Certification Authorities for Transport Airplane (CATA) Products

CATA Worklist Item FAA-004 - Runway Excursion Hazard Classification

Date Raised:	07 DEC 2017		Status:	**Closed**
Initial Release:	19 NOV 2024		Updated:	
Raised By:	/"/			
SME Team (* denotes lead authority):	**ANAC***	**EASA**	**FAA**	**TCCA**
	/"/	/"/	/"/	/"/
Subject:	**Runway Excursion Hazard Classification**			
Reference Requirements/ Guidance:	RBAC/CS/14CFR/AWM (5)25.1309			
Related Issue(s): (Identify Discussion Paper number, if any)	None			

Description of Issue(s):

(Give a brief description of issue(s))

Certification authorities' guidance for classifying the severity of airplane systems failure conditions, which could cause the airplane to exit the runway surface, are not harmonized. Currently there are two independent approaches in the guidance:

1) Based on airplane's aerodynamic performance. This approach utilizes a scale of runway excursion speeds to classify the severity of the failure condition. The higher the speed at the point of excursion, the higher the classification of the failure condition.

2) Based on prevention of system failures that would cause runway excursions. This approach considers any uncontrolled excursion potentially dangerous. Excursion speed is secondary factor in determining the classification.

Although the actual outcome depends on what the airplane might encounter after it leaves the runway surface, neither approach requires applicants to consider the runway/airport configuration (e.g. obstacles along or beyond the runway boundary, seawall runways, or presence of EMAS.)

Applicants have raised concerns that the 2nd approach is excessive, and could result in unnecessary design changes, given the historically low number of runway excursion events that have been associated with system failures.

Background:

(Give a brief background of issue(s))

In showing compliance to §/CS 25.1309 and other system safety rules such as §§ 25.671, 25.901, 25.933, the applicant must define the effects and resulting hazard classifications of system failure conditions. For example, failures of the nose gear steering or wheel-braking system can cause loss of directional control on the ground, and result in an uncontrolled departure from the runway surface. The actual outcome of a given runway excursion likely depends on the surrounding runway environment (runway area obstacles, load bearing capability of the surrounding area, etc.) as well as on the airplane design features. However, the authorities do not require applicants to consider the runway/airport configurations due to the impracticality of considering all airports design features in the airplane certification process.

By the Certification Review Item (CRI) process, EASA issues a scale where the classification depends on the speed at which the airplane departs the runway surface.

To standardize compliance determination, the FAA issued policy statement PS-ANM-25-11 which establishes a policy that an uncontrolled runway excursion is catastrophic at "high taxi speeds" or

greater, and is hazardous otherwise, while allowing applicants to justify their proposed hazard classifications if different from those described in the policy statement. The policy also allows applicants to propose what they consider high taxi speeds in accordance with the airplane intended operations and procedures.

Harmonization of these classification criteria was one of the tasks ARAC assigned to the Flight Test Harmonization Working Group. The FTHWG recommended an excursion speed based hazard classification, together with a list of factors that affect speed, such as aircraft weight, crosswind, airport elevation/temperature, runway length/width, runway surface condition, etc. Thus, the FTHWG recommended utilizing aerodynamic performance as the primary consideration for hazard classification. However, there were dissenting opinions from ALPA, EASA and the FAA on some aspects of the recommendation.

Proposed Prioritization:

(Per CATA Worklist Items Prioritization schema)

Question	Answer
1. Is there an active working group related to this issue?	FTHWG proposed a method of compliance, but there were some dissenting opinions from FAA, EASA and ALPA. Note: The recommendation was accepted by the ARAC.
2. In which documents are there deviations amongst the authorities?	EASA CRIs. FAA Policy Memo PS-ANM-25-11 and various issue papers from agencies prior to the PS.
3. Was this issue raised by or at the CMT?	No
4. What is the level of impact on projects in the future (i.e. minor, major, critical)?	Critical. Differences in approach have contributed to design changes to airplane systems.
5. How many authorities does the issue impact?	ANAC, EASA, FAA, TCCA.
6. What is the approximate complexity of the issue (i.e. low, medium, high)?	Medium

Recommendation, Objectives and Expected Outcome:

(The authority or industry member that proposes a CWI provides an initial recommendation to the CATA. The CATA may refine the objectives.)

CATA to establish a working group comprised of System Safety SME(s) from each member's organization, with support from other disciplines as needed. This working group is to review the above approaches, the ARAC recommendation, and industry compliance showing to §/CS 25.1309 (and other system safety related rules). The working group will recommend to CATA a plan to address the issues/concerns identified above.

CATA Decision (Phase 1)

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Phase 1. The CATA accepted this proposed CWI into its work program.

CATA Comments to SME Team:

The SME team will propose a project plan to the CATA. This project plan should either confirm or propose modifications to the objectives described in the Recommendation and Objectives section and should propose major milestones in support of achieving those objectives.

SME Initial Recommendation:
SME Working Group meeting at EASA (May 17th, 2019): The SME Working Group finds it premature to address a plan for regulation/guidance harmonization based on the runway overrun criteria currently proposed by the FTHWG. The FTHWG Topic 10 report includes dissenting opinions from FAA, EASA and ALPA. In addition, we believe there is the need for a broader review of the proposed criteria. The SME Working Group recommends the FTHWG to distribute its Topic 10 report to an expanded group of SME from domains other than flight test (including systems safety, propulsion, mechanical, and

electrical systems) to review the proposed criteria. The FTHWG should then address the results of the expanded SME review and revise the criteria, if required.

CATA response to SME initial recommendation:

The CATA tasked the SME team to take a fresh look at the runway excursion hazard classification methodology, from the perspective of those well-versed in system safety. The goal of this CATA exercise is to, if possible, develop a harmonized approach that will enhance predictability and consistency in the validation process across the CMT authorities. Today we have different approaches applied by the different CMT member authorities. These differences have been documented in issue papers, CRIs, etc., resolution of which frequently has required a significant expenditure of resources on individual projects. Industry ultimately has to envelope the different approaches if they are seeking global acceptance. What the CATA is seeking is a harmonized approach, which if followed by an applicant and supported by their CA, will be accepted without validation review by the other 3 authorities. The CATA acknowledge that such a solution could require more burdensome compliance activities relative to the approach documented in the FTHWG recommendation. That's OK from a CATA perspective.

We would like the SME team to revisit this task, considering not only the FTHWG recommendation, but also taking into consideration the dissenting opinions, the FAA policy statement, and the knowledge and experience they each bring to the team. The SME team should provide to the CATA a plan for reaching a recommended harmonization position regarding runway excursion hazard classification methodology. This plan should initially focus on identification of known areas of disharmony, including key assumptions such as runway overrun speed limits for hazard classifications, consideration of environmental factors on stopping performance, and other areas identified by the team. In some areas, the team may decide to agree on the most conservative methodology. In other areas, the team may decide that a precise methodology need not be firmly described, instead relying on prescribed principles and the discretion of the certifying authority. Other aspects may require outside expertise, in which case the need should be identified in the plan. The plan should include a proposed timeline and major milestones.

To summarize, the goal is to drive more predictability and efficiency into the validation process by removing the need for direct validating authority involvement when the applicant follows a prescribed approach.

SME update on the issue for CATA evaluation:

The areas of disharmony are well understood by the SMEs, and by industry via the FTHWG discussions along with dissenting opinions as recorded in their report. After evaluation of the FTHWG material and discussion in a dedicated meeting at EASA, the SMEs consider that an ARAC would be more suitable for harmonizing the subject considering its complexity. Such a task would need involvement from other domains beside flight test and system safety. We do not see a viable way to develop a viable plan that could achieve complete harmonization within a reasonable time frame.

As discussed with some SMEs, however, the ANAC understands that seeking partial harmonization may be a viable approach for the short term, and can achieve the objective of reducing validation efforts when addressing at least the most critical failures. The ANAC sees potential for quick harmonization if this task is limited to the runway excursion speeds criterion alone and is available to continue working on this task if the proposed scope reduction is agreed by CATA.

SME Team Project Plan:

Milestone	Deadline	Status
Establish Work Plan	/"/	Closed

Certification Authorities for Transport Airplane (CATA) Products

CATA Worklist Item FAA-004 - Runway Excursion Hazard Classification

Phase 2. Understand CMT authority differences		
FTHWG recommendations reviewed, and scope defined	/"/	Closed
Phase 3. Develop initial proposition of harmonized practice.		
Develop harmonize practice	/"/	Closed
Phase 4. Finalize proposition and submit to CATA		
CWI paper revised with SMEs position and submitted to CATA	/"/	Closed

SME Discussions:

(Indicate Source (Meeting, Telecon or E-mail) and Date, Include Significant Issues/Developments, and Actions if applicable)

Update	Action Owner	Status
<DEC 2021> Update Work plan delivered	All	Closed
<MAY 2022> Update Scope delivered	All	Closed
<SEP 2024> Update SME recommendation completed	All	Closed

SME Recommendation (Phase 4 Completion)

(Recommendations from SME Working Group; may contain links and/or embedded documents)

The appendix 1 provides supplemental guidelines on demonstrating compliance with §25.1309 for the subject of runway excursion hazard classification. This harmonized practice has been found acceptable by the ANAC, EASA, FAA, and TCCA and its use is expected to significantly enhance the predictability and consistency for type design validation involving these CMT authorities.

This harmonized practice has been established from the examination of existing material developed to address the subject, mainly:

- ARAC Flight Test Harmonization Working Group (FTHWG) Topic 10 Runway Excursion Hazard Classification Recommendation Report Rev A.
- FAA Policy Statement PS-ANM-25-11 Guidance for Hazard Classifications of Failure Conditions that Lead to Runway Excursions.
- EASA CRI - Interpretative Material (IM) - Runway Excursion Hazard Classifications.

Considering the main objective to facilitate acceptance in the type design validation process, this practice presents some differences from the FTHWG Topic 10 recommendations. Mainly:

- Before introducing more specific parameters and criteria for assessing failures which may result in runway excursions, this practice emphasizes the importance for the applicants to develop robust fail-safe system designs for providing deceleration capability. The SMEs thus consider that the use of the supporting parameters and criteria presented in this practice should be done in the context of already established state-of-the-art designs. This is in line with existing guidelines presented in PS-ANM-25-11.
- FTHWG proposed lateral runway excursion speed-based criteria that differentiate the scenarios in which all MLG exit runway vs scenarios in which any MLG remains on the runway. The SMEs understand that when the first MLG departs the runway, the resulting condition is subject to considerable uncertainty since controllability and deceleration capability cannot be fully ensured once the airplane is partially off the runway. It is also worth noticing that the FTHWG lateral speed criterion had a dissenting opinion from ALPA. The approach used for this harmonized practice, in line existing with existing §25.1309 guidance, was to build conservativism into the analysis so that such uncertainty does not compromise safety. The speed-based criteria were then adapted such that a runway excursion is considered to occur when any landing gear first departs the runway, and the possibility of reduction in the hazard classification if any MLG remains on the runway is not adopted.
- Other minor differences and additional guidelines are proposed for some specific parameters. These were mainly due to: address dissenting opinions in the FTHWG Topic 10 report; provide useful insight on the use of specific typical and intensifying parameters based on experience

from the SMEs and resolve small acceptance differences on a conservative basis. See appendix 1 for more details.

As discussed in the Phase 1 of this CWI, fully addressing this subject is a wide scope task. Several of the considerations and parameters related to assessment of failures conditions that may result in runway excursions are multidisciplinary and have been subjected to additional discussions in other forums. Given the narrow scope and short-term objective of this tasking, the SMEs made efforts to avoid duplicating work performed by other working groups. As an example, several aspects of this harmonized practice have been discussed in the Failure Assessment: Methodology and Evaluation (FAME) topic in phases 4 and 5 of the ARAC Flight Test Harmonization Working Group (FTHWG). Whenever possible, cross references to such discussions are provided for each applicable parameter in this harmonized practice.

As tasked by the CATA, this practice document presents guidelines and criteria related to runway excursion based on the objective of harmonization improvement. The use of these criteria and guidelines are expected to facilitate validation between CMT authorities for the assessment of failure conditions which may result in runway excursions. Notwithstanding, the applicants may still coordinate with their certification authority to develop and agree on their own specific parameters, criteria and analysis.

Final CATA Position:

(Explain agreement, dissent or conclusion on the SME recommendation)

The CATA accept the SME team's recommendation and proposed guidance paper. The guidance paper is appended directly to this CWI. The CWI represents an agreement that the guidance paper is harmonized and accepted by all CMT authorities.

The CWI form, including the appended paper, document a CMT member authority agreement that member authorities may reference when they are acting as the certificating authority (CA). Following CA endorsement for a particular project, the other CMT member authorities, when acting as validating authority, will accept the approach. If any member-authority under CATA becomes aware of circumstances that make it apparent that following the guidance paper would not result in compliance with the member-authority's applicable airworthiness standards, then the use of this guidance paper is non-binding, and the member-authority may require additional substantiation or design changes as a basis for finding compliance.

Certification Authorities for Transport Airplane (CATA) Products

CATA Worklist Item FAA-004 - Runway Excursion Hazard Classification

Release of CWI:

CATA Representative	Name	Signature	Date
ANAC	Daniel Pessoa Marcelo Leite	Daniel Pessoa Martins Cunha Assinado de forma digital por Daniel Pessoa Martins Cunha DN: dc=br, dc=gov, dc=anac, ou=ANAC, ou=SAR, ou=USUARIOS, cn=Daniel Pessoa Martins Cunha Dados: 2024.11.25 14:01:46 -03'00' Marcelo Henrique Morales Leite Assinado de forma digital por Marcelo Henrique Morales Leite DN: dc=br, dc=gov, dc=anac, ou=ANAC, ou=SAR, ou=USUARIOS, cn=Marcelo Henrique Morales Leite Dados: 2024.11.19 13:51:45 -03'00'	
EASA	Israel Navarro Mathilde Labatut	P.A.	26 Nov 2024
FAA	Hung Cao James Wilborn	HUNG T CAO Digitally signed by HUNG T CAO Date: 2024.11.26 12:32:12 -05'00' JAMES E WILBORN Digitally signed by JAMES E WILBORN Date: 2024.11.26 11:21:58 -08'00'	
TCCA	Sébastien Garsuault Canh Nham	Garsuault, Sebastien Digitally signed by Garsuault, Sebastien Date: 2024.11.26 15:16:27-05'00' Nham, Canh Digitally signed by Nham, Canh DN: C=CA, O=GC, OU=TC-TC, CN="Nham, Canh" Reason: I am the author of this document Location: Date: 2024.11.26 16:46:06-05'00' Foxit PDF Editor Version: 13.1.3	

Appendix 1 – CATA Worklist Item FAA-004 – Runway Excursion Hazard Classification

1. Subject

Runway excursion hazard classification

2. Statement of Issue

Certification authorities' guidance for classifying the severity of airplane systems failure conditions that could result in runway excursion events are not harmonized:

- EASA issues a CRI for each program to provide guidance regarding minimum classification of runway excursions as a function of excursion speeds.
- The FAA issued policy statement PS-ANM-25-11 which establishes that an uncontrolled runway excursion is catastrophic at "high taxi speeds" (around 30 kts) or greater, and hazardous otherwise. The policy allows applicants to justify their proposed hazard classifications if different from those described in the policy statement.

Harmonization of these classification criteria was one of the tasks ARAC assigned to the Flight Test Harmonization Working Group (FTHWG). The FTHWG recommended an excursion speed-based hazard classification, together with a list of factors that affect speed, such as aircraft weight, crosswind, airport elevation/temperature, runway length/width, runway surface condition, etc. Thus, the FTHWG recommended utilizing aerodynamic performance as the primary consideration for hazard classification. However, there were dissenting opinions from ALPA, EASA and the FAA on some aspects of the recommendation.

The Certification Authorities for Transport Airplanes (CATA) established a working group comprised of System Safety SME(s) from each member's organization to review the existing FAA and EASA approaches; the FTHWG recommendation including the dissenting opinions; and current industry compliance practices. The goal of the working group is to develop a harmonized position to enhance predictability and consistency in the validation process across the CMT authorities.

3. Applicability

This document provides additional guidelines on demonstrating compliance with §25.1309 for the subject of runway excursion hazard classification. This document does not replace §25.1309 guidance but it should be used as supplementing material for dealing with the specific hazard of failures that may result in runway excursions while still fitting with the overall intent of §25.1309 regulation and existing guidance.

This document does not change or create any additional regulatory requirements, nor does it authorize change in, or permit deviations from, regulatory requirements.

4. Definitions

This section presents definitions specific to the context of this document:

- Runway excursion: A runway excursion is considered to occur when any landing gear first departs the runway/taxiway laterally or longitudinally during taxi, takeoff, or landing ground roll.

5. Harmonized Practice

This harmonized practice has been found acceptable by the ANAC, FAA, EASA and TCCA for the assessment of failure conditions that may result in runway excursions. The applicants may coordinate with their certification authority to develop and agree on their own specific criteria and analysis, although the use of the following guidelines is expected to significantly enhance the predictability and consistency for type design validation involving these certification authorities.

The following sections present the parameters (e.g., longitudinal runway excursion, lateral excursion, field elevation, runway width) and the criteria (e.g., speed, engine power setting, flight phase (TO or LDG) of reference that, based on experienced engineering and operational judgment, should provide reasonable analysis coverage for most designs when assessing system failures which may result in runway excursions.

Since some of these parameters provide discrete criteria for the assessment, additional substantiation may be necessary for some designs to ensure that the approved flight envelope[1] is covered such as:

- adopting more conservative criteria and/or parameters;
- performing sensitivity analyses to substantiate how much the airplane systems are affected by changes in the criteria and/or parameters;
- or other substantiation agreed with their certification authority.

The intent is to ensure that there is no unacceptable escalation of the failure condition hazard classification.
The applicant's methodology for assessment of runway excursions, including assumptions, adopted parameters, criteria, methods for substantiation of coverage, etc. should be agreed with their certification authority early in the program, and be part of the overall system safety process documented in the applicable Safety Program Plan.

5.1. Design Considerations

The main intent of any safety analysis is to identify safety objectives commensurate with the airplane failure condition assessment such that, when properly allocated to the system development process, should result in safe system designs. A runway excursion is a potentially Catastrophic event, and it is still one of the most common categories of aviation accidents.
Before considering the application of any supporting criteria to assess failure conditions that may result in runway excursion events, the applicants should primarily focus on the high-level goal of ensuring the development of state-of-the-art designs to prevent (or minimize the effects of) these failures regardless of speed. Among other characteristics, through the application of the fail-safe design concept, such systems should be designed to ensure required levels of availability and integrity of ground deceleration, directional control, and crew indication functions.

5.2. Speed-Based Criteria

Although any runway excursion event is potentially Catastrophic, it is recognized that the severity of such an event is significantly dependent on the airplane's energy and dynamic behavior when exiting the runway. Therefore, speed-based criteria are an important part of the assessment of runway excursion effects, but other factors must also be assessed.
The applicant's Safety Assessment process should confirm the suitability of chosen performance justifications and associated hypothesis/assumptions. The applicant should then evaluate whether using speed-based criteria is appropriate or not in the context of each failure condition under assessment. For example, the speed at which the airplane departs the runway may not be relevant if the airplane is accelerating as a result of the failure.

[1] The subject of flight envelopes for failure assessment is under harmonization discussions within the Failure Assessment Methodology (FAME) topic of the ARAC Flight Test Harmonization Working Group (FTHWG). In the context of this document, approved flight envelope refers to the full normal operating envelope of the airplane as defined by the Airplane Flight Manual (AFM) together with any modification to that envelope associated with abnormal or emergency procedures. [Ref.: AMC 25.1309 / AC 25.1309 Draft Arsenal paragraph 9.a.]

When appropriate, the speed-based criteria should be considered as one of the supporting inputs for determining the severity classification, i.e. the failure conditions should not be classified solely based on runway excursion speeds. All other severity classification criteria of §25.1309 remain valid and must be evaluated as well. The most severe effect should drive the final classification of the failure condition. Considering the above, the Certification Authorities recognize the following minimum classifications as harmonized practice for supporting the failure condition assessment based on runway excursion speeds:

Table 1 - Runway Excursion Speed-Based Criteria

Parameter	Criteria	
	Runway Excursion Speed Interval	**Minimum Classification Based on Speed**
Longitudinal Runway Excursion	V > 60 kts	Catastrophic
	30 kts < V ≤ 60 kts	Hazardous
	V ≤ 30 kts	Major
Lateral Runway Excursion	V > 60 kts	Catastrophic
	30 kts < V ≤ 60 kts	Hazardous
	V ≤ 30 kts	Major

As with any criteria or assumptions used for §25.1309 compliance, uncertainty in the analysis should be accounted for in a way that does not compromise safety. The speed-based criteria in this table are a guiding principle only and should not be used as an absolute design criterion. For instance, when conducting an analysis, the applicant should not base their determination on Major or Hazardous classification solely on whether the resulting excursion speed is around 30 knots. Experienced engineering and operational judgment should always be applied when assessing failure condition effects.

5.3. Operational and Environmental Conditions

The outcome of a given runway excursion likely depends on the surrounding runway environment and operational conditions. These conditions may identify relevant intensifying or alleviating factors to be considered in the failure condition assessment. Considering the variety of such conditions, a non-standardized approach can lead to significantly different outcomes even if the same speed-based criteria is used.
This section presents some operational and environmental conditions that the Certification Authorities found relevant to highlight acceptable harmonized approaches to consider when evaluating failure conditions for runway excursion effects.

5.3.1. Runway width

The baseline runway width for assessment of failures which may potentially result in lateral runway excursions should be defined and documented in the AFM. The aircraft must be shown to be safely controllable and compliant with applicable airworthiness requirements when operating on runways with the defined baseline runway width or more. As a reference, the applicant may use the ICAO airport design level letter code applicable to their airplane or narrower.
The information of the baseline runway width in the AFM should be seen as information to be considered by operations i.e., it should not be interpreted as a limitation, unless it is proposed as such by the applicant. For instance, the baseline runway width information can be documented in the AFM in a similar way as the information of the maximum demonstrated crosswind.
A reduction in runway width represents an intensifying factor which could potentially negatively impact the classification of failure conditions associated with lateral deviations. As such, should the operation on runways narrower than the baseline runway be proposed by the applicant, the hazard classification of such failure conditions should be reassessed to permit safe operation of the aircraft on narrow runways. These reassessments, along with proposed compensating features or operating limitations, should be documented to safely accommodate narrow runway operations.

5.3.2. Field elevation

A default value of 5,000 ft should be used as a reference for airport field elevation when performing the analysis. Based on experience, in combination with other operational and environmental conditions, this value should be adequate for most designs to satisfactorily cover the envelope in which the airplane is certified to operate. Involvement of stability and control, performance or propulsion experts may be needed to assess the validity or extrapolation of such data to cover significantly higher field elevations for the specific design.

5.3.3. Aircraft configuration

It is recognized that different airplane configurations such as high wing vs low wing and fuselage mounted engines vs wing mounted engines could have different effects in a runway excursion scenario. However, past practices have shown that changing the runway excursion criteria to account for these differences in airplane configurations is usually not necessary.
When doing the analysis, the applicant must ensure that the configuration of the airplane systems is representative of the scenario being evaluated for each failure condition of concern and the associated flight crew procedures. This includes most critical configurations of flap and slat position setting, engine thrust setting (takeoff power, air idle, ground idle), alert inhibits, and so forth.

5.3.4. Crosswind

The applicant should always consider a crosswind magnitude of at least 10 kts in the assessment with a probability of one, as this is a typical condition that the airplane is expected to encounter during operations.

Crosswinds above 10 kts should be considered as an intensifying condition for the runway excursion assessment. Experience has shown that using a crosswind value of 25 kts is generally sufficient for the assessment of the intensifying condition. However, if the failure condition is deemed Catastrophic at a crosswind of 25 kts, it might be necessary to identify from which crosswind magnitude (i.e. between 10 and 25 kts) the failure condition becomes Catastrophic to ensure compliance (top level probability of the system failure(s) combined with the high crosswind). In addition, focused evaluations using crosswinds higher than 25kts might be necessary for cases of single failures that become Catastrophic when combined with such higher crosswinds.[2]

Several models exist for assigning probabilities to crosswinds. For example, for crosswinds higher than 10 kts, the EASA CS AWO gaussian model 1 has been accepted by the certification authorities as a reasonable reference model for crosswind level as a function of probability. If necessary for focused evaluations, the crosswind model can be extrapolated for higher crosswinds although winds with associated probability of less than 10^{-6} need not be considered. Consideration of crosswinds in failure condition assessment is currently under discussion in the Failure Assessment: Methodology and Evaluation (FAME) topic of the Flight Test Harmonization Working Group (FTHWG).

5.3.5. Landing field length

The deceleration capability of the airplane following failures affecting deceleration should be determined in a manner consistent with performance requirements in subpart B, such as §§25.109 and 25.125.

It is recognized that most runway excursions that occur during landing are related to inclement weather and non-stabilized approaches. Operational factors exist to help account for operational variations during landing. Unless directly impacted by the failure condition effects, a stabilized approach and landing may be assumed when performing the analysis. For example, this includes assuming landing on the touchdown point with appropriate speed and descent rates for the configuration. Features such as Runway Overrun Awareness and Alerting System (ROAAS) provide alerts to the flight crew when the airplane is at risk of not being able to stop within the available distance to the end of the runway. In the EASA system, CS 25.705 requires that a ROAAS must be installed to reduce the risk of a longitudinal runway excursion. Although ROAAS is an alerting system intended to be a safety net for the risk of runway excursions, the analysis should not take credit of ROAAS alerts in the assessment of failure conditions.

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[2] The assessment of single failures leading to Uncontrollable Hight Thrust (UHT) failure conditions are typically covered through guidance and criteria contained in project specific Issue Paper (IP), Certification Review Item (CRI), or equivalent process. Draft Advisory Circular 25.901-2X is normally adopted as a reference for guidance on this subject. Criteria for assessment of UHT failure conditions have been discussed in the FTHWG and this subject is also addressed in ongoing NPRM FAA-2022-1544 “System Safety Assessments”.

5.3.6. Weight and CG

The most critical combination of weight and CG within the approved flight envelope should be considered for each failure condition when performing the analysis. A single worst-case combination may not be appropriate for all failure conditions and flight phases (e.g., light weights may be more critical for controllability aspects, whereas heavier weights may be more critical for the effects on airplane performance). Therefore, some failure conditions may warrant additional analysis/rationale to justify the weight and CG combination used in the assessment.

5.3.7. Takeoff field length

The reference Takeoff Field Length (TOFL) should always consider the AFM Accelerate-Stop-Distance limited by weight, field elevation and weight/CG. No credits should be taken from obstacle clearance or clearway or stop way from runway end safety areas in the determination of the reference TOFL.

5.3.8. Runway surface condition

A dry runway should be considered as the baseline runway for the analysis. The applicant should coordinate with their certification authority on when and how to consider performance and controllability aspects for failure conditions in wet or contaminated runways, as this is a topic still under discussion for harmonization. The potential effects related to all the runway conditions for which the airplane is designed to operate (dry, wet, contaminated, unpaved) must be considered in the design of the airplane systems. This includes the application of appropriate environmental qualification standards, as well as protection and isolation of sensors and other components subject to contaminants or debris resulting from such operations. The airplane systems function should not be adversely affected by conditions such as hydroplaning and skidding that the airplane is reasonably expected to encounter when operating on wet, contaminated, or unpaved runways.

5.3.9. Off runway conditions

Off-runway surroundings and surface conditions may differ quite extensively from one airport to another. Since it is very difficult to account for such variety of conditions in the runway excursion assessment, the applicant may assume that the airport is designed and maintained according to ICAO standards for the type of runway. This means there is no need for the applicant to consider off-runway obstacles such as buildings, rigid structures, airport vehicles, personnel, or other aircraft in the vicinity of the reference runway for the analysis. Similarly, ice/snow on the edges of the runway need not be considered as a concern during a runway excursion since it is assumed that the airport runway is properly maintained for clearance of snowbanks and ice.

5.3.10. Speed for failure consideration during takeoff

For the takeoff cases, the applicant should perform the analysis considering that the failure occurs at the most critical speed for each failure condition during takeoff run. Higher speeds tend to be more critical from the point of view of

longitudinal excursions (since they result in longer distances). On the other hand, service history has shown that there might be cases where asymmetric failures at low speeds may be more critical for controllability due to reduced aerodynamic effectiveness of the control surfaces. The applicant should then carefully examine each failure condition and potential effects before selecting the most critical case. Assuming V1 as the critical speed for failures might not always be appropriate. Critical speeds for failure consideration during takeoff should also consider the alerting philosophy of the airplane. As an example, some airplanes will inhibit some crew alerts at certain speeds during takeoff to manage flight crew workload. Those design strategies may result in annunciated and non-annunciated scenarios with potential differences in crew actions and failure effects depending on the speed at which the failure occurs.

5.4. Additional Considerations

This section includes important topics and clarifications in addition to the runway excursion criteria and parameters that the applicant must consider.

5.4.1. System development assurance process (ARP4754/ED-79)

The applicant should incorporate their methodology for assessing failure conditions that may lead to runway excursions into the existing safety assessment process that is also an integral part of the system development assurance process. The conditions, assumptions, requirements, analysis results and safety-related requirements should be captured and managed in accordance with the overall development assurance process to ensure these data are properly validated, verified, and subject to configuration control throughout the project's life cycle, including changes to the type design (see section 5.4.2 below).
The regulatory authorities have noted that some operational requirements (e.g., runway width) are not being captured as aircraft level requirements. As a result, these requirements are not being reassessed as part of the modification impact analysis as changes are introduced. Additional efforts should be made to ensure the set of aircraft level requirements is complete and correct.

5.4.2. Assessment of changes to the type design

The use of updated regulations and guidance for changes to the type design is typically dictated by performing the Change Product Rule (CPR) documented in FAA AC 21.101-1B and EASA GM 21.A.101. When discussing which policy applies to the change to the type design (e.g. ACs and policy statements) FAA AC 21.101-1B §5.2 states that *"In general, you should use the latest FAA policy in effect at the date of application."* Although using new policies is the standard case for changes to the type design, the applicant may also seek an agreement with their certification authority to use another means of compliance. EASA GM 21.A.101 has similar guidelines for the use of the Latest Certification Specifications.
Runway excursion is a significant aircraft level safety concern, as justified by service history of in-service events. Consistent application of harmonized runway excursion criteria and conditions for failure assessment, including changes to the type design, is essential to ensure designs are appropriately evaluated, resulting

hazard classifications are coherent, and level playing field amongst transport category airplanes is maintained. Additional guidelines for scoping and evaluating systems safety impacts on changes to the type design are provided in the *"Modifications to Aircraft or Systems"* section of ARP4754B/ED-79B.

The certification authorities consider that the methods, criteria, and conditions described in this harmonization paper improve technical aspects of the means of compliance, especially for projects that used non-harmonized criteria in the past. CPR guidelines should be used to determine acceptable means of compliance for runway excursion hazard classification (e.g., issue papers, policy, certification memorandum). If the runway excursion hazard classification is already part of the means of compliance agreed for the certification basis, it should be reassessed for design changes.

5.4.3. Use of 25.735(b)(1) exception

§25.735(b)(1) limits the effect of a single failure of the braking system to doubling the brake roll stopping distance prescribed in §25.125. Certain single failures covered by §25.735(b)(1) are excepted from the requirements of §25.1309(b). Past practices have shown it is valuable to further clarify the use of the double braking distance exception against the runway excursion criteria discussed in this document.

§25.735(b)(1) is a system level criterion and it is not related to hazard classification assessment for runway excursion. The runway excursion hazard classification criteria are an aircraft level criterion. The applicant must comply with §25.735(b)(1) for the design of the braking system, including definition of the system requirements. The applicant must also comply with §25.1309(b) as an aircraft level consideration to minimize hazards related to runway excursion.

6. Conclusion

This document presents guidelines with parameters and criteria related to the assessment of potential runway excursion effect, as well as additional considerations on the subject. The use of these parameters and criteria are expected to facilitate validation between CMT authorities for the assessment of failure conditions which may result in runway excursions. Notwithstanding, the applicants may still coordinate with their certification authority to develop and agree on their own specific parameters, criteria and analysis.