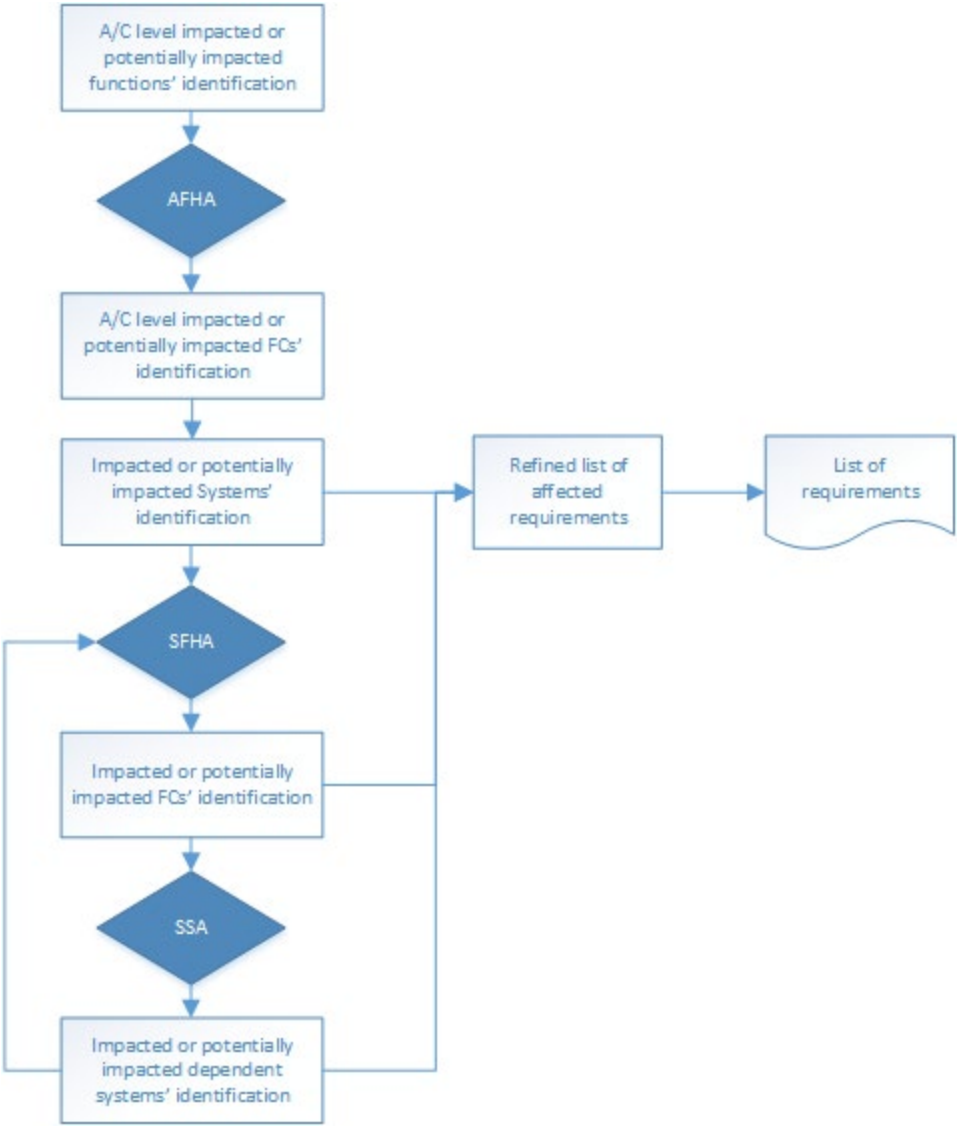
RATIONALE: The safety documentation linked to the Major Significant change needs to be reviewed to determine which areas are impacted or potentially impacted in the framework of the proposed design change. The guidance for scoping the Affected Areas should use safety assessment principles (i.e., decomposition and validation process) and provide practical examples of the methodology with associated Affected Area assessment templates.

APPROACH: The Major Significant change under analysis brings changes at the product level. These changes may be at aircraft, system, or equipment level and may induce product level behavior modification (e.g., control, power). Identifying the requirements for new functions at aircraft or system level is straightforward. However, modifying existing functions may be more difficult.

To facilitate this task, the ARC proposes to use the safety documentation to ensure identifying the affected areas from a completeness perspective:

- At first step: Aircraft level impact or potentially impacted functions have to be identified.
- At second step: Aircraft level impacted or potentially impacted Failure Conditions are identified by the safety documentation (aircraft level FHA, ASA). This enables identifying the impacted or potentially impacted systems).
- At third step: impacted or potentially impacted Failure Conditions are identified by the safety documentation (system level FHA, SSA).
- At fourth step: impacted or potentially impacted dependent systems are identified by the safety documentation (SSA).

At each step (second, third and fourth), the Affected Areas identification is re-evaluated and thus the certification requirements. On this basis, the corresponding Affected Areas/certification requirements can be confirmed or adjusted (including physical and non-physical affected changes, functional and non-functional affected changes). The FAA should revise AC21.101-1B § 3.9 and Appendices C and D to reflect the approach outlined in the flowchart below (see also REC9):



AFHA = Aircraft level FHA
ASA = Aircraft level Safety Assessment
SFHA = System level FHA
SSA = System Safety Assessment

Recommendations for Type Certificate Data Sheets

The ARC developed various recommendations related to Type Certificate Data Sheets.

REC13 The FAA should ensure the recognition and the continued use of Additional Design Requirements and Conditions on product Type Certificate Data Sheets where design features are a condition of a § 21.101(b)(3) exception.

INTENT: To ensure that the current practices regarding the documentation of Additional Design Requirements and Conditions (ADRC) are retained following the implementation of the ARC's recommendations for CPR regulatory amendments and related guidance.

RATIONALE: Since 2003, the FAA has allowed design features or conditions to be documented on the TCDS as ADRCs. These ADRCs are necessary to demonstrate that a product's level of safety meets the conditions necessary for an exception under § 21.101(b)(3), specifically that the level of safety is higher than the Baseline Product but may be less than the full intent of the regulatory requirement from which the exception is being granted. Design features are often necessary to maintain the level of safety required as a condition of granting an exception under § 21.101(b)(3). As such, they become part of the certification basis for the aeronautical product and should be recorded as ADRCs on the product's TCDS to provide necessary information to future modifiers.

ADRCs must be a recognized and enforceable means to ensure that the level of safety of the product is not subsequently degraded by removing or modifying the design feature. Recording the design feature as an ADRC in the TCDS provides transparency for all regulatory agencies and applicants and confirms that the design feature must be maintained in any future changes to preserve the product's safety level at or above the established certification basis. The ARC notes that, with over 20 years of practice, most applicants have developed processes to document ADRCs on the TCDS.[41] Thus, the ARC is confident that enhancing this capability would significantly benefit the industry and avoid reducing the level of safety for existing and future products.

APPROACH: Advisory Circular 21.101-1B Appendix E, paragraph E.2.7 Step 7, "Document the Conclusion" currently states:

> "… If the determination to grant the exception is based on the product's design features, those features are documented at a high level in the TCDS. Documentation in the TCDS is required so that

[41] The ARC offers the following examples: 14 CFR 25.125 – Landing (787-9/-10) - The enhanced stall protection (ESP) is required by design to ensure the intended level of safety. Any subsequent type design changes, modifications, or repairs that disable or modify ESP are not acceptable. *See also* Security Considerations (787-9/-10) - The Boeing Model 787-9/-10 was granted an exception per 14 CFR 21.101(b) for §§25.795(b)(1), (c)(2) and (c)(3)(i) based on design features similar, but not equivalent, to their intent. These security features must be considered in any subsequent type design change, modification, or repair to ensure the level of safety designed into the 787-9/-10 is maintained. Modifications that reduce flight critical system separation or adversely impact flight deck smoke protection, system separation, and protections for searching above the overhead stowage compartments are not acceptable.

the features are maintained during subsequent changes to the product, therefore, maintaining the product's agreed level of safety. …"

The ARC recommends clarifying the above statement by adding the following text to Step 7:

> *"…When the applicant has identified design features that offer an incremental increase in safety or partial compliance with the latest amendment, those design features will be documented as Additional Design Requirements and Conditions on the TCDS."*

The ARC acknowledges that although the current practice has been established for more than 20 years, it is not codified in the regulations, and the ARC's recommendation is to amend advisory material. If the FAA determines that a regulatory requirement is necessary to preserve the current practice, the ARC recommends that the FAA amend § 21.101(b)(3) to ensure that any design features that are conditions of granting an exception are recorded in the TCDS as an ADRC.

REC14 The FAA should provide guidance for identifying Affected Areas in the Type Certificate Data Sheet (TCDS).

INTENT: To ensure accurate identification and documentation of the Affected Areas on the Type Certificate Data Sheet.

RATIONALE: FAA Order 8110.4C "Type Certificate" specifies:

> **3-3. TYPE CERTIFICATE DATA SHEET (TCDS)**
>
> (4) Certification Basis
> *(a) Define the applicable regulations and amendments, special conditions, and the effective date of the applicable 14 CFR sections. For each change in the TC, record the applicable regulations that are different from the regulations recorded at TC issuance*.
> [xxx]
> (d) Identify all special conditions and ELOS findings.

Additional guidance on the certification basis/Affected Areas documentation is needed to ensure the Changed Product Rule process outcome is adequately recorded on the TCDS. Accurate TCDS documentation is crucial for maintaining a clear record of the certification basis and all modifications for the purposes of maintaining aircraft safety. It also helps to ensure appropriate TCDS understanding, facilitates compliance, and facilitates effective determination of applicable airworthiness requirements for subsequent changes both by the TC holder and an STC applicant. This would also ensure that CAAs consistently document the certification basis/Affected Areas on the TCDS, which is currently not standard practice.

APPROACH: The applicable airworthiness and environmental regulations should be documented against an exhaustive list of Affected Areas. Affected Areas could be identified by their name, designation, or ATA code based on the Issue Paper G-1 conclusion.[42] Proportionality of the Affected Areas should also be reflected in the TCDS (as per REC11), and certain airworthiness requirements should also be considered (as per REC9).

In addition, the ARC recommends identifying all special conditions, elected compliance with later amendments, exemptions, and ADRCs (refer to REC13 for more details). Optional Design Regulations (e.g., icing conditions and ditching), applicable Special Federal Aviation Regulations, and Equivalent Level of Safety findings should also be identified to ensure complete documentation of the certification basis.

The FAA should amend AC21.101-1B accordingly along with related FAA Order(s) as referenced in Chapter 5 Appendix I. Moreover, to ensure the recommended guidance is properly applied, the FAA should implement a standardized review process to update the TCDS with each modification and develop appropriate checklists, templates, and training.

The ARC strongly recommends the FAA add a new task to the CPR ARC Charter to develop guidance for documentation of the TCDS Certification Basis. The ARC also recommends the FAA amend the TCDS documentation to align with the other recommendations in this report (REC13).

[42] Issue Paper G-1 "Certification Basis" is the tool by which the certification basis is documented between the FAA and the applicant. See AC 20-166 - Issue Paper Process.

VII. Request for Additional Tasking

The ARC identified topics that need more development, and requests additional taskings on the following:

Related Recommendation	Related Topic	Reason For Additional Tasking
REC1 through REC4	Recommendations for Reference Type Design	Develop guidance for § 21.19 to support implementation of the integrated recommendations for assessing substantial.
REC2 & REC 4	Recommendations for Reference Type Design	Develop the concept of retroactively identifying a new RTD and a defined grandfathering process, including the justification required to do so. The ARC feels strongly that RTD implementation should be delayed until after this additional tasking is complete.
REC3	Recommendations for Reference Type Design	Evaluate alternative approaches for the transition of legacy products to the new § 21.19 rule language and evaluate effects of the transition on products certified with international authorities.
REC6	Recommendation for the new definitions for significant changes.	Expand the current list of examples provided in Appendix A of AC21-101-1B, including updating and refining the content for the Part 25 tables.
REC8	Recommendations to improve the management of affected areas.	Develop a more relevant example for Appendix C of AC 21.1.1-1B that has implications for FD/HFE/SCI.
REC8 through REC12	Recommendations to improve the management of affected areas.	Update AC 21.101-1B to ensure the ARC recommendations are integrated in an optimized manner.
REC8 through REC12	Recommendations to improve the management of affected areas.	Update the guidance material after the SCI NPRM is complete to formally define FD/HFE/SCI and implement disclosure requirements for Part 25 applicants.
REC11	Recommendations to improve the management of affected areas.	Update AC21.101-1B, Appendix E to incorporate the Level of Effort approach for determining eligibility for exceptions under the existing “Impractical” or “Does Not Contribute Materially to the Level of Safety” principles (as outlined in IAWG Recommendations 1BR1a and 1BR1b). The Level of Effort approach was first proposed by the GAMA CPR Industry Task Force.
REC14	Recommendations for Type Certificate Data Sheets	Develop the guidance for documenting the Affected areas/Certification Basis within the TCDS, including amending the TCDS documentation to include the Certification Basis and accommodate the ARC’s recommendations.

VIII. Recommended Regulatory Text Amendments (additions and deletions)

§ 21.1 Applicability and definitions.

...

(b) For the purposes of this part—

...

(8) ***Reference Type Design*** is a design configuration:

- for which compliance with a certification basis, acceptable to the FAA for the purpose of establishing an RTD configuration, has been established and a complete showing is made for the entire product, and
- against which changed products must be assessed for determining whether compliance with the provisions of 14 CFR 21.19 "Changes requiring a new type certificate" would be required.

(~~8~~9) ***State of Design*** means the country or jurisdiction having regulatory authority over the organization responsible for the design and continued airworthiness of a civil aeronautical product or article;

(~~9~~10) ***State of Manufacture*** means the country or jurisdiction having regulatory authority over the organization responsible for the production and airworthiness of a civil aeronautical product or article.

(~~10~~11) ***Supplier*** means a person at any tier in the supply chain who provides a product, article, or service that is used or consumed in the design or manufacture of, or installed on, a product or article.

§ 21.19, Changes requiring a new type certificate.

(a) Except as provided in paragraph (b) of this section, e~~E~~ach person who proposes a major change to a product must apply for a new type certificate if the FAA finds that the difference in the resulting product compared to the applicable reference type design ~~proposed change in design, power, thrust, or weight~~ is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.

(b) An applicant for the following changes is not required to apply for a new type certificate:

(1) Design changes under § 21.99,

(2) Design changes required to maintain compliance under Parts 34, 36, or 38,

(3) Derivative aircraft or modifications supporting special use (e.g., Conversions to oversize cargo freighter, firefighting, Military Commercial Derivative, Medical Evacuation aircraft),

(4) Changes to Type Certificates, via Amended or Supplemental Type Certificates, for which initial application is submitted prior to [insert date that is 5 years following date that the final rule becomes active], or

(5) Other changes found to be acceptable to the FAA.

IX. Recommended Advisory Material Amendments

A. Proposed amendment to AC 21.101-1B Appendix J (REC7)

J.10 ~~Product Level Change. A change or combination of changes that makes the product distinct from other models of the product (e.g., range, payload, speed, design philosophy). Product level change is defined at the aircraft, aircraft engine, or propeller level of change.~~

J.10 Product Level Change.

Any change is a change to the product and its effects are assessed at the product level. Some changes affect the key operational and design characteristics and depending on the magnitude of the change, a major change could be classified as major, not-significant, significant or substantial. Only a change affecting the key operational and design characteristics which makes the product distinct from its baseline configuration (or reference type design as applicable) is considered a "product level change" and therefore would be classified as either significant or substantial.[43]

B. Proposed Amendment to AC 21.101-1B Appendix D (REC9)[44]

APPENDIX D. OTHER GUIDANCE FOR AFFECTED AREAS

An "area" is a scalable scope of assessment that is completed at various systems levels, i.e., at the detailed item, software, or equipment-level, up the hierarchical tier to a systems-level, system-of-systems-level (SoS) that involves two or more systems, or aircraft-level. It is important to identify the scope of an area to assess it as affected or not for certification.

D.1 Sample Questions in Determining Affected Areas.

Based on a proposed significant product level change to the baseline product, below are sample questions to assist in identifying other areas that may be affected by the change. The sample questions are generalized so as to apply to an area that is identified at the detailed item-level up to the aircraft-level. If the answer to any of these questions is yes, then the area is considered affected.

7. Are the product level design and operational characteristics affected by the change?
8. Is another area impacted as a consequence of the proposed significant product level change?
9. Is another area required to change to accommodate the proposed significant product level change?

[43] *See* REC7.

[44] Proposed changes are denoted in the colored text (blue text indicates proposed additions and red text indicates proposed deletions).

10. Is there an ~~functional~~ effect (i.e., functional, physical, operational, other) on the unchanged area by a change to the system or system function of which it is a part?
11. Does the unchanged area need to comply with ~~a~~ system- or product-level requirements (e.g., Flight Deck, Human Factors Effects, Safety Critical Information) that ~~is~~ are part of the change?
12. Is the existing compliance for the area invalidated? Is new or additional analysis required to show the validity of the existing compliance demonstration?

C. Proposed Amendments to AC21.101-1B Appendix (REC8)

See REC8 above for details.

X. Definitions & Acronyms

A. Definitions

The ARC proposes to define new terms and improve definitions for existing terms throughout its recommendations. Specific details are in the **Approach** sections for recommendations REC2, REC3, REC5, REC6, REC7, REC8, REC10, and REC11 of this report.

B. Acronyms

Acronym	Designation
AC	Advisory Circular
ACSAA	Aircraft Certification, Safety, and Accountability Act
ADRC	Additional Design Requirements and Conditions
AEH	Airborne Electronic Hardware
AFHA	Aircraft level Functional Hazard Assessment
AMDT	Amendment
AP	Auto-Pilot
APU	Auxiliary Power Unit
ARC	Aviation Rulemaking Committee
ASA	Aircraft level Safety Assessment
BP	Baseline Product
CAA	Civil Aviation Authority
CFR	Code of Federal Regulations
CPR	Changed Product Rule
DFZ	Designated Fire Zone
DNCMLS	Does Not Contribute Materially to the Level of Safety
DP	Dual-Pilot
CMR	Certification Maintenance Requirement

Acronym	Designation
EASA	European Union Aviation Safety Agency
EMI	Electromagnetic Interference
EMC	Electromagnetic Compatibility
EWIS	Electrical Wiring Interconnection Systems
eVTOL	Electric Vertical Take-Off & Landing
FAA	Federal Aviation Administration
FBW	Fly-By-Wire
FD	Flight Deck
FFLZ	Flammable Fluid Leakage Zone
FHA	Functional Hazard Analysis
HEC	Human External Cargo
HIC	Head Injury Criteria
HIRF	High Intensity Radiated Fields
HFE	Human Factors Effect
HW	Hardware
IAWG	International Authorities Working Group
ICAO	International Civil Aviation Organization
IEL	Indirect Effects of Lightning
IFR	Instrument Flight Rules
LIE	Lightning Indirect Effects
MFD	Multi-Function Display
MPSC	Maximum Passenger Seating Capacity
MTOW	Maximum Take-Off Weight
NPRM	Notice of Proposed Rule Making
NVIS	Night Vision Imaging System

Acronym	Designation
OAT	Outside Air Temperature
OEM	Original Equipment Manufacturer
PFD	Primary Flight Display
PSSA	Preliminary System Safety Assessment
REC	Recommendation
RTD	Reference Type Design
SCI	Safety Critical Information
SFHA	System-level Functional Hazard Assessment
SoS	System of Systems
SP	Single-Pilot
SSA	System Safety Assessment
STC	Supplemental Type Certificates
SW	Software
TC	Type Certificate
TCDS	Type Certificate Data Sheet
VFR	Visual Flight Rules

XI. Appendices

Appendix A – Examples of Aircraft System Changes & Impact Assessment/Justification of the Quantitative Criteria

A. Part 25 Aircraft System Changes

1. Examples of Systems Changes That Would Trigger the Systems' Input Into the Substantial Change Objective Criteria:

- A change or accumulation of changes which transforms a reference type design with a federated systems architecture into a product with a highly integrated systems architecture. Includes critical functions such as flight directional control, navigation, flight crew alerting, etc.
    - The example above requires a complete investigation of systems compliance given the extensive architectural changes required to fully integrate multiple systems executing critical product level functions. It is also highly likely that this would extensively impact critical aspects of the flight crew human-machine interface at the product level.

- Reduction in the number of minimum required flight crew of the changed product with extensive systems architectural change.
    - The example above requires essentially a complete investigation of applicable systems' compliance when new assumptions related to the pilot role in executing critical product level functions drive extensive changes to the systems architecture. Factors for consideration may include centralized and automated control and alerting systems, overall systems failure consequences review and handling, or review of overall human machine interface etc.

- A change or accumulation of changes that transforms a reference type design with a completely conventional mechanical primary flight control system into a product with a completely electronic primary flight control system such as Fly-by-Wire or similar architecture.
    - The example above requires a complete investigation of systems compliance when the accumulation of changes spans multiple systems executing critical functions such as power distribution and management, flight crew indication and prioritization, primary aircraft axis control, handling qualities, etc.

- Installation of an autoland system (excluding emergency autoland systems).
    - Complete investigation of systems compliance when associated with a comprehensive architecture update of Flight Management, Indicating, or Navigation.

- Installation of an autopilot system
    - Complete investigation of systems compliance when associated with a comprehensive architecture update of Flight Management, Flight Controls, Indicating, Navigation, or Power Management.

2. Examples of Systems Changes *That Would NOT Trigger the Systems' Input Into the Substantial Change Objective Criteria:*

- Reduction in the number of minimum required flight crew for the changed product when the related systems architecture and functions have already been developed and certified.
    - Level of investigation mainly limited to operating procedures and type rating for reduction of the number of crew.

- Installation of an Autoland system (excluding emergency Autoland systems) for which changes across systems performing critical functions is not required.
    - Level of investigation mainly limited to new Autoland system compliance, including Human Machine interface and the interface with other aircraft systems.

- Installation of an autopilot system on an aircraft with an architecture that supports the installation without extensive change.
    - Level of investigation mainly limited to new autopilot system compliance, including Human Machine interface and the interface with other aircraft systems.

- Adding aircraft surveillance and protection or other individual systems (e.g., Ground Proximity Warning Systems, Traffic Collision Avoidance Systems, windshear detection systems, overrun warning systems, performance monitoring systems, etc.), which do not require an update of other systems architecture.
    - Level of investigation mainly limited to the compliance of the new system, the related human machine interface and the interface with other aircraft systems.
    - The examples above do not drive a complete investigation of systems compliance when the individual changes or their accumulation do not span across multiple systems executing critical product level functions extensively impacting either the product's architecture and integration or critical aspects of the human-machine interface.

B. Impact Assessment/Justification of the Quantitative Thresholds for the Objective Criteria

The magnitude of the quantitative thresholds for the objective criteria were determined from an impact assessment of the proposed objective criteria using a combination of historical data from certified products, design experience and consideration of future certification projects. The following provides a high-level summary of impact assessment conclusions.

1. ***Number of criteria met to declare a change substantial (three criteria for Parts 23, 25, 27/29)***
   This number is consistent with the impact assessment done on the existing AC 21.101-1B examples of substantial changes, completed with concluding that a few existing non substantial projects could have been classified substantial given the extent of the cumulated changes and the impact on the level of investigation of compliance.

2. ***Fuselage circumference changes (>20% for Part 23, 25, 27/29)***
   Fuselage circumference is rarely modified over the life of a program, except in business aviation where it can be done for comfort reasons. Example 4, from the Part 25 not substantial table, shows an increase of 16% without a large impact on the level of reinvestigation. Changes in diameter do not have a substantial impact on the level of reinvestigation of the product for changes less than the threshold.

3. ***Fuselage length change (>20% for Part 27/29, >40% for Part 23, 25)***
   Fuselage length change is the typical way to accommodate a different payload (or increase comfort for business aviation). Example 1 from the Part 25 from the not substantial table shows an increase of 18% without a substantial impact and example 32 from the Part 25 not substantial table shows an increase of 41% with a substantial impact on the level of reinvestigation for this criterion. Design experience and consideration of future certification projects were used in the determination of the threshold.

4. ***Wing area change (>30% for Part 23, 25)***
   Wing area change is typically associated with the need to increase lift on large aircraft. Example 9 from the Part 25 not substantial table shows an increase of 20% without a substantial impact on the level of reinvestigation for this criterion. Example 10 from the Part 25 not substantial table shows an increase of 43% with a substantial impact on the level of reinvestigation for this criterion. Higher percentages may be reached on business aviation for specific design options and other objectives (e.g., fuel capacity).

5. ***Horizontal tail plane area change (>30%) & vertical tail plane area change (>30%) (for Part 23, 25)***
   Tail plane area change is another typical change that will come when the other parameters change requiring an adaptation of the airframe aerodynamic characteristics. Example 12 from the Part 25 not substantial table shows an increase of 11% in horizontal tail plane area change and example 31 shows an increase of 27% in vertical tail plane area without a substantial impact on the level of reinvestigation. Example 10 from the Part 25 not substantial table shows an increase of 43% in horizontal tail plane area which is typically associated to other changes with a substantial impact on the level of reinvestigation for this criterion.

6. ***Thrust[45] / Weight: Generally, a change in thrust and/or maximum take-off weight (mass) of more than 35% (Part 27/29) or 45% (Part 23, 25)***
   Thrust and weight changes typically come with a change in the payload or range capacity. Example 1 from the Part 25 not substantial table shows an increase of 28% MTO Thrust and 32% MTOW without a substantial impact on the level of reinvestigation, while examples 2 or 4 from the Part 25 substantial table are typically associated with other changes, bringing together a substantial level of reinvestigation for this criterion.

[45] Power for rotorcraft and propeller driven aircraft. Power as used in this section is not to be confused with principles of propulsion.

Appendix B - Substantial Assessment Examples

A. Part 23 Substantial Assessment Examples

PART 23 Aircraft							
21.19 Table Substantial		**Proposed Multi-Factor Objective Criteria**					
Example	**Description of Change**	**Changes to an aircraft's main physical configuration or overall construction**	**Airframe and structural changes such as fuselage width; fuselage length; or wing, Vstab, or Hstab area**	**Extensive changes to aircraft systems that support controllability/ maneuverability, the human-machine interface, or the operational requirements/ capabilities of the aircraft**	**Change in engine using different principles of propulsion or operation (e.g., propeller to fan)**	**Change in thrust of more than DD% and/or maximum take-off weight (mass) of more than EE%**	**Comments**
AC 21.101 Appendix A, Table A-1 examples							
1	Change in wing location (tandem, forward, canard, high/low)	X	X	X			
2	Fixed wing to tilt wing	X	X	X	X		

3	A change in the number of engines	X		X		?	
4	Replacement of piston or turbo-prop engines with turbojet or turbofan engines			X	X		Eliminate this as a unilateral substantial change. Include discussion for P23 criteria.
5	Change in engine configuration (tractor/pusher)	X	X?	X			
6	Increase from subsonic to supersonic flight regime		X	X	X	?	
7	Change from an all-metal to all-composite airplane	X	X?	X			
8	Certificating a part 23 (or predecessor amendment airplane basis airplane such as CAR 3) into another regulatory category such as part 25						This is a unique, automatic substantial change. No objective criteria necessary.

Examples of Substantial Part 23 Projects							
1		X	X	X	X	X	107% increase in weight Piston to turbojet engine 18% increase in length 45% increase in wing area
2			X	X		X	Change in Wing Structure principle of construction Add pressurization Add autopilot 60% increase in weight 41% increase in Hp
Examples of Non-Substantial Part 23 Projects							
1				X		X	Weight Increase 33.4% SLS Thrust Increase 48.4% Wing Area Increase 23% Exposed Wing Area Increase 24% H-Tail Area increase 16% V-Tail Area Increase 20% Fuse length Increase 17% No change in fuselage width or circumference
1			X	X		X	Weight Increase 64% SLS Thrust Increase 90.6% Wing Area Increase 37% Exposed Wing Area Increase 38% H-Tail Area increase 31% V-Tail Area Increase 20% Fuse length Increase 21% No change in fuselage width or circumference Wing sweep increase 11 deg

2				X		X	Systems changes for human-machine interface Wing area change 7% Hp change 58%
2			X	X			Change of fuselage width from original TC'd design and to structure design to withstand loads due to pressurization of the cabin. Added pressurization system Change in Wing Structure principle of construction Add autopilot
3						X	Was this a substantial change, or a voluntary applicant decision to apply for a new TC? 55% increase in weight 63% increase in Hp 9% increase in wing area 18% increase in fus length
4				X		X	Systems changes for human-machine interface Hp/Thrust increase 126% Weight increase 46%

B. Part 25 Substantial Assessment Examples

PART 25 Aircraft							
21.19 Table Substantial		Proposed Multi-Factor Objective Criteria					
Example	Description of Change	Changes to an aircraft's main physical configuration or overall construction	Airframe and structural changes such as fuselage circumference changes (>20%), fuselage length change (>40%), wing or empennage area (>30%), wing sweep change (10%), airframe level assembly method or other structural change related to change in the number and/or location of engines and/or rotors	Accumulation of changes across Aircraft systems that execute critical product level functions extensively impacting either: the overall product's architecture (driving extensive architectural changes) and integration across multiple systems, or critical aspects of the flight crew Human-Machine Interface at a product level.	Change in engine or rotors using different principles of propulsion or operation	Change in thrust and/or maximum take-off weight (mass) of more than 45%	Comments

AC 21.101 Appendix A, Table A-4 examples							
1	Change to the number or location of engines, e.g., four to two wing-mounted engines or two wing-mounted to two body-mounted engines.	X	X	X		?	
2	Change from a high-wing to low-wing configuration.	X	X	X		?	
3	Change from an all-metal to all-composite aeroplane.	X	X	X		?	
4	Change of empennage configuration for larger aeroplanes (cruciform vs 'T' or 'V' tail).	X	X	X		?	
5	Increase from subsonic to supersonic flight regime.		X	X	X	?	

Examples of Substantial Part 25 Projects							
1		X					Common product development - same structure, same systems
2		X		X		X	**Example given for reference - was actually a new product** "MTOW increase 52% Max Thrust increase 24% Fuselage circumference increase 6% Fuselage length increase 5% Wing area increase 23%
3		X	X	X			**Example given for reference - was actually a new product** Changes to main physical configuration or overall construction triggered based on introduction of nearly **complete composite primary structure**. **Complete structural substantiation** including crashworthiness. **Completely new airplane systems architecture.**
4			X	X		X	**SLS Thrust increase 93%** **MTOW increase 74%**

Examples of Non-Substantial Part 25 Projects							
1							Aerodynamic & loads distribution changes mainly coming from bigger engine & longer fuselage (+18%) - no flight control system change MTOW increase 32% / Max Thrust increase 28%
2							Main Deck Cargo Door not considered as a "main physical configuration" change
3						X	Differences: MTOW +40%, Mas Thrust +88%, Wing Area + 20%, fuselage length +23% **Complete update of certification basis**
4							Fuselage Diameter Increase 16% MTOW Increase 0.1% Max Pax decrease 25%
5			X	X			This is a "what-if". **Move from federated electro-mechanical instruments and system controls to integrated digital avionics and system controls.** Fuselage Diameter Increase 13% Length Increase 7% Span Increase 8% Exposed Wing Area increase 7% **Integrated wing carry-thru structure -> external wing center section**

							Engine SLS Thrust Increase 16% MTOW Increase 19% Max Pass Increase 9%
6			X	X		X	**Move from federated electro-mechanical instruments and system controls to integrated digital avionics and system controls.** Fuselage Diameter Increase 13% OAL Increase 19% Span Increase 20% Ref Wing Area Increase 42% **Exposed Area Increase 37%** **Integrated wing carry-thru structure -> external wing center section** Horizontal Tail Increase 18% **SLS Thrust Increase 91.5%** **MTOW Increase 88.9%** **Would be considered Substantial under new criteria**

7				X			Same fuselage cross-section and body length; New, high-aspect ratio wing, span = 33.7 m (+ 17%); New GTF engines, max thrust = 23,300 lb (+ 17%); Increased MTOW = 56,400 kg (+ 9%); New full FBW flight control system; New avionics suite & flight deck displays; Same operational concept, type rating
8				X			Wing area: 18% increase Fuselage length: 4% Increase MTOW: 19% increase Engine thrust: No change NOTE: Various changes to autopilot, flight instruments, and engine instruments.
9				X			Wing area: 20% increase Horizontal tail area: 12% increase Fuselage length: 11% Increase MTOW: 27% increase Engine change with 21% thrust increase Various systems changes to autopilot, flight instruments, and engine instruments. Glass cockpit.

10			X	X		X	Wing area: 43% increase Horizontal tail area: 43% increase Fuselage length: 20% Increase MTOW: 57% increase Engine change with Full Authority Digital Engine Controls (FADEC) with 29% thrust increase Addition of composites on some flight control surfaces. Various changes to autopilot, flight instruments, and engine instruments. Glass cockpit.
11			X	X		X	Wing area: 43% increase Horizontal tail area: 43% increase Fuselage length: 20% Increase MTOW: 58% increase Engine change with Full Authority Digital Engine Controls (FADEC) with 35% thrust increase NOTE: Addition of composites on some flight control surfaces. Various changes to autopilot, flight instruments, and engine instruments. Glass cockpit. Integrated Avionics System.
12				X			Wing area: 20% increase Horizontal tail area: 11% increase Fuselage length: 12% Increase MTOW: 29% increase Engine change with Full Authority Digital Engine Control (FADEC) with 21% thrust increase

							NOTE: Various changes to autopilot, flight instruments, and engine instruments. Glass cockpit. Integrated Avionics System.
13							Fuselage length increase (+4,5%) Increased MTOW (+5%) Engine upgraded model but within the same Engine TCDS (+5% max T/O thrust) Systems adaptation
14							New engines (+16% max T/O thrust) but using same principles (double flow) Systems adaptation
15							New engines but (+16% max T/O thrust) but using same principles (double flow) Systems adaptation + New Primus Epic Avionic
16							New engines (+16% max T/O thrust) but using same principles (double flow) Systems adaptation New Primus Epic Avionic + Added winglet (+10% span)

17							New engines (+16% max T/O thrust) but using same principles (double flow) Systems adaptation New Primus Epic Avionic Added winglet (+10% span) + Added internal slats + Systems adaptation
18							MTOW increase 18% Max Thrust increase 17% Change to Full glass cockpit, equipped with 5 large high-resolution Liquid Crystal Displays (LCD)
19							MTOW increase 27% Max Thrust increase 17% Fuselage length increase 20% Wing area increase 12% **A/C fully re-certified against updated Type Design Reference**
20							MTOW increase 15% Max Thrust increase 15% Change to Full glass cockpit, equipped with 5 large high-resolution Liquid Crystal Displays (LCD)

21							MTOW increase: 4% (via SB 1) MTOW increase: 8% (via SB 2) MTOW increase: 9.3% (via SB 3) Wing area change: 15.6% Engines changed from geared to high bypass turbofan MTO Thrust change: 21.9%
22							MTOW increase: 8% MTOW increase: 9.3% (via SB 3) Wing area change: 15.6% Engines changed to high bypass turbofan MTO Thrust change: 21.9%
23				X			Note: Amended certification basis MTOW increase: 15% MTOW increase: 16.8% (via SB 4) Wing area change: 15.6% Tail cone fuel tank added Engines changed from geared to high bypass turbofan MTO Thrust change: 22.9% **Major avionics upgrade - Federated to integrated system - glass cockpit (MFDs, EICAS, EFIS), etc.**

24				X			Note: Major design changes to integrated avionics system, operational capabilities, etc. Amended certification basis New marketing designation changes for later ranges of serial numbers. MTOW increase: 16.8% Wing area change: 15.6% Tail cone fuel tank added Engines changed from geared to high bypass turbofan MTO Thrust change: 22.9% **Major avionics upgrade - Federated to integrated system -glass cockpit (MFDs, EICAS, EFIS), etc.**
25				X			Derivative - New marketing designation Multi-MTOW design within original certified specifications Major avionics upgrade, Enhancement of Ergonomics and Enhancement of Aesthetics within the flight deck - - Major avionics upgrade certification drove new certification basis for areas of change and areas affected by the change.

26				X			Derivative - New marketing designation Multi-MTOW design within original certified specifications Major avionics upgrade, Enhancement of Ergonomics and Enhancement of Aesthetics within the flight deck - Major avionics upgrade certification drove new certification basis for areas of change and areas affected by the change. Introduction of ATS. - Engine model change, same OEM. MTO Thrust change: 3.4%
27							**Derivative - new airplane model designation (Same TC)** - New marketing designation 32" forward fuselage reduction; Fuselage length decrease: 2.7% reduced fuel capacity (aft fuel tank removed) MTOW decrease: 6.6%

28				X			Derivative - new airplane model designation (same TC) - New marketing designation 32" forward fuselage reduction; Fuselage length decrease: 2.7% reduced fuel capacity (aft fuel tank removed) MTOW decrease: 6.6% - Major avionics upgrade certification drove new certification basis for areas of change and areas affected by the change. Introduction of ATS. - Engine model change, same OEM (for some models only). MTO Thrust change: 3.4%
29			X	X			**Full Type Certification; New certification basis** **Derivative - new airplane model designation (Same TC)** - New marketing designation MTOW increase: 22.8% Fuselage length increase: 11.6% **Wing area change: 43%** Engine change - MTO Thrust change: 28.3% **Conventional flight controls to full Fly-by-wire (FBW) technology with sidestick controllers** Computerized AFM (CAFM) Major avionics upgrade

30						X	%Fuselage Circumference Change = 0% %Fuselage Length Change = 17% %Wing Area Change = 9% %Horizontal Empennage Area = 9% %Vertical Empennage Area = 0% Accumulated Systems Change = digital autopilot and autothrottle, autoslat, digital stall warning, revised mach trim and new speed trim, electric aileron and rudder trim, new engine instruments **%Max TO Thrust = 58%** %Max TO Weight = 26%
31			X			X	%Fuselage Circumference Change = 0% %Fuselage Length Change = 17% **%Wing Area Change = 37%** %Horizontal Empennage Area = 13% %Vertical Empennage Area = 27% Accumulated Systems Change = digital autopilot and autothrottle, autoslat, digital stall warning, revised mach trim and new speed trim, electric aileron and rudder trim, new engine instruments, glass cockpit with federated systems, FADEC engine control, revised generators and power distribution (same architecture),

							new APU **%Max TO Thrust = 47%** %Max TO Weight = 40%
32			X			X	%Fuselage Circumference Change = 0% **%Fuselage Length Change = 41%** **%Wing Area Change = 40%** %Horizontal Empennage Area = 13% %Vertical Empennage Area = 27% Accumulated Systems Change =digital autopilot and autothrottle, autoslat, digital stall warning, revised mach trim and new speed trim, electric aileron and rudder trim, new engine instruments, glass cockpit with federated systems, FADEC engine control, revised generators and power distribution (same architecture), new APU, new flight control functions including fly-by-wire spoilers, and evolutionary (not architecture) changes across other systems. **%Max TO Thrust =109%** **%Max TO Weight = 66%**

33							%Fuselage Circumference Change = 0% %Fuselage Length Change = 16% %Wing Area Change = 0% %Horizontal Empennage Area = 0% %Vertical Empennage Area = 0% Accumulated Systems Change = No significant systems changes %Max TO Thrust = 27% %Max TO Weight = 21%
34						X	%Fuselage Circumference Change = 0% %Fuselage Length Change = 16% %Wing Area Change = 2% %Horizontal Empennage Area = 0% %Vertical Empennage Area = 0% Accumulated Systems Change = Systems changes include new tail strike protection and aileron droop flight control functions, addition of semi-levered main landing gear truck, and evolutionary (not architecture) changes across other systems. **%Max TO Thrust = 49%** %Max TO Weight = 42%

35						X	%Fuselage Circumference Change = 0% %Fuselage Length Change = 0% %Wing Area Change = 2% %Horizontal Empennage Area = 0% %Vertical Empennage Area = 0% Accumulated Systems Change = Systems changes include new tail strike protection and aileron droop flight control functions, and evolutionary (not architecture) changes across other systems. **%Max TO Thrust = 49%** %Max TO Weight = 41%
36				X			%Fuselage Circumference Change = 0% %Fuselage Length Change = 0% %Wing Area Change = 3% %Horizontal Empennage Area = 0% %Vertical Empennage Area = 0% **Accumulated Systems Change** = Transition from 3 to 2 flight crew with CRT (glass) primary instruments and EICAS display. Other Systems changes include new FMC and updates to autopilot, high lift, and brakes. %Max TO Thrust = 37% %Max TO Weight = 19%

37				X		X	%Fuselage Circumference Change = 5% %Fuselage Length Change = 8% %Wing Area Change = -3% %Horizontal Empennage Area = 0% %Vertical Empennage Area = 0% **Accumulated Systems Change** = Transition from 3 to 2 flight crew with CRT (glass) primary instruments and EICAS display. Other Systems changes include new FMC and updates to autopilot, high lift, brakes, fly-by-wire outboard ailerons, new pitch augmentation flight control function, addition of RAT, and evolutionary (not architecture) changes across other systems. **%Max TO Thrust = 53%** %Max TO Weight = 34%

C. Part 27-29 Substantial Assessment Examples

21.19 Table Substantial		Proposed Multi-Factor Objective Criteria					
Example	**Description of Change**	**Changes to an aircraft's main physical configuration (e.g., number and location of engines and rotors) or overall construction (e.g., going from a full metallic to a full composite airframe).**	**Airframe and structural changes such as fuselage circumference changes (>20%), fuselage length change (>20%), rotor diameter / blade surface increase (>35%) and airframe level change to incorporate an additional rotor system.**	**Accumulation of changes across Aircraft systems that execute critical product level functions extensively impacting either: the overall product's architecture (driving extensive architectural changes) and integration across multiple systems, or; critical aspects of the flight crew human-machine interface at a product level.**	**A change in engine using completely different principles of propulsion or operation**	**Change in power and/or maximum take-off weight (mass) of more than 35%**	**Comments**
AC 21.101 Appendix A, Table A-4 examples							

1	Change from the number and/or configuration of rotors (e.g., main & tail rotor system to two main rotors).	X	X	X			
2	Change from an all-metal to all-composite rotorcraft	X					Example should be deleted from Appendix A
Examples of Substantial Part 27-29 Projects							
1			X	X		X	Pre-CPR Change to 4 bladed rotor from 2 Federated instruments to IAS Change to MTOW Note that a new RTD would be required as these products are identified on the same type certificate.
2		X	X	X			Post-CPR Same engine and drive system configuration Change in construction Change to structure for improved crashworthiness Federated avionics to IAS Note that a new TC was created
3			X	X			Post-CPR Same drive system and rotor as a previous model Change in construction

							Change to structure for improved crashworthiness Federated avionics to IAS Note that a new TC was created
Examples of Non Substantial Part 27-29 Projects							
1			X	X			New tail rotor (fenestron), new engine, new avionics, MTOW increase
2			X	X			New powerplant, New 5-bladed spheriflex rotor, Reinforced MGB, New servo-actuators, new avionics, Reinforced fuselage MTOW increase Note: TC application made before CPR
3			X	X			Not substantial: Change to 4 bladed rotor from 2 Federated instruments to IAS

Appendix C – Mapping of Key Design and Operational Characteristics to the Significant Change Criteria

Product Key Design and Operational Characteristics	**Significant Criteria Mapping** **(see Significant Change Criteria Definition)**
• Key Operational Characteristics: o Kinds of Operation (e.g., VFR, IFR, day, night, icing) o Operating Limitations - MTOW - MPSC - Operating envelope (Altitude/speed/OAT) - Power/Thrust o Aircraft Flight Performance o Flight Crew Requirements o Maintenance Concept	Assumptions used for Certification
• Key Design Characteristics: o Main physical characteristics - Fuselage size - Wing shape, size, and location - Tail shape, size, and location - Number and location of engines or rotors	General Configuration
• Key Design Characteristics: o Architecture (Functional/Physical) and Technology of systems ensuring the: - Controllability/Maneuverability - Human-Machine Interface - Structural Integrity - Propulsion type - Occupant Safety/Survivability	Assumptions used in Certification and General Configuration
• Key Design Characteristics: o Structure material and processes	Principles of Construction

Appendix D – Examples of Substantial Changes

Table A-1. Examples of Substantial Changes for Airplanes (Part 23)

Example	Description of Change	Notes	ARC Comments
1.	Change in wing location (tandem, forward, canard, high/low).	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.	Typical Singular Criteria - Limited if any examples
2.	Fixed wing to tilt wing	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.	No existing examples found
3.	A change in the number of engines.	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.	Typical Singular Criteria - recommend clarification (addressing position instead of total quantity)
4.	Replacement of piston or turbo-prop engines with turbojet or turbofan engines.	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.	Typical Singular Criteria
5.	Change in engine configuration (tractor/pusher).	Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.	Typical Singular Criteria - recommend clarification (addressing position instead of total quantity)
6.	Increase from subsonic to supersonic flight regime.		No existing examples found
7.	Change from an all-metal to all-composite airplane.	Proposed change in design is so extensive that a substantially complete investigation of compliance applicable regulations is required.	No existing examples found
8.	Certificating a part 23 (or predecessor amendment airplane basis airplane such as CAR 3) into another regulatory category such as part 25.	This does not include change of level (or category) within part 23.	Typical Singular Criteria with existing examples.
9.	Addition of Highly Complex Integrated Systems e.g., fly by wire, control by power, fully autonomous.	Flight direction is controlled by thrust and power (i.e., completely new control scheme)	New

Table A-2. Examples of Significant Changes for Small Airplanes (Part 23)

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
1.	Addition of winglet-Winglet and outboard wing reinforcement.	Yes	No	Yes	The addition of the winglet required a reduction in the maneuver load factors which resulted in structural changes in the wing, thereby making it significant.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
2.	Change of stall warning and/or stall performance due to introduction of "load neutral" winglets	Yes	No	Yes	The topic of winglets may deserve special treatment since their addition affects many disciplines but, depending on the design, the effects may only be significant for one area. Whether a significant structural impact could drive otherwise unchanged fight characteristics to newer rules (or vice versa) is something that could use clarification. Change of stall warning and/or stall performance should be considered a secondary change and thus may not be significant even if the primary change were significant. However if the winglets were cosmetic, small enough and shaped correctly, would likely be considered not significant. However, if addition of load alleviation/flight characteristics augmentation system were required, the addition of the winglets would be significant.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
3.	Fuselage diameter increase/Increase cabin length	Yes	No	No	Many areas were affected by the fuselage diameter of cabin length change and were considered Significant Changes as well: (1) All doors, (2) Rotor Non-Containment. Some areas were changed due to the fuselage diameter increase but were considered to be secondary changes and deemed to have no benefit to the level of safety by going to the latest amendment level. Some examples of those areas are: (1) Nose gear location and installation and (2) Hydraulic tubing and cable runs	Above certain Percentage may be part of Substantial Evaluation.
4.	Autoland	No	No	Yes	Emergency auto-land is likely not significant, autoland, however, is significant.	
5.	Conventional tail to T-tail or V-tail, or vice versa.	Yes	No	Yes	Change in general configuration. Requires extensive, structural flying qualities and performance reinvestigation. Requires new airplane flight manual (AFM) to address performance and flight characteristics.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
6.	Changes in wing configuration such as change in dihedral, changes in wing span, flap or aileron span, addition of winglets, or increase of more than 10 percent of the original wing sweep at the quarter chord.	Yes	No	Yes	Change in general configuration. Likely requires extensive changes to wing structure. Requires new AFM to address performance and flight characteristics. **Note**: Small changes to the wingtip or winglet are not significant changes. See table for "not significant" changes.	
7.	Changes to tail configuration such as the addition of tail strakes or angle of incidence of the tail.	Yes	No	Yes	Change in general configuration. Likely requires extensive changes to tail structure. Requires new AFM to address performance and flight characteristics. Note: Small changes to tail are not significant changes.	
8.	Tricycle/tail wheel undercarriage change or addition of floats.	Yes	No	No	Change in general configuration. Likely, at airplane level, general configuration and certification assumptions remain valid.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
9.	Passenger to freighter configuration conversion that involves the introduction of a cargo door or an increase in floor loading of more than 20 percent, or provision for carriage of passengers and freight together.	Yes	No	Yes	Change in general configuration affecting load paths, aeroelastic characteristics, aircraft related systems, etc. Change in design assumptions.	
10.	Replace reciprocating engines with the same number of turbo-propeller engines.	Yes	No	No	Requires extensive changes to airframe structure, addition of aircraft systems, and new AFM to address performance and flight characteristics.	
11.	Addition of a turbo-charger that changes the power envelope, operating range, or limitations.	No	No	Yes	Invalidates certification assumptions due to changes in operating envelope and limitations. Requires new AFM to address performance and flight characteristics.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
12.	The replacement of an engine of higher rated power or increase thrust would be considered significant if it would invalidate the existing substantiation, or would change the primary structure, aerodynamics, or operating envelope sufficiently to invalidate the assumptions of certification.	No	Yes	Yes	Invalidates certification assumptions. Requires new AFM to address performance and flight characteristics. Likely changes to primary structure. Requires extensive construction reinvestigation.	
13.	A change in the type of material, such as composites in place of metal, or one composite fiber material system with another (e.g., carbon for fiberglass), for primary structure would normally be assessed as a significant change.	No	Yes	Yes	Change in principles of construction and design from conventional practices. Likely change in design/certification assumptions.	
14.	A change involving appreciable increase in design speeds V_D, V_B, V_{MO}, V_C, or V_A.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.	
15.	Installation of a short takeoff and landing (STOL) kit.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
16.	A change in the rated power or thrust could be a significant change if the applicant is taking credit for increased design speeds per example 10 of this table.	No	No	Yes	Certification assumptions invalidated. Requires new AFM to address performance and flight characteristics.	
17.	Fuel state such as compressed gaseous fuels or fuel cells. This could completely alter the fuel storage and handling systems and possibly affect the airplane structure.	No	No	Yes	Changes in design/certification assumptions. Extensive alteration of fuel storage and handling systems.	
18.	A change in the flight control concept for an aircraft, e.g., to fly by wire (FBW) and side-stick control, or a change from hydraulic to electronically actuated flight controls, would in isolation normally be regarded as a significant change.	No	No	Yes	Changes in design and certification assumptions. Requires extensive systems architecture and integration reinvestigation. Requires new AFM.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
19.	Change to airplane's operating altitude, or cabin operating pressure greater than 10 percent in maximum cabin pressure differential.	No	No	Yes	This typically invalidates certification assumptions and the fundamental approach used in decompression, structural strength, and fatigue. May require extensive airframe changes affecting load paths, fatigue evaluation, aeroelastic characteristics, etc. Invalidates design assumptions.	
20.	Addition of cabin pressurization system.	No	Yes	Yes	Extensive airframe changes affecting load paths, fatigue evaluation, aeroelastic characteristics, etc. Invalidates design assumptions.	
21.	Changes in types and number of emergency exits or an increase in maximum certificated passenger capacity.	Yes	No	Yes	Emergency egress requirements exceed those previously substantiated. Invalidates assumptions of certification.	
22.	A change in the required number of flightcrew that necessitates a complete flightdeck rearrangement, and/or an increase in pilot workload.	No	No	Yes	Extensive changes to avionics and aircraft systems. Invalidates certification assumptions. Requires new AFM.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
23.	Expansion of an aircraft's operating envelope.*	No	No	Yes* *Some changes may be deemed "not significant" depending on the extent of the expansion.	An expansion of operating capability is a significant change (e.g., an increase in maximum altitude limitation, approval for flight in icing conditions, or an increase in airspeed limitations).	
24.	Replacement of an aviation gasoline engine with an engine of approximately the same horsepower utilizing, e.g., diesel, hybrid, or electrical power.	No	No	Yes	A major change to the airplane. The general configuration and principles of construction will usually remain valid; however, the assumptions for certification are invalidated.	
25.	Comprehensive flightdeck upgrade, such as conversion from entirely federated, independent electro-mechanical flight instruments to highly integrated and combined electronic display systems with extensive use of software and/or complex electronic hardware.	No	No	Yes	Affects avionics and electrical systems integration and architecture concepts and philosophies. This drives a reassessment of the human-machine interface, flightcrew workload, and re-evaluation of the original design flightdeck assumptions.	
26.	Introduction of autoland.	No	No	Yes	Invalidates original design assumptions.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
27.	Conversion from a safe life design to a damage-tolerance-based design.	No	No	Yes	Where the airframe-established safe life limits change to damage tolerance principles, then use of an inspection program in lieu of the safe life design limit invalidates the original assumptions used during certification.	
28.	Extensive structural airframe modification, such as a large opening in the fuselage.	Yes	No	No	Requires extensive changes to fuselage structure, affects aircraft systems, and requires a new AFM to address performance and flight characteristics.	
29.	Fuselage stretch or shortening in the cabin or pressure vessel.	Yes	No	[1] The ARC emphasizes the importance of maintaining the distinction between a major change and a significant change. A change can be major, but not significant as measured from the baseline product.	Cabin interior changes are related changes since occupant safety considerations are impacted by a cabin length change. Even if a new cabin interior is not included in the product level change, the functional effect of the fuselage plug has implications on occupant safety (e.g., the dynamic environment in an emergency landing, emergency evacuation, etc.), and thus the cabin interior becomes an affected area.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
30.	Conversion from normal category to commuter category airplane.	Yes	No	Yes	Requires compliance with all commuter regulatory standards. In many cases, this change could be considered a substantial change to the type design. Therefore, a proposed change of this nature would be subject to FAA determination under § 21.19.	
31.	Installation of a full authority digital engine control (FADEC) on an airplane that did not previously have a FADEC installed.	No	No	Yes		

Table A-3. Examples of Not Significant Changes for Small Airplanes (Part 23)

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
1.	Upgrade highly integrated avionics with highly integrated avionics	No	No	No	Including addition of touch screen capability to integrated avionics	
2.	Autothrottle	No	No	No	Agrees with SAIL.	
3.	Emergency Autoland	No	No	No	It might be inappropriate to conclude that all of FAA concurs with "not-significant" for EAL applications. The addition of EAL could invalidate assumptions. For example, you could have what was previously a simple mechanical brake systems now have an “uncommanded” failure mode for the EAL servos attached that they never had before. So, a system that per Part 23 didn’t even require a look through the system safety process, may now need some System Safety process compliance.	Requiring an assessment of system safety does not make it significant though.
4.	Improved Diagnostics	No	No	No	Include upgraded equipment to support enhanced diagnostic capabilities	
5.	Increased Aircraft Connectivity	No	No	No	New equipment that added new aircraft connectivity capabilities.	** What about Connectivity to primary cockpit systems?

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
6.	Windshield Heat Controller Replacement	No	No	No	Upgrade the windshield heat controller to new unit with same requirements as original unit.	
7.	Lithium-Ion Battery	No	No	No	Add new main ship battery using lithium ion technology, similar to other aircraft.	Other Aircraft indicating prior approved installations, in similarly protected environment
8.	Digital Flight Management System (FMS) Controller	No	No	No	Upgraded equipment	
9.	Add Engine Low Oil Pressure Switch	No	No	No	New I/O for increased monitoring	
10.	Wing Skin Splice material change	No	No	No	No structural change, completed for corrosion prevention.	Seems very Specific
11.	MLG Trailing Link & Axle Changes	No	No	No	No structural change, completed for corrosion prevention.	Seems very Specific
12.	Cockpit Interior Update	No	No	No	Updates to interiors to align with avionics upgrades. No structural changes.	Why connected to Avionics? What about cabin interior material/finish changes?
13.	Cockpit Environmental Control System Ducting Improvement	No	No	No	Updates to ducting to improve airflow and balance.	
14.	Cabin / Cockpit Acoustic Treatment Update	No	No	No	Different material for improved sound dampening.	
15.	Windshield and Cockpit Side Window UV filtering	No	No	No	New coating for UV protection, no structural differences.	
16.	Windshield Seal & Installation Improvement	No	No	No	No structural change, completed for corrosion prevention.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
17.	Service Air Check Valve	No	No	No	Maintenance improvement	
18.	Nose Gear Shimmy Damper	No	No	No	Maintenance improvement	
19.	Maintenance Interval	No	No	No	Maintenance improvement	Does not include ALIM changes.
20.	Acoustic Pylon Treatment	No	No	No	Acoustic improvement	
21.	Add Broadband System	No	No	No	Cabin entertainment addition. Will also impact need for antennas.	
22.	New Flight Data Recorder	No	No	No	New equipment or replace existing unit	
23.	New Cockpit Voice Recorder	No	No	No	New equipment or replace existing unit	
24.	Remove Pressure Transducer from Vapor Cycle Cooling System	No	No	No	Maintenance improvement	
25.	Added Auxiliary Battery	No	No	No	New battery to provide additional battery power during ground operations.	
26.	Changes to existing FADEC SW	No	No	No	Change does not change the overall product configuration or the original certification assumptions.	
27.	Addition of Unattended APU Operation	No	No	No	Basic principles of APU operation remain unchanged and no change to original certification assumptions.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
28.	Winglet secondary non-significant changes; Change to wingtip position/anti-collision lights; Change to wing anti-ice system exhaust	No	No	No		
29.	Fuel volume increase by changing the standpipe	No	No	No		
30.	Thrust increase	No	No	No	Percentage? Where does it become Significant and where does it become part of Substantial evaluation? Current Guidance 10% significant Proposal: ~30-40% becomes criteria for Substantial Eval.	
31.	Engine Durability improvements	No	No	No		
32.	Weight increase (example 300 lbs)	No	No	No	Percentage? Similar to thrust above.	
33.	Cabin pressurization system change from electropneumatic to all electronically controlled	No	No	No		
34.	Hydraulic reservoir moved out of the rotor non-containment zone in the tailcone to a flammable fluid zone in the aft fairing.	No	No	No		
35.	Wing inspection lights changed from halogen to LED.	No	No	No		

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
36.	Approval for takeoff and landing on unpaved surfaces	No	No	No		
37.	Change stall speed basis from conventional stall speeds (VS) to reference stall speeds (VSR).	No	No	No		
38.	Addition or upgrade of datalink systems including position reporting and ADS-C systems.	No	No	No	May impact antenna installations	
39.	Adding or upgrading ground situational awareness (Taxi/runway position) or performance monitoring systems (such as ROAAS)	No	No	No		
40.	TSO equipment replacement or addition of non-essential options	No	No	No		
1	Addition of wingtip modifications (not winglets).	No	No	No	A major change to the airplane. Likely, the original general configuration, principles of construction, and certification assumptions remain valid.	
2	Installation of skis or wheel skis.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
3	Forward looking infrared (FLIR) or surveillance camera installation.	No	No	No	Additional flight or structural evaluation may be necessary, but the change does not alter basic airplane certification.	
4	Litter, berth, and cargo tie down device installation.	No	No	No	Not an airplane-level change.	
5	Increased tire size, including tundra tires.	No	No	No	Not an airplane-level change.	
6	Replacement of one propeller type with another (irrespective of increase in number of blades).	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	
7	Addition of a turbo-charger that does not change the power envelope, operating range, or limitations (e.g., a turbo-normalized engine, where the additional power is used to enhance high altitude or hot day performance).	No	No	No	Not an airplane-level change.	
8	Substitution of one method of bonding for another (e.g., change in type of adhesive).	No	No	No	Not an airplane-level change.	
9	Substitution of one type of metal for another.	No	No	No	Not an airplane-level change.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
10	Any change in construction or fastening not involving primary structure.	No	No	No	Not an airplane-level change.	
11	A new fabric type for fabric-skinned aircraft.	No	No	No	Not an airplane-level change.	
12	Increase in flap speed or undercarriage limit speed.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	
13	Structural strength increases.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	
14	Instrument flight rules (IFR) upgrades involving installation of components (where the original certification does not indicate that the airplane is not suitable as an IFR platform, e.g., special handling concerns).	No	No	No	Not an airplane-level change.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
15	Fuel tanks where fuel is changed from gasoline to diesel fuel and tank support loads are small enough that an extrapolation from the previous analysis would be valid. Chemical compatibility would have to be substantiated.	No	No	No	Not an airplane-level change.	
16	Limited changes in a pressurization system, e.g., number of outflow valves, type of controller, or size of pressurized compartment, but the system must be resubstantiated if the original test data are invalidated.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	
17	Install a different exhaust system.	No	No	No	Not an airplane-level change.	
18	Changes in engine cooling or cowling.	No	No	No	Not an airplane-level change.	
19	Changing fuels of substantially the same type, such as AvGas to AutoGas, AvGas (80/87) to AvGas (100LL), ethanol to isopropyl alcohol, Jet B to Jet A.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
20	Fuels that specify different levels of "conventional" fuel additives that do not change the primary fuel type. Different additive levels (controlled) of MTBE, ETBE, ethanol, amines, etc., in AvGas would not be considered a significant change.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	
21	A change to the maximum takeoff weight of less than 5 percent, unless assumptions made in justification of the design are thereby invalidated.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	discuss removing 5%
22	An additional aileron tab (e.g., on the other wing).	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	
23	Larger diameter flight control cables with no change in routing, or other system design.	No	No	No	Not an airplane-level change.	
24	Autopilot installation (for IFR use, unless the original certification indicates that the airplane is not suitable as an IFR platform).	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
25	Increased battery capacity or relocate battery.	No	No	No	Not an airplane-level change.	
26	Replace generator with alternator.	No	No	No	Not an airplane-level change.	
27	Additional lighting (e.g., navigation lights, strobes).	No	No	No	Not an airplane-level change.	
28	Higher capacity brake assemblies.	No	No	No	Not an airplane-level change.	
29	Increase in fuel tank capacity.	No	No	No	Not an airplane-level change.	
30	Addition of an oxygen system.	No	No	No	Not an airplane-level change.	
31	Relocation of a galley.	No	No	No	Not an airplane-level change.	
32	Passenger to freight (only) conversion with no change to basic fuselage structure.	No	No	No	Although a major change to the airplane, likely the original general configuration, principles of construction, and certification assumptions remain valid. Requires certification substantiation applicable to freighter requirements.	
33	New cabin interior with no fuselage length change.	No	No	No		
34	Installation of new seat belt or shoulder harness.	No	No	No	Not an airplane-level change.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
35	A small increase in center of gravity (CG) range.	No	No	No	At airplane level, no change in general configuration, principles of construction, and certification assumptions.	
36	Auxiliary power unit (APU) installation that is not flight essential.	No	No	No	Although a major change to the airplane level, likely the original general configuration, principles of construction, and certification assumptions remain valid. Requires certification substantiation applicable to APU installation requirements.	
37	An alternative autopilot.	No	No	No	Not an airplane-level change.	
38	Addition of Class B terrain awareness and warning systems (TAWS).	No	No	No	Not an airplane-level change.	
39	Extending an established life limit.	No	No	No	This extension may be accomplished by various methods, such as ongoing fatigue testing, service life evaluation, component level replacement, and inspections based on damage tolerance principles.	

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
40	Flightdeck replacement of highly integrated and combined electronic display systems with other highly integrated and combined electronic display systems.	No	No	No	Not significant if the architecture concepts, design philosophies, human-machine interface, or flight crew workload assumptions are not impacted.	
41	Interior cabin reconfigurations are generally considered not significant. This includes installation of in-flight entertainment (IFE), new seats, and rearrangement of furniture.	No	No	No		
42	Modification to ice protection systems.	No	No	No	Re-certification required, but certification basis should be evaluated for adequacy.	

Table A-7. Examples of Substantial Changes for Rotorcraft (Parts 27 and 29)

Example	Description of change	Notes	ARC Comments
1.	Change from the number and or configuration of rotors (e.g., main & tail rotor system to two main rotors).	The change will affect the aircraft main physical configuration, require extensive airframe and structural changes and impact aircraft system architecture and human-machine interface. Therefore, the proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.	Notes updated to reflect the impacts based on the multi-factor objective criteria being proposed by the ARC.
~~2.~~	~~Change from an all-metal rotorcraft to all-composite rotorcraft.~~	~~Proposed change in design is so extensive that a substantially complete investigation of compliance with the applicable regulations is required.~~	Recommend to delete this example as alone, it would not meet the multi-factor objective criteria being proposed by the ARC.
2.	A multi-factor change where ALL three items are changing: *Changing the number of main rotor blades *MTOW increase of 40% or greater *Changing from federated instruments to an integrated avionics system.	Change affects the system architecture, human-machine interface, aircraft structure and main rotor surface area. A substantially complete investigation of compliance with the applicable regulations is required	New

Table A-8. Examples of Significant Changes for Rotorcraft (Parts 27 and 29)

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
1.	Comprehensive flightdeck upgrade, such as conversion from entirely federated, independent electro-mechanical flight instruments to highly integrated and combined electronic display systems with extensive use of software and/or complex electronic hardware.	Yes	No	Yes	Original assumption was a non-integrated, federated flightdeck. Change affects avionics and electrical systems integration and architectural concepts and philosophies which drives a reassessment of the hazards, human-machine interface, and flightcrew workload. General configuration is also affected as the cockpit is distinctly different from its predecessor.	Change proposed to clarify the new design assumptions and change to the general configuration.
2.	Certification for flight into known icing conditions.	No	No	Yes	Flight into known icing adds additional aircraft level hazards that were not part of the original certification.	Note added to add explanation.
3.	(Fixed) flying controls from mechanical to fly by wire.	No	No	Yes	Fly by wire introduces new hazards and drives a complete reassessment of the rotorcraft controllability, flight control failures and human machine interface.	Note updated to identify the new hazards to be assessed.
4.	Addition of an engine; e.g., from single to twin or reduction of the number of engines; e.g., from twin to single.	Yes	No	Yes	Addition or deletion of an engine makes the new product distinguishable from the original product. Original assumption included the number of engines and a change to this assumption requires reassessment of applicable hazards.	Principles of construction are not changed in this case, other factors drive the significance. Added note to clarify the impact to the configuration and assumptions.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
~~5.~~	~~A change of the rotor drive primary gearbox from a splash type lubrication system to a pressure lubricated system. due to an increase in horsepower of an engine or changing from a piston engine to turbine engine.~~	~~No~~	~~Yes~~	~~Yes~~		Not a product level change and should be "Not Significant". Type of lubrication system doesn't change the principles of construction or assumptions at the product level. The assumption was a transmission to transfer power which is still true. A new example has been added to address transmission power changes. If the example is to stay, recommend removing the engine reference as it can be interpreted as a different significant change.
5.	A fuselage or tail boom modification that changes the primary structure, aerodynamics, and operating envelope sufficiently to invalidate the certification assumptions.	Yes	No	Yes	The change makes the new product distinguishable from its predecessor. The increased operating envelope adds additional verification that cannot be extrapolated from the original certification.	Note added to explain the two criteria that were triggered.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
6.	~~Application of an approved primary structure to a different approved model (e.g.,~~ Installation on a former model of the main rotor approved on a new model that introduces new materials or technology.	No	Yes	Yes	The principles of construction are changed due to the new material or technology. The new rotor changes the verification such that it cannot be extrapolated from the original certification.	Example revised to focus on the significant change and the note added to explain the triggering of the criteria.
7	~~Emergency medical service (EMS) configuration with primary structural changes sufficient to invalidate the certification assumptions.~~ Addition or expansion of external doors affecting primary structure.	Yes	No	No	~~Many EMS configurations will not be classified as significant. Modifications made for EMS are typically internal, and the general external configuration is normally not affected. These changes should not automatically be classified as significant.~~ ~~**Note:** Door addition or enlargement involving structural change would be significant.~~ Addition or enlargement of doors makes the new product configuration distinguishable from its predecessor and requires complete reassessment of the structure.	Example should be based on the significant aspect which is the change of the door not the fact its EMS. Recommend the example focus on the significant aspect and not EMS.
8.	Skid landing gear to wheel landing gear or wheel landing to skid.	Yes	No	Yes	Change from wheels to skids or skids to wheels makes the product distinguishable from it predecessor. Change to wheels from skids adds new hazards that need to be addressed.	Note added to explain the two criteria that were triggered.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
9.	Change of the number of rotor blades.	Yes	No	Yes	Change of number of blades makes the product distinguishable from its predecessor. Assumptions are impacted because the original performance is not able to be extrapolated.	Note added to explain the two criteria that were triggered.
10.	Change tail anti-torque device (e.g., tail rotor, ducted fan or other technology).	Yes	No	Yes	Change of type of tail rotor makes the product distinguishable from its predecessor. Assumptions are impacted because the original performance is not able to be extrapolated.	Its not clear in the example that the principles of construction are changed, but the configuration and assumptions are changed. Note added to explain the two criteria that were triggered.
11.	Passenger configured helicopter to a Firefighting equipment configured helicopter requiring extensive internal modifications.	Yes	No	Yes	~~Depends on the firefighting configuration.~~ Addition of internal tanks or bladders would require extensive structural modifications. The addition of internal tanks adds new hazards to be assessed.	Original example was carried from the FW with internal tanks. Most firefighting helicopter use external tanks or buckets which would not be significant changes. Addition of internal tanks (like FW) would be significant. Example modified to clarify.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
12.	Passenger configured helicopter to an agricultural configured helicopter requiring extensive internal modifications.	Yes	No	Yes	~~Depends on the agricultural configuration.~~ Addition of internal tanks or bladders would require extensive structural modifications. The addition of internal tanks adds new hazards to be assessed.	Original example was carried from the FW with internal tanks. Most agricultural helicopters use external spray tanks which would not be significant changes. Addition of internal tanks (like FW) would be significant. Example modified to clarify.
13.	An initial Category A certification approval to an existing configuration.	No	No	Yes	Assumptions are changed as Category A performance cannot be extrapolated from the original Category B performance.	Note added to clarify the change in assumptions.
14.	An initial IFR certification approval to an existing configuration. ~~IFR upgrades involving installation of upgraded components for new IFR configuration.~~	No	No	Yes	Change affects systems integration and architectural concepts and philosophies which drives a reassessment of the hazards, human-machine interface, and flightcrew workload.	The same exact example is Not Significant in the other table with a different note. Recommend the example be made distinct from the Not Significant example.
15.	Human external cargo (HEC) certification approval.	No	No	Yes	HEC introduces a new type of operation that requires assessment of new hazards not considered during the initial certification.	Note added to explain the assumptions for certification.
16.	Reducing the number of ~~pilots for IFR~~ from two to one.	No	No	Yes	Primarily relates to changes to pilot workload in IFR, but can be extended to other types of operation where the human machine interface or pilot workload is significantly impacted.	Example modified and explanation for the change in assumptions added.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
17.	An avionics upgrade (other than flightdeck) that changes a federated avionics system to a highly integrated avionics system.	No	No	Yes	Original assumption was a non-integrated, federated avionics system. Change affects avionics and electrical systems integration and architectural concepts and philosophies which drives a reassessment of the hazards.	Example clarified to differentiate from Example 1. Note added to explain the change in assumptions.
18.	An avionics upgrade that changes the method of input from the flightcrew, which was not contemplated during the original certification (e.g., novel change to implement voice activated controls)	No	No	Yes	~~A change that includes touchscreen technology typically does not invalidate the assumptions used for certification.~~ ~~A change that incorporates voice activated controls or other novel human-machine interface would likely invalidate the assumptions used for certification.~~ Changing to a novel method of input requires assessment of new hazards and the human-machine interface.	Added the example in the description and removed it from the notes. Note updated to explain the change to the assumptions.
19.	Change of primary structure from metallic to composite.	No	Yes	No	Composite construction adds new materials and material characteristics.	New
20.	Change from a piloted helicopter to an optionally piloted helicopter.	No	No	Yes	New hazards are introduced that need to be assessed.	New
21.	Increase of maximum take-off weight by more than 10%.	No	No	Yes	The original performance is beyond what can be reasonably extrapolated.	New
22.	Installation of an Auto-Land System	No	No	Yes	New hazards are introduced that need to be assessed.	New

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
23.	Increase of engine or transmission take-off power ratings by more than 10%.	No	No	Yes	The original performance is beyond what can be reasonably extrapolated. Could include changes to the transmission lubrication system.	New
24.	Initial ditching certification.	No	No	Yes	New hazards are introduced that need to be assessed.	New
25.	Change of primary structure from metallic to additive manufactured.	No	Yes	No	Additive manufacturing adds new materials and material characteristics.	New
26.	Change of type of engine (e.g., piston to turbine, turbine to hybrid).	Yes	No	Yes	New hazards are introduced that need to be assessed.	New
27.	Introduction of a FADEC control from a mechanical engine control.	No	No	Yes	New hazards are introduced that need to be assessed.	New

Table A-9. Examples of Not Significant Changes for Rotorcraft (Parts 27 and 29)

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
1.	Emergency floats.	No	No	No	~~Must comply with the specific applicable requirements for emergency floats~~. This installation, in itself, does not change the rotorcraft configuration, overall performance, or operational capability. Expanding an operating envelope (such as operating altitude and temperature) and mission profile (such as passenger carrying operations to external load operations, flight over water, or operations in snow conditions) are not by themselves so different that the original baseline certification assumptions are no longer valid at the type certificated product level.	Minor change to comments recommended.
2.	FLIR, surveillance camera, loud speaker, searchlight installation, etc.	No	No	No	~~Additional flight or structural evaluation may be necessary but the change does not alter the basic rotorcraft certification.~~ Addition of external mission equipment is not a product level change.	Example revised to add other mission equipment and note updated to explain that it is not a product level change.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
3.	Helicopter terrain awareness warning system (HTAWS) for operational credit.	No	No	No	~~Certificated under rotorcraft HTAWS AC guidance material and FAA TSO-C194.~~ Does not alter the basic rotorcraft configuration and therefore is not a product level change.	Note does not need to identify the specific MoC and TSO. Note updated to confirm this is not a product level change.
4.	Health usage monitoring system (HUMS) for maintenance credit.	No	No	No	~~Certificated under rotorcraft HUMS AC guidance material~~. Does not alter the basic rotorcraft configuration and therefore is not a product level change.	Does not need to identify the MoC. EASA for example has a CS for VHM. Note updated to confirm this is not a product level change.
5.	Expanded limitations with minimal or no design changes, following further tests/justifications or different mix of limitations (CG limits, oil temperatures, altitude, ~~minimum/ maximum~~ weight/altitude/temperature (WAT) limits, minimum/ maximum external temperatures, speed, engine ratings, etc.).	No	No	No	Although testing and analysis may be required, changes to operating or performance envelopes do not require new verification methods and do not invalidate the original certification assumptions.	Example modified to reflect performance/ envelope changes. Weight moved to a separate example. Note revised to relate to the example.
6.	Change from a single channel FADEC to a dual channel FADEC.	No	No	No	Change does not change the overall product configuration or the original certification assumptions.	"No"s were missing.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
7.	Installation of a new or alternate engine of the same propulsion type (e.g., piston to piston or turbine to turbine) with an increase in power rating of less than 10%.~~, equivalent to the former one, leaving aircraft installation and limitations substantially unchanged.~~	No	No	No	~~Refer to AC 27-1 or AC 29-2 for guidance. Does not alter the basic rotorcraft configuration, provided there is no additional capacity embedded in the new design.~~ Change of an engine from one manufacturer to another would not typically distinguish one product from another. Hazards need to be reassessed but are relatively unchanged as long as the engine technology is unchanged.	Example revised reflect engine technology and to add a threshold for the change in power (similar to what has traditionally been accepted as "Not-significant" and in the Part 25 examples). Note updated to explain the Not-Significant decision.
8.	Windscreen installation.	No	No	No	Does not alter the basic rotorcraft configuration and therefore is not a product level change.	Note updated.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
9.	Snow skis, “Bear Paws.”	No	No	No	~~Must comply with specific requirements associated with the change. an operating envelope (such as operating altitude and temperature) and~~ Expanding the mission profile (such as passenger carrying operations to external load operations, flight over water, or operations in snow conditions) are not by themselves so different that the original certification assumptions are no longer valid at the type certificated product level.	Note made more specific the change.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
10.	External cargo hook or hoist for non-HEC.	No	No	No	~~Must comply with the specific applicable requirements for external loads. This installation, in itself, does not change the rotorcraft configuration, overall performance, or operational capability. an operating envelope (such as operating altitude and temperature) and~~ Expanding a mission profile (such as passenger carrying operations to external load operations excluding HEC, flight over water, or operations in snow conditions) are not by themselves so different that the original certification assumptions are no longer valid at the type certificated product level.	Example updated to reflect a non-HEC approval and note updated to better reflect the example.
11.	IFR upgrades involving installation of upgraded components to replace existing components.	No	No	No	Upgrading equipment on an already IFR certified aircraft does not distinguish the changed product from its predecessor and does not introduce new aircraft level hazards.	Note updated to explain why the change is not a product level change.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
12.	A non-highly integrated avionics change from federated electro-mechanical displays to federated electronic displays.	No	No	No	Changing from one type of federated system to another federated system does not introduce new hazards and therefore does not invalidate the original certification assumptions.	Example updated to differentiate the change from a Significant change. Note updated to explain why the change is not a product level change.
13.	An avionics (non-flightdeck) change replacing an integrated avionics system with another integrated avionics system.	No	No	No	Although the hazards need to be reassessed, they are relatively unchanged, therefore the assumptions used to certify a highly integrated avionics system ~~should be~~ are the same for another highly integrated avionics system.	Clarified this covers non-flightdeck changes. Note updated to explain why the change is not a product level change.
14.	Flightdeck replacement of highly integrated and combined electronic display systems with other highly integrated and combined electronic display systems.	No	No	No	Although the hazards need to be reassessed, they are relatively unchanged, therefore the assumptions used to certify a highly integrated avionics system should be the same for another highly integrated avionics system. The change will be not significant if the architecture concepts, design philosophies, human-machine interface do not introduce new verification methodologies.	Note updated to expand on the assumptions for certification.

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
~~15.~~	~~IFR upgrades involving installation of upgraded components for new IFR configuration.~~	~~No~~	~~No~~	~~No~~	~~No changes in architecture concepts, design philosophies, human-machine interface, or flightcrew workload.~~	Recommend deleting this example as IFR upgrades are already covered in other examples.
15.	Flightdeck replacement or upgrade of avionics systems in a VFR ~~non-appendix "B" (IFR) or~~ non-CAT "A" rotorcraft that can enhance safety or pilot awareness.	No	No	No	Introduction of equipment in a VFR rotorcraft that can improve pilot situation awareness and safety does not introduce new aircraft level hazards and is not a product level change	Example clarified to mean VFR and note expanded to explain why the criteria are not triggered.
16.	Modifications to non-crashworthy fuel systems intended to improve its crashworthiness.	No	No	No	Does not alter the basic rotorcraft configuration and therefore is not a product level change.	Note added to explain the not significant decision
17.	Changing the hydraulic system from one similar type of fluid to another, e.g., a fluid change from a highly flammable mineral oil based fluid (MIL-H-5606) to a less flammable synthetic hydrocarbon based fluid (MIL-PRF-87257)	No	No	No	Does not alter the basic rotorcraft configuration and therefore is not a product level change.	Note added to explain the not significant decision
18.	Installation of a TSO C-127 dynamic seat in a helicopter with an existing certification basis prior to addition of § 29.562, *Emergency landing dynamic conditions*.	No	No	No	Does not alter the basic rotorcraft configuration and therefore is not a product level change	Example updated to reflect installation of a new type of seat and note updated.
19.	New autopilot or stability augmentation system for a VFR aircraft.	No	No	No	Does not alter the basic rotorcraft configuration and therefore is not a product level change. Assumptions are the same as for basic aircraft stability and control.	New

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
20.	Integration of existing federated, independent electro- mechanical gages into an existing federated, highly integrated electronic display system.	No	No	No	Since the baseline product already contains highly integrated electronic displays the assumptions used for certification are not invalidated. The change will be not significant if the human-machine interface does not introduce new verification methodologies.	New
21.	Increase of maximum take-off weight by less than 10%.	No	No	No	Although testing and analysis may be required, changes to increase the take-off weight do not require new verification methods and do not invalidate the original certification assumptions.	New
22.	Change of non-primary structure from metallic to composite.	No	No	No	Changing the materials of non-primary structure do not change the assumptions for certification.	New
23.	Increase of transmission take-off power ratings by less than 10%.	No	No	No	Although testing and analysis may be required, changes to increase the take-off power rating do not require new verification methods and do not invalidate the original certification assumptions.	New

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
24.	Increase of transmission power ratings within the existing take-off power ratings.	No	No	No	Although testing and analysis may be required, changes to increase miscellaneous power ratings do not require new verification methods and do not invalidate the original certification assumptions.	New
25.	Emergency Medical Service (EMS) configuration.	No	No	No	Most EMS configurations will not be classified as significant. Modifications made for EMS are typically internal, and the general external configuration is normally not affected. If extensive changes to primary structure are required, then the change may become significant.	New. Added a not significant example for EMS. If the original design assumption was an aircraft that can be used for multi-purpose (as almost all helicopters are) then this is not significant by itself.
26.	Installation of avionics communication and navigation systems.	No	No	No	Installation of communications and navigation systems and their antennae are not a product level change.	New
27.	Avionics or flightdeck software updates.	No	No	No	Software changes generally do not introduce new aircraft level hazards therefore the certification assumptions are unchanged. The change will be not significant if the human-machine interface is not impacted and does not introduce new verification methodologies.	New

Example	Description of change	Is there a change to the general configuration? § 21.101(b)(1)(i)	Is there a change to the principles of construction? § 21.101(b)(1)(i)	Have the assumptions used for certification been invalidated? § 21.101(b)(1)(ii)	Notes	ARC Comments
28.	Change to main rotor or tail rotor chord or length with performance change less than 10%.	No	No	No	Although testing and analysis may be required, changes to small changes to the main or tail rotor do not require new verification methods and do not invalidate the original certification assumptions.	New
29.	Functionality enhancement of an existing autopilot.	No	No	No	The change will be not significant if the human-machine interface does not introduce new verification methodologies. Special Conditions may be required for enhanced IFR modes.	New

Appendix E – ARC Recommendations by Charter Tasking

The correlation between the topics and proposed recommendations is shown in the table below.

Topic	Linked Recommendation(s)	Recommendation Object
Topic 4a	REC 1	Multi-factor objective Criteria for Substantial classification
	REC 2	Reference Type Design definition & guidance
	REC 3	§ 21.19 Regulatory Text
	REC 4	Transition Period and Grandfathering
Topic 4b	ARC Report Sec. V	Evaluation of IAWG draft objective criteria for substantial determination
	REC 1	Multi-factor objective Criteria for Substantial classification
Topic 4c	REC 1	Multi-factor objective Criteria for Substantial classification
	REC 2	Reference Type Design definition & guidance
	REC 3	§ 21.19 Regulatory Text
Topic 4(c)-1	REC 6	AC21.101-1B Appendix A Updates
	REC 2	AC21.101-1B Appendix A Updates
Topic 4(c)-2	REC 5	Revised definition for automatic criterion § 21.101(b)(1)(i), “General configuration”
	REC 5	Revised definition for automatic criterion § 21.101(b)(1)(i), “Principles of construction”
	REC 5	Revised definition for automatic criterion § 21.101(b)(1)(ii), “Assumptions used for certification”
Topic 4(c)-3	REC 7	Revised definition for “Product Level Change”
Topic 4(d)-1	REC 10	Definition and Framework of Affected Areas
	REC 9	Develop guidance for scoping/checking the completeness of the affected areas using system safety principles (decomposition and validation process)
	REC 12	Practical examples of implementing the methodology with associated affected area assessment templates
	REC 14	Guidance for proper identification of the affected areas in the TCDS

Topic	Linked Recommendation(s)	Recommendation Object
	REC 13	The FAA should ensure the recognition and the continued use of Additional Design Requirements and Conditions (ADRC) on product Type Certificate Data Sheets where design features are a condition of a 21.101(b)(3) exception.
	REC 2	The FAA should update the definition of “Baseline Product” in AC21.101-1B to reflect the definition in FAA Order 8110.48A
Topic 4(d)-2	REC 8	Develop guidance detailing the iterative and continuous update methodology for affected areas assessment (including FD/HFE/SCI requirements)
	REC 12	Practical examples of implementing the methodology with associated affected area assessment templates
	REC 14	Guidance for proper identification of the affected areas in the TCDS
	REC 13	The FAA should ensure the recognition and the continued use of Additional Design Requirements and Conditions (ADRC) on product Type Certificate Data Sheets where design features are a condition of a § 21.101(b)(3) exception.
Topic 4(d)-3	REC 10	Definition and Framework of Affected Areas
	REC 9	Certain airworthiness requirements pertaining to Flight Deck, Human Factors Effects, and Safety Critical Information need consideration in the AC 21.101 guidance to determine the scope of affected areas.
	REC 11	Define criteria for extending with proportionality the Affected Areas to the scope of the applicable certain airworthiness requirements (including FD/HFE/SCI)
	REC 12	Practical examples of implementing the methodology with associated affected area assessment templates
	REC 14	Guidance for proper identification of the affected areas in the TCDS
	REC 13	The FAA should ensure the recognition and the continued use of Additional Design Requirements and Conditions (ADRC) on product Type Certificate Data Sheets where design features are a condition of a § 21.101(b)(3) exception.

Appendix F – ARC Member Voting Responses and Ballots

The recommendations contained in this report were robustly discussed and constitute the ARC's best effort to complete the mission of the Charter. The ARC notes the need for additional work as contemplated in Section 5, paragraph B of the Charter, which allows the ARC to propose related follow-on tasks to the FAA Co-Chair. The ARC has included a list of topics requested for additional tasking in Section VII of this report.

The ARC completed its deliberations and report drafting on December 17, 2024. Ballots were distributed to the 25 voting ARC members. The tally is as follows:

12 – Concur as Written
11 – Concur with Comment
0– Concur with Exception
0 – Non-Concur
2 – Ballot Not Submitted

Company	Representative	Vote
Aerospace Industries Association (AIA)	Chad Kirk	Concur with Comment
AIA of Canada	David Turnbull	Concur
Airbus	Jean-Philippe Tarres	Concur
Airbus Helicopters	Olivier Jeunehomme	Concur with Comment
Aircraft Electronics Association	Ric Peri	Concur with Comment
Archer	Eric Wright	Ballot Not Submitted
ATR	Camille Bentz	Concur with Comment
Bell	Mike Deer	Concur with Comment
Boeing	Bernhard Muster	Concur with Comment
Bombardier	John Kotnjek	Concur
Cirrus	Chris Mitchell	Concur
Collins Aerospace	Brian Raker	Concur
Dassault Aviation	Laurent Franzoni	Concur with Comment

Company	Representative	Vote
Embraer	José Luiz Rocha Belderrain	Concur with Comment
Erickson Inc.	Ilex Brandenberger	Concur
Garmin	Paul Mast	Concur
General Electric	James Snyder	Concur
Gulfstream	Keith Candline	Concur
Honda Aircraft	John Rock	Concur
Pratt and Whitney	Keith Morgan	Concur
Pratt and Whitney, Canada	Peter Turyk	Ballot Not Submitted
Rolls-Royce	Bruce Cook	Concur
Textron Aviation	Brian Richardet	Concur with Comment
The General Aviation Manufacturers Association (GAMA)	Walter Desrosier	Concur with Comment
The General Aviation Manufacturers Association (GAMA)	Kyle Martin	Concur with Comment

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Chad E. Kirk
Voting Member Organization	Aerospace Industries Association (AIA)

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: _____

2. Concur with Comment or Exception(s):

AIA concurs with the report, and looks forward to working with the FAA and our industry partners on the additional taskings requested therein.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: 12/19/2024

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	David Turnbull
Voting Member Organization	Aerospace Industries Association of Canada (AIAC)

As a voting member and full participant of the Changed Product Rule ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: Dec 18, 2024

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

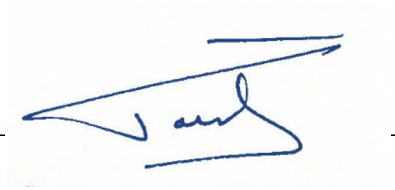
Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Jean-Philippe TARRES
Voting Member Organization	AIRBUS

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____  ____ Date: 18 December 2024

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Olivier JEUNEHOMME
Voting Member Organization	Airbus Helicopters

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: _____

2. Concur with Comment or Exception(s):

I concur with the full report content with the comment that further tasking, as defined in § VII of the report, is necessary to simplify, integrate and better illustrate the new proposed CPR Process.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: __19/12/2024_____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Richard Peri
Voting Member Organization	Aircraft Electronics Association (AEA)

As a voting member and full participant of the Changed Product Rule ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: __19 December 2024_____

The focus of the report seems to be to address the Part 25 world and OEM's. Although the suggested changes to the guidance are applicable to STC's I think having STC examples in the report would have helped. Also in terms of changes to the guidance talking about how an STC applicant can make evaluations without having some critical data in hand would be beneficial and simply some of the work that is necessary in making the determination. We could tackle this though in the revision to the AC.

Two examples of the system change that would trigger a systems input into substantial are the installation of autoland and autopilot. These seem to be an odd addition to make something substantial. In Part 23 these have been done as significant but not substantial. Maybe it is just me in missing the how the method of reviewing the series of changes to make it substantial works. It may be the lead into this section identifies this process described early in the document - ie these examples would mean that this element would be counted as one of the 3 product key characteristics affected to make the change potentially substantial.

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: ___ Richard Peri _____ Date: __19 Dec 2024__

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Camille BENTZ
Voting Member Organization	ATR

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: _____

2. Concur with Comment or Exception(s):

I concur with the final report as written. By this comment, I would like to emphasize the importance of proceeding with the proposed additional tasking (under the Chapter VII. Request for Additional Tasking), both for 21.19 and 21.101.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: Camille BENTZ Digitally signed by: Camille BENTZ DN: CN = Camille BENTZ email = camille.bentz@atr-aircraft.com C = FR O = ATR OU = ATR Date: 2024.12.18 14:07:51 +01'00' _____ Date: 18-December-2024

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Michael Deer
Voting Member Organization	Bell Textron

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

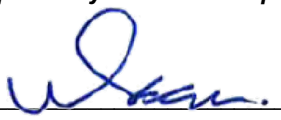
1. Concur with the Final Report as written

Voting Member Signature: _____ Date: _____

2. Concur with Comment or Exception(s):

Concur with the final report while recognizing the additional taskings that have been identified to further refine the AC content regarding the Reference Type Design and affected areas.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature:  Date: 19 December 2024

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Bernhard Muster
Voting Member Organization	Boeing

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: _____

2. Concur with Comment or Exception(s):

I concur with the report as written and emphasize the importance of chartering the additional taskings requested for both 21.19 and 21.101.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: Bernhard Muster, 139926 Digitally signed by Bernhard Muster, 139926 Date: 2024.12.19 12:54:40 -08'00' Date: Dec. 19, 2024

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	**John Kotnjek**
Voting Member Organization	**Bombardier**

As a voting member and full participant of the Changed Product Rule ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: John Kotnjek Digitally signed by John Kotnjek DN: cn=John Kotnjek Date: 2024.12.19 13:21:51 -05'00' Date: 2024-12-19

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Chris Mitchell
Voting Member Organization	Cirrus

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature:  Digitally signed by Christopher Mitchell
Date: 2024.12.18 14:51:33 -06'00' Date: December 18, 2024

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Brian Raker
Voting Member Organization	Collins Aerospace

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: 12/19/2024

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	LAURENT FRANZONI
Voting Member Organization	DASSAULT AVIATION

As a voting member and full participant of the [INSERT NAME] ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: _____

2. Concur with Comment or Exception(s):

While content of the report is satisfactory and already records the need for additional tasking, i made a comment in order to capture the importance of these supplementary activities specially for the definition of significant changes, the management of affected areas and the TCDS instruction.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: Laurent Franzoni - 00036520 Signature numérique de Laurent Franzoni - 00036520 DN : c=FR, o=Dassault-Aviation, ou=Personnel RH, cn=Laurent Franzoni - 00036520 Date : 2024.12.18 10:21:18 +01'00' Date: 18-Dec-2024

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Jose Luiz Belderrain
Voting Member Organization	Embraer

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: _____

2. Concur with Comment or Exception(s):

The extensive revision to the rule and associated guidance material as proposed by the ARC is necessary; however, since the outcome will be likely complicated, with many new concepts, a thorough and effective training must be available to all stakeholders --- Authorities, OEM´s, product modifiers.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature:  Date: 18 December 2024

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Ilex Brandenberger
Voting Member Organization	Erickson Incorporated

As a voting member and full participant of the Changed Product Rule ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: Ilex Brandenberger Date: 12/18/2024

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Paul Mast
Voting Member Organization	Garmin

As a voting member and full participant of the Changed Product Rule ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: Paul Mast Date: 12-18-2024

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	James Snyder
Voting Member Organization	GE Aerospace

As a voting member and full participant of the Changed Product Rule ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _  _____ Date: _December 19, 2024_

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Keith Candline
Voting Member Organization	Gulfstream Aerospace Corporation

As a voting member and full participant of the Changed Product Rule ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature:  Date: 18 December 2024

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	John R. Rock
Voting Member Organization	Honda Aircraft Corporation, LLC

As a voting member and full participant of the Changed Product Rule ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: __December 19, 2024_____

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Keith R Morgan
Voting Member Organization	Pratt & Whitney

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: Keith R Morgan Digitally signed by: Keith R Morgan DN: CN = Keith R Morgan email = keith.morgan@prattwhitney.com C = US O = Pratt Whitney OU = Certification Airworthiness Date: 2024.12.18 10:44:57 -05'00' _____ Date: 18 Dec 2024

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	J. Bruce Cook
Voting Member Organization	Rolls-Royce Deutschland Ltd & Co KG for Rolls-Royce.

As a voting member and full participant of the Changed Product Rule ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Digitally signed by Cook, Bruce Date: 2024.12.19 18:21:55 +01'00' Airworthiness Date: __19 December 2024_____

2. Concur with Comment or Exception(s):

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: _____ Date: _____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Brian Richardet
Voting Member Organization	Textron Aviation

As a voting member and full participant of the The Changed Product Rule (CPR) ARC, I hereby acknowledge that I have reviewed the Final Report and recommendations and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____ Date: _____

2. Concur with Comment or Exception(s):

1) REC 8: What if FHA and SSA aren't existing? Most products, new or derivatives, did not develop proper FHA and SSA until 2012 and later.

2) REC 13: Care should be taken to not require TDCS description of ADRCs to contain intellectual property as the TCDSs are public information. We need have a process that allows for OEMs' investment in developing intellectual property to be protected.

3) The report has been revised throughout within the week and days preceding ballot due date, leaving ARC members insufficient time to perform a full review of a "final" report. This occurred in a highly compressed ARC schedule and within the weeks leading to Christmas holiday. While the ARC members may concur with the **intent** of the recommendations, there may be unintentional errors in the wording of some recommendations, rationales and background information. Readers of this report should bear in mind the literal reading of the text may not be consistent with the intent of the recommendations which the ARC members intend to put forward. There are several opportunities, including NPRM, for further Regulatory/Industry CPR ARC alignment. This document serves as a reasonable starting point for continued discussion.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: Brian K Richardet:A01094E0000017C0EE8C39B00008EDA Digitally signed by Brian K Richardet:A01094E0000017C0EE8C39B00008EDA Date: 2024.12.18 15:55:52 -06'00' Date: December 19, 2024

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Walter Desrosier
Voting Member Organization	General Aviation Manufacturers Association (GAMA)

As a voting member and full participant of the Changed Product Rule Aviation Rulemaking Committee (CPR-ARC), I hereby acknowledge that I have reviewed the draft final report and recommendations in the Word document titled "*CPR ARC Draft Final Report – Dec 17, 2024 – track changes accepted and comments removed.docx*" and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____N/A_____ Date: _____

2. Concur with Comment or Exception(s):

On behalf of GAM and as a member of the CPR-ARC, I concur and support the outcome of this intensive collaborative effort between the industry, FAA, and partner authoriites to deliver this report on a highly complex topic in a very restrictive timeframe. We wish to specifically highlight areas that are particularly important for our membership of general aviation manufacturers and equipment and system suppliers that support continued airworthiness and improvements of the existing fleet of GA aircraft:

- Ensuring that the legacy General Aviation (GA) fleet can be maintained with changes that incorporates safety/performance/environmental improvements - i.e. 21.19 thresholds do not apply to in-service GA products in such a way that would limit or prevent continuous improvements to aircraft in the fleet (Ref Rec 1 Sec VI.A)
- Ensuring new production GA can be updated with changes that incorporate safety/performance/environmental improvements – i.e. grandfathering provisions and 5-year effective date period (Ref Rec 3 prorposal for para (b)(1), (b)(3), (b)(4), and recommendation for additional tasking to evaluate alternative approaches for the transition of legacy products)
- Critical importance of maintaining harmonization across CMT states of design for any proposed changes to 21.19, 21.101 and related guidance materials in order to support safety cooperation and support for global export, operations and continued operational safety of aircraft (Ref FAA Reauthorization Act provisions establishing IAWG and improvements to requirements and processes for 21.101 and 21.19.
- To appropriately address the above, we wish to explicitly endorse the request for additional taskings to the CPR ARC as outlines in the report Section VII: Request for Additional Tasking.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature: Walter Desrosier Date: _____12/19/2024_____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____N/A_____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.

The Changed Product Rule (CPR)
Aviation Rulemaking Committee (ARC)
Statement of Concurrence / Non-Concurrence

Voting Member Name	Kyle Martin
Voting Member Organization	General Aviation Manufacturers Association (GAMA)

As a voting member and full participant of the Changed Product Rule Aviation Rulemaking Committee (CPR-ARC), I hereby acknowledge that I have reviewed the draft final report and recommendations in the Word document titled "*CPR ARC Draft Final Report – Dec 17, 2024 – track changes accepted and comments removed.docx*" and make the following statement:

1. Concur with the Final Report as written

Voting Member Signature: _____N/A_____ Date: _____

2. Concur with Comment or Exception(s):

On behalf of GAMA, we support the outcome of this intensive collaborative effort between the industry, FAA, and partner authoriites to deliver this report on a highly complex topic in a very restrictive timeframe. We wish to specifically highlight areas that are particularly important for our membership:

- Ensuring that the legacy General Aviation (GA) fleet can be maintained with changes that incorporates safety/performance/environmental improvements - i.e. 21.19 thresholds do not apply to in-service GA products.
- Ensuring new production GA can be updated with changes that incorporate safety/performance/environmental improvements – i.e. grandfathering provisions and 5-year effective date period
- Critical importance of maintaining harmonization across CMT states of design for any proposed changes to 21.19, 21.101 and related guidance materials
- To appropriately address the above, we wish to explicitly endorse the request for additional taskings to the CPR ARC as outlines in the report Section VII: Request for Additional Tasking.

Provide comment or exception in the text box above. Member may submit a separate paper on company letterhead if additional space is required. Separate papers may not exceed 2 pages in length.

Voting Member Signature:  Date: _____12/19/2024_____

3. Non-Concur. Letter of Dissent must be provided.

Voting Member Signature: _____N/A_____ Date: _____

Letters of Dissent must be on company letterhead and may not exceed 2 pages in length.