Report

NSS Aviation System Safety Criteria 2018

Prepared for Civil Aviation Authority of New Zealand

by

Navigatus Consulting

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Civil Aviation Authority of New Zealand

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Glossary

Term	Meaning
ADS-B	Automatic Dependent Surveillance - Broadcast
AI	Artificial Intelligence
AIP	Aeronautical Information Publication
AN	Air Navigation
ANSP	Air Navigation Service Provider
ASSC	Aviation System Safety Criteria
ATC	Air Traffic Control – a sub-function of Air Traffic Service
ATM	Air Traffic Management
ATS	Air Traffic Service – a sub-function of Air Traffic Management
CAA	NZ Civil Aviation Authority.
CAR	Civil Aviation Rules
CFIT	Controlled Flight In to Terrain
CONOPS	Concept of Operations (NSS project term)
FaSTA	Foresight and Strategic Trends Analysis (Navigatus)
FIR	Flight Information Region
DME	Distance Measuring Equipment
GBNA	Ground Based Navigation Aid (or Aided)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IRU	Inertial Reference Unit
MON	Minimum Operational Network (as it relates to navigation)
NAANP	National Airspace and Air Navigation Plan
Navigatus	Navigatus Consulting Ltd
NSS	New Southern Sky programme
PB	Performance Based
PBC	Performance Based Communications
PBN	Performance Based Navigation
PBS	Performance Based Surveillance
RPT	Regular Passenger Transport
RNAV	Area Navigation
RNP	Required Navigation Performance
SARPs	ICAO Standards and Recommended Practices
SME	Subject Matter Expert
VFR	Visual Flight Rules
VOR	VHF Omnidirectional Range

Definitions

The following terms are used within, and for the purposes of, this report:

- Contingency Situation: A non-normal situation following an unplanned event that has resulted in a loss of function or capability within the aviation system, and during which a fall-back or alternative mode of operation is required (*Recovery or Contingency Operations*). E.g. loss of GNSS, partial or full loss of surveillance coverage, aircraft equipment failure etc.
- Contingency Operations: Operations conducted during a *Contingency Situation* that are expected to endure beyond the recovery phase. During these operations:
  - Safety: The operating regime must ensure continued safe operations during the *Contingency Operations*.
  - Impact: A degradation of social connections and economic efficiency would be expected.
- Continuity: Within the context of safety criteria; 'continuity' means the continued safe service or operation of the part of the system in question.
- Complexity: The measure of complexity is dependent on the variety of interrelating factors, including mix of aircraft types (e.g. equipment and aircraft performance), traffic density, route structure, navigation/communication requirements, mix of operational modes, aerodrome structure, terrain, and airspace category.
- Density: A measure of the number of aircraft in relationship to airspace volume.
- Disruption: A temporary, localised interruption to planned operations that does not require a change to the normal operation of the aviation system and so does not constitute a *Contingency Situation*. During these operations:
  - Safety: Safety continues to be assured through routine established procedures.
  - Impact: Very limited economic disruption occurs.
- Recovery Operation: The expected immediate operational response to a *Contingency Situation.* During these operations:
  - Safety: Procedures and fall-back system capability would ensure continued safety while aircraft are being recovered either onto the ground or into contingency operations.
  - Impact: The priority will be to safely recover aircraft. Any other aviation activity will be limited during the period of recovery.
- Integrity: The condition of being unimpaired or able to perform to the intended criteria, performance or meeting the design specification, internal consistency. Integrity can also refer to absence of corruption or interference in electronic data.
- Minimum operational network (MON): The minimum NZ aviation regime considered necessary to support essential safe recovery and contingency operations following an extended GNSS system failure.

- Risk: A function or measure of the consequence of a future event and the chance of that outcome occurring.
    - In the context of aviation safety risk, consequence is primarily a function of the number of people exposed to harm.
    - Probability is a function of many local and system-wide factors and variables.
- Safety Case: A Safety Case is a structured argument, supported by evidence, intended to justify that a system is acceptably safe for a specific application in a specific operating environment (*UK Def. Stan 00-56 Issue 4 (Part 1)*.

The following are standard ICAO definitions (Doc 4444); reproduced here for clarity.

- ATM: Air Traffic Management. The dynamic, integrated management of air traffic and airspace including air traffic services, airspace management and air traffic flow management – safely, economically and efficiently – through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.
- ATS: Air Traffic Service. A generic term meaning variously: flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).
- ATC: Air Traffic Control Service. A service provided for the purpose of:

  a) preventing collisions:

  1. between aircraft, and
  2. on the manoeuvring area between aircraft and obstructions; and

  b) expediting and maintaining and orderly flow of traffic.
- FIR: Flight Information Region. Airspace of defined dimensions in which flight information service and alerting service are provided.
- FIS: Flight Information Service. A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.

1 Executive Summary

This report sets out the New Zealand Aviation System Safety Criteria (ASSC) as developed in mid-2018. These safety criteria are based on those developed in early 2016 but reflect a rapidly evolving understanding of the expected New Zealand aviation system at the planned end of the New Southern Sky (NSS) programme in 2023. It is apparent that some aspects of the national and global aviation environment have been changing rapidly with emerging technologies, particularly relating to unmanned aircraft (UA), creating new opportunities and challenges. In addition, broader global aviation developments and the knowledge gained from two years of NSS work, mean a review of the safety criteria was needed if they were to remain relevant to the changing understanding of the 2023 environment.

The complete set of ASSC should be read and understood in conjunction with the NSS Concept of Operations (CONOPS version 2.0). The CONOPS 2 describes the 2023 New Zealand aviation system in action while the ASSC sets the safety criteria for the system and ensures the NSS programme develops a system that can deliver the safety objectives of the National Airspace and Air Navigation Plan (NAANP). The safety criteria also guide many other areas of Civil Aviation Rules (CAR) assessment, and the development of changes to New Zealand's aviation system associated with NSS.

As this 2018 version of the safety criteria follows the same three-level structure developed in 2016, the criteria set will appear familiar to users. However, while most of the criteria remain essentially unchanged, by building on the knowledge developed in 2016, a revised logical breakdown – particularly for the second level (system level) has been devised. This in turn has resulted in this logic being reflected in the third level (sub-system level). Where changes between the earlier and revised criteria have been made, the rationale for change has been fully recorded as has the rationale for the new criteria.

While a smaller number of Subject Matter Experts (SMEs) have been involved in the 2018 work than in the original 2016 project, considerable effort has gone into ensuring all stakeholder groups have contributed fully to the process and that the thinking behind each 2016 criterion has been fully considered prior to making any change.

During this latest safety criteria development process, it became apparent that a rigorous evaluation of the changing industry would be needed if the new ASSC were to be as relevant and accurate as reasonably possible. To that end, outside the contracted ASSC project scope, the Navigatus project team undertook a high-level Foresight and Strategic Trends Analysis (FaSTA) to enable a rigorous test of the criteria against the future state.

The 2018 criteria map, list of criteria, FaSTA evaluation, rationale for change and detailed ASSC list are presented in this report. A summary of changes between the 2016 and 2018 ASSC are listed below in Table 1 and also in further detail in Table 2.

Table 1: Summary of NSS Safety Criteria (4 parts)

2016 ASSC Goals	2018 ASSC Goals
1. Safety Objectives 2. Principles 3. Assumptions	1. Safety Objectives (*no change*) 2. Principles (*no change*) 3. Assumptions (*as before but with new assumptions added based on advancing insights into developments – see Appendix D2 for existing (2016) and new (2018) assumptions*)
2016 Top-level ASSC	**2018 Top-level ASSC**
1. NZ Alignment with ICAO 2. Current rules 3. Performance monitoring 4. Aviation cooperation for safety 5. Aviation system robustness & resilience 6. Shared safety performance information	1. NZ Alignment with ICAO 2. Regulatory framework 3. Performance monitoring 4. Aviation cooperation for safety 5. Aviation system robustness & resilience
2016 System-level ASSC	**2018 System-level ASSC**
1. Competency of personnel 2. Aeronautical data management 3. Vertical guidance on instrument approaches 4. Straight-in instrument approaches 5. Equipment software	1. Terrestrial Infrastructure (TI) 2. Aircraft Equipage (AE) 3. Air Navigation 4. Software, Data, Information (SD) 5. Human Factors (HF)
2016 Sub-system criteria	**2018 Sub-system criteria**
1. Airspace x 4 2. ATM x 5 3. Comms x 1 4. Conventional means navigation x3 5. PBN x 5 6. Surveillance x 5	1. Terrestrial Infrastructure x 4 2. Aircraft Equipage x 6 3. Air Navigation x 20 4. Software, Data, Information x 5 5. Human Factors x 3

A separate ASSC PowerPoint Slide pack has also been provided to aid communication of the 2018 ASSC and rationale for each.

Navigatus acknowledges the considerable time and energy of the many individuals who contributed during workshops and meetings, and thanks the Ministry of Transport, the CAA, Airways NZ, and NZ Aviation federation for engaging throughout the project and so enabling Navigatus to complete this work.

2 Introduction

2.1 Background and Purpose

The first project to develop aviation safety criteria for the New Southern Sky (NSS) programme was completed by Navigatus in 2016. The criteria are set out in the Navigatus Consulting report titled “Establishment of Aviation System Safety Criteria”, dated 15 April 2016. Since then the safety criteria have been used to guide the projects, workstreams and the Working Group of the NSS Programme. The shared high-level direction provided by the safety criteria has ensured the work of NSS has been consistent with the safety objectives of the NAANP. The safety criteria have also guided many other areas of Civil Aviation Rules (CAR) assessment and the development of changes to New Zealand’s aviation system associated as part of NSS.

The 2016 safety criteria work was based on the understanding of the expected New Zealand aviation system at the end of the NSS Programme in 2023. By early 2018 it became apparent that some aspects of the national and global aviation environment are changing rapidly, with emerging technologies, particularly for UA, creating new opportunities and challenges. In addition, broader global aviation developments, and the knowledge gained from two years of NSS work, meant a review of the safety criteria was needed if the criteria were to remain relevant to the changing understanding of the 2023 environment. Moreover, the NSS working group, stakeholder projects and industry participants continue to require the best and most-relevant guidance for their work and investments.

This report sets out a reworked set of Aviation System Safety Criteria (ASSC) for NSS (Appendix A). As before, they are aligned with National Airspace Policy of New Zealand (2012), the NAANP, and NSS safety objectives and principles. This 2018 version of the safety criteria follows the same three-level structure developed for the 2016 safety criteria so the criteria set will appear familiar to users. However, while many of the criteria remain as before, by building on the knowledge developed in 2016, a revised logical breakdown – particularly for the second level (system level) has been designed. Where changes between the earlier and revised criteria have been made the rationale for change has been recorded (Appendix B).

To direct the development of the 2018 ASSC the project team first identified the known, assumed and predicted changes to the national and global aviation system that had been observed since 2016. During that process it soon became apparent that a deeper, more rigorous evaluation of the changing industry would be needed if the new ASSC were to be as relevant and accurate as reasonably possible. To that end, outside the contracted ASSC project scope, the Navigatus project team undertook a high-level Foresight and Strategic Trends Analysis (FaSTA) to enable a rigorous test of the criteria against the future state. This not insignificant package of work provided what proved to be a valuable foundation on which to test the original ASSC set for relevance to the future state and so identify the need or otherwise for changes to the criterion. A summary of the FaSTA is presented in Appendix C.

While this report sets out the ASSC as developed in 2018, the rapid rate of change that has become evident within the aviation sector in the short period since the development of the

2016 ASSC set is likely to continue and so there would appear to be a need for regular periodic review of the ASSC to keep ahead of change in order to remain relevant.

The separate FaSTA research identified leading global strategic trends and crafted them into short statements that naturally fell into five broad groups. The groups are not exclusive; many of the statements apply across more than one group and are closely interconnected. The FaSTA groups are:

- Unmanned Aircraft – sixteen statements;
- Technology – twelve statements;
- Cyber and Digital – eight statements;
- Human Factors – nine statements;
- Operational Factors – six statements.

As the FaSTA is a separate initiative, only a list of statements as required for the purpose of guiding and informing the review of the ASSC has been prepared for this ASSC report. This approach has allowed the FaSTA work to be succinct and directly relevant to this ASSC project.

3 Development of Aviation System Safety Criteria

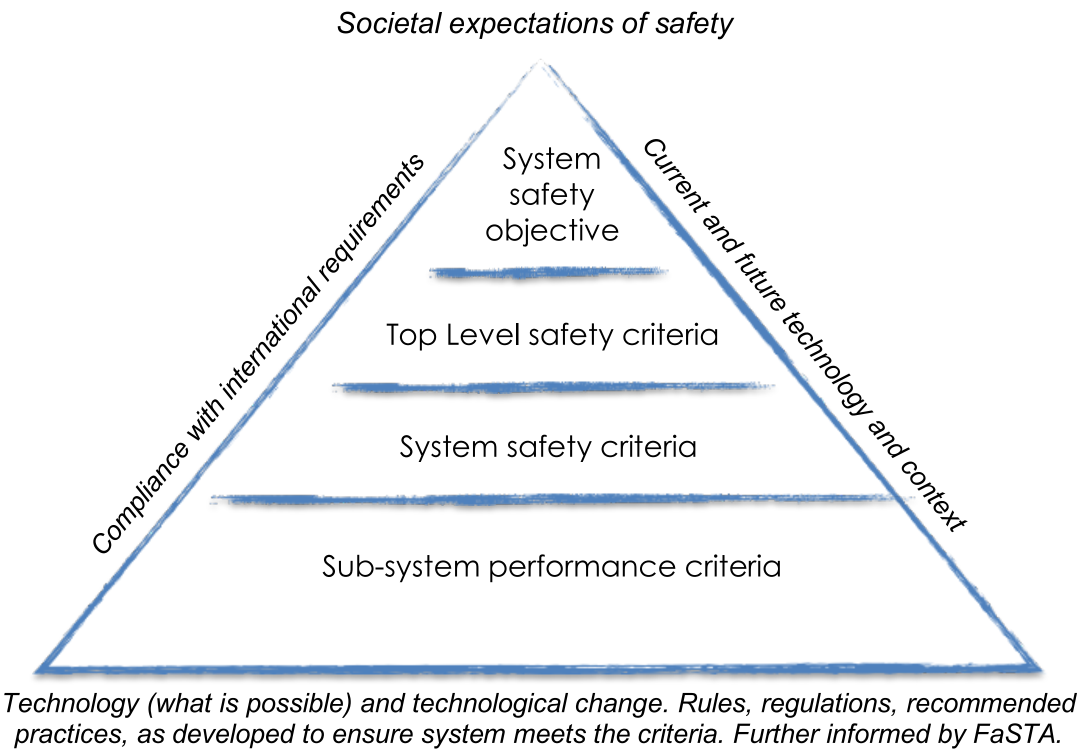
3.1 Overview

The intention for the 2018 ASSC project was to update the safety criteria work of 2016 to ensure relevance to the rapidly developing future state and to provide ongoing direction and guidance in relation to safety for the NSS project work streams.

The structure of the 2016 safety criteria as set out in the Navigatus Report, *Establishment of Aviation System Safety Criteria*, was used as a blueprint for this 2018 work. The first step of the review process determined that, as the original structure had proved sound, and to ensure the 2018 work built on the earlier work, the same overall structure should be retained. This would also allow commonality and comparability between the 2016 and 2018 criteria sets and ensure the criteria in this report more applicable and understandable for end-users who are familiar with the 2016 structure. The full 2018 ASSC set is presented at Appendix A. The project scope and objectives are detailed at Appendix D, while the process and methodology used to review and refresh the ASSC are detailed at Appendix E.

The framework shown at Figure 1 illustrates the philosophy for the original ASSC development – a top-down approach to defining three levels of criterion. This framework was reviewed and as the levels are directed by extant aviation system safety directives it was retained for the 2018 work. The addition of the FaSTA to the 2018 work is reflected in the three statements along the sides of the Figure 1 triangle.

Figure 1. ASSC Philosophy



As stated in the 2016 report, the ASSC are intended to form the essential foundation to ensure safety by informing development decisions as well as subsequent policy and Rules development. The ASSC help to ensure that the risk and impact of each change on the aviation system as a whole is understood and can be managed. This will reduce the likelihood of unexpected or unplanned conditions developing.

The ASSC therefore, form the safety foundation of the aviation system as it is developed. The detailed list of ASSC in Appendix A includes each criterion statement with the relevant threats and supporting rationale.

3.2 Structure

The structure for the criteria remain as for the 2016 work, namely three levels;

- Top Level
- System Level
- Sub-system Level

Each level is described below with the resulting differences between the 2016 and 2018 ASSC within each level summarised in Table 2. It can be seen from this that the 2018 ASSC levels two and three have been renamed. This is to assist usability and allow stakeholders to more easily follow the interconnections and relationships as these may apply to their decision and system context.

3.2.1 Top Level

The Top-Level ASSC (Level 1) lie directly beneath the National strategic safety statements and apply to the whole New Zealand aviation system. If properly defined, Top-Level ASSC should change little over time with only slight adjustments to ensure full coverage of the ever-evolving and expanding aviation system. The main change made to the Top-Level ASSC from 2016 was essentially a refinement of two criteria; *Aviation cooperation for safety* and *Shared safety performance information* have now been combined into one criterion.

3.2.2 System Level

System Level (Level 2) ASSC also apply to the whole aviation system but are those specific to the NSS Programme context. For 2018 the Level 2 ASSC were re-worked into five main categories under which the Level 3 ASSC were grouped. This change has allowed a stronger logical hierarchy that forms a framework for the Level 3 criterion groupings.

3.2.3 Sub-system Level

The Sub-system (Level 3) ASSC align directly with the new Level 2 criteria. While many of the 2018 Level 3 ASSC statements are the same or very similar to the 2016 set, a number of 2016 criteria were deleted and replaced by new or revised criteria. A number of new criteria were also added to ensure the scope fully captures the expanding aviation system, new technologies and widening user base. The terms used for the groupings were also modified. While the total number of Level 3 criteria has therefore expanded from 22 to 38, users should find the tighter logical basis for the groupings simple to follow.

Table 2: Comparison summary: 2016 ASSC to 2018 ASSC

ASSC Version	Top-level ASSC	System-level ASSC	Sub-system criteria
2016 ASSC	1. NZ Alignment with ICAO 2. Current rules 3. Performance monitoring 4. Aviation cooperation for safety 5. Aviation system robustness & resilience 6. Shared safety performance information	1. Competency of personnel 2. Aeronautical data management 3. Vertical guidance on instrument approaches 4. Straight-in instrument approaches 5. Equipment software	1. Airspace x 4 2. ATM x 5 3. Comms x 1 4. Conventional means navigation x3 5. PBN x 5 6. Surveillance x 5
2018 ASSC	1. NZ Alignment with ICAO 2. Regulatory framework 3. Performance monitoring 4. Aviation cooperation for safety 5. Aviation system robustness & resilience	1. Terrestrial Infrastructure (TI) 2. Aircraft Equipage (AE) 3. Air Navigation (AN) 4. Software, Data, Information (SD) 5. Human Factors (HF)	1. TI x 4 2. AE x 6 3. AN x 20 4. HF x 3 5. SD x 5

3.3 Applying the ASSC

While each of the criterion statements stand alone, based on relevance and evidenced by supporting rationale, many of the ASSC are tightly interconnected. The relationships between the criterion statements are too complex to represent in a network diagram and table. Instead, users should digest and understand the full set of criteria so that interconnections and relationships can be identified depending on the needs and context of each particular user. The categories of the Level 2 and Level 3 statements are not exclusive and do not specifically relate to different users: all users should be able to deduce which criterion statements relate to their interests, requirements and responsibilities. For this reason, the criterion statements are crafted to include rather than exclude users.

Where there are particularly close interrelationships between ASSC, they are presented in a logical progressive sequence. For example: Air Navigation (AN) 1-4 are a close sequence of criterion statements that both stand alone and successively build on the previous criterion. How these statements will be considered and applied will differ according to the user. An Air Navigation Service Provider (ANSP) will naturally interpret these criteria as they relate to ATS and ATM systems, while an aviation organisation may interpret the criteria in terms of operational equipage and fuel efficiency.

The ASSC are intended to be relevant to as many stakeholders and users as possible and have not been crafted to serve the needs of any particular development context. This is to ensure relevance to all stakeholders, users and decision contexts.

By way of example; an aviation stakeholder considering a system development would first inspect the ASSC to identify each that is relevant to the system and its use. These criteria would then be applied to each development decision or used as a benchmark or tests of the options being considered. In doing so they will also need to develop an understanding of the relationships between the applicable criterion within the context of the development.

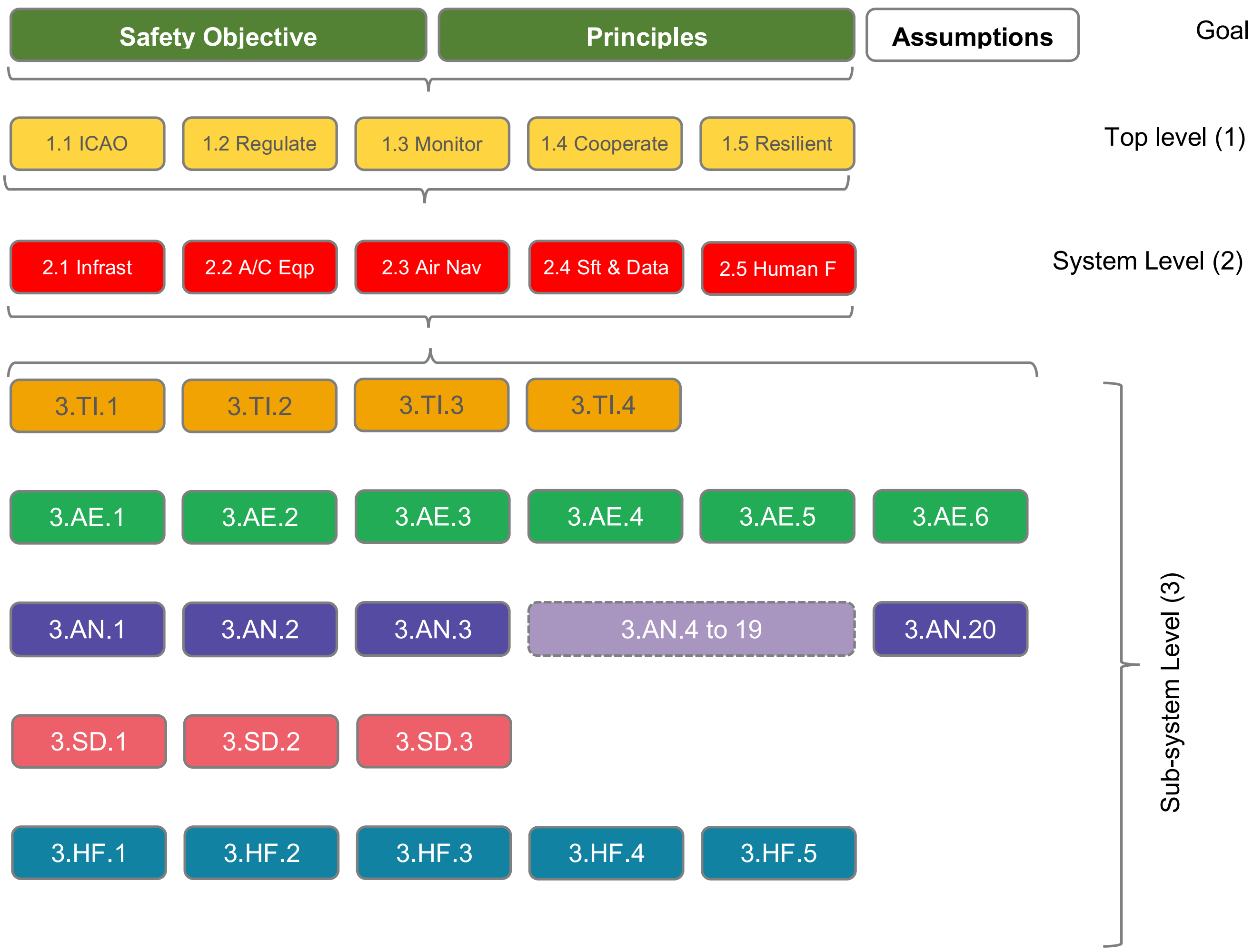
So, for example, a stakeholder considering the process of switching from the normal mode of system navigation to a recovery mode may identify the following criteria as being directly applicable to inform and guide their decision making:

- Top level: 1.5 (Aviation system robustness and resilience);
- System level: 2.2, 2.3, 2.4 (Aircraft Equipage, Air Navigation, Human Factors);
- Level 3: TI.3 (Terrestrial Infrastructure reliability and resilience);
- Level 3: AE.1, AE.2, AE.3, AE.6 (PBN cap, Non PBN cap, Contingency, Surv equip),
- Level 3: AN.10, AN.11, AN.12, AN.14, AN.15, AN.16 (GNSS, Non GNSS, MON etc),
- Level 3: HF.1, HF.2, HF.4 (Training, Competency, Human fallibility).

4 Aviation System Safety Criteria 2018

4.1 ASSC MAP (2018)

The ASSC map below uses the same structure to the ASSC map in the 2016 report. This will allow users to make direct comparisons between the 2016 and 2018 maps if and as required. A revised colouring scheme has been used in the 2018 map.



4.2 List of ASSC: Title and criterion statement

Top Level Criteria

01 Top Level Criteria	
1.1	**NZ Alignment with ICAO**
	NZ's aviation system and its constituent elements will be based on the relevant ICAO standards, recommended practices and documents (when available). Alternatives and variations will be tested to ensure safety is maintained in the New Zealand environment.
1.2	**Regulatory Framework**
	The regulatory requirements of the NZ Civil Aviation Act and Rules will apply.
1.3	**Performance Monitoring**
	The performance of the aviation system is monitored and assessed against the applicable requirements.
1.4	**Aviation Cooperation for Safety**
	All stakeholders in the aviation system shall work cooperatively and share safety information to ensure their elements and the overall system operates safely and holistically.
1.5	**Aviation System Robustness and Resilience**
	The aviation system must be robust and resilient in order to safely respond to events and disruptions.

System Level Criteria

02 System Level Criteria	
2.1	**Terrestrial Infrastructure**
	All terrestrial infrastructure covered by aviation regulation (including facilities, airports, operating surfaces, ground-based navigation and surveillance structures etc.) shall be compliant and suitable for the required purpose.
2.2	**Aircraft Equipage**
	Aircraft Equipment performs in accordance with required regulatory standards and is compatible with the aviation system.
2.3	**Air Navigation**
	The ATM, airspace design and air navigation architecture systems, processes and capacity shall provide for the safe and efficient operation of current and future approved airspace users.
2.4	**Software, Data, Information**
	NZ's aviation system and its constituent elements will be based on the relevant ICAO standards, recommended practices and documents (when available).
2.5	**Human Factors**
	All aspects of system design shall aim to protect against human fallibility and maximise human capability.

Sub-system Level Criteria - Terrestrial Infrastructure

03 Sub-System Criteria	
Terrestrial Infrastructure	
3.TI.1	**Aerodrome**
	The suitability and safety of an aerodrome should be assessed and maintained as appropriate for the nature of intended operations.
3.TI.2	**Non-Aerodrome Terrestrial Infrastructure**
	The suitability and safety of non-aerodrome terrestrial infrastructure should be assessed and maintained as appropriate for the nature of intended operations.
3.TI.3	**Reliability and Resilience**
	Physical infrastructure associated with aviation facilities is designed, constructed and maintained to meet the reliability and resilience needs of the aviation system.
3.TI.4	**Compliance**
	Aviation infrastructure should be designed, constructed and maintained in accordance with all relevant compliance requirements.

Sub-system Level Criteria – Aircraft and Equipment

03 Sub-System Criteria	
Aircraft and Equipment	
3.AE.1	**PBN Navigation Capability**
	All aircraft navigating to Performance Based Navigation (PBN) standards are to be equipped with a functioning non-GNSS navigation system sufficient to allow safe navigation to an appropriate recovery aerodrome.
3.AE.2	**Non-PBN GNSS Navigation Capability**
	All aircraft navigating using GNSS not performing to PBN standards are to be equipped with an alternative means of navigating safely to a safe operating surface.
3.AE.3	**Contingency Operations Following Loss of PBN**
	Aircraft using the contingency network following loss of PBN capability should be equipped with a means of navigating safely.
3.AE.4	**New Entrant Integration**
	UA and other new participants or users must be equipped to integrate safely into the existing aviation system.
3.AE.5	**Communication Equipment**
	Aircraft shall have sufficient communication equipment for the class and designation of airspace in which they are operating and to support safe integration into the aviation system.
3.AE.6	**Surveillance Equipment**
	To enable the required level of ATM, aircraft must have suitable equipment to integrate into the surveillance system for the airspace in which it is operating.

Sub-system Level Criteria – Air Navigation

03 Sub-System Criteria	
Air Navigation	
3.AN.1	**Airspace Design Complexity**
	Airspace design and procedures are optimised to minimise complexity.
3.AN.2	**Strategic Level Airspace Design**
	Airspace and associated procedures are designed to a strategic airspace plan and take account of stakeholder needs and capabilities.
3.AN.3	**Performance Based Procedures**
	Performance based (PBN) procedures are preferred for normal IFR operations.
3.AN.4	**Airspace is designed to realise the safety benefits of PBN**
	Airspace design realises safety benefits of PBN procedures for IFR taking account of aircraft and on ground constraints, and consideration of VFR operations.
3.AN.5	**Approach Design**
	All instrument approaches must be designed to be as efficient as practical while maximising safety as assessed on available evidence.
3.AN.6	**Airspace Designed to Accommodate all Users**
	Airspace design shall ensure all users can be safely accommodated, taking account of aircraft and on-ground constraints.
3.AN.7	**Surveillance System**
	There must be a suitable surveillance system to enable the required level of ATM.
3.AN.8	**Cooperative surveillance system**
	A cooperative surveillance system must be provided in controlled airspace where a surveillance service is required.
3.AN.9	**Non-Cooperative Surveillance**
	Controlled Airspace with a high density of regular passenger air transport must have a non-cooperative surveillance system enabling separation from unidentified traffic.

3.AN.10	**Non-GNSS Cooperative Surveillance Capability**
	There must be a non-GNSS-dependent cooperative surveillance capability to enable ATM for recovery and contingency operations in the event of the loss of the GNSS-dependent cooperative surveillance capability.
3.AN.11	**GBNA coverage for aircraft recovery using the MON**
	There will be GBNA coverage to provide a minimum operational network (MON) for safe recovery and contingency operations of aircraft if GNSS navigational capability is not possible.
3.AN.12	**Re-establishment of Navigation Capability Following Loss of GNSS**
	Aircraft flying to PBN standards and out of GBNA coverage are to be able to continue safe flight in order to re-establish their navigation capability to enable recovery, and as required, contingency operations following loss of GNSS navigation.
3.AN.13	**GBNA coverage for contingency operations**
	There will be GBNA coverage to enable contingency operations.
3.AN.14	**GBNA Instrument Approach and Departure Procedures**
	Aerodromes equipped with GBNA are to have at least one suitable GBNA instrument approach and departure procedure (not including ILS) for each instrument runway end where practicable. The procedures should be published.
3.AN.15	**Air Traffic Management System Capability and Capacity**
	The Air Traffic Management system shall have the capability and capacity to manage the density and complexity that can be reasonably envisaged during normal, disruption, recovery and contingency operations.
3.AN.16	**ATM Reliability and Resilience**
	ATM, including internal and external networks, should be resilient enough to ensure effective traffic management in normal, disruption, recovery and contingency operations.
3.AN.17	**ATS Procedures for non-normal situations**
	ATS shall publish procedures for foreseeable non-normal events.
3.AN.18	**ATC Access to Meteorological Information**
	Significant meteorological information shall be available and integrated with ATS and ATM.
3.AN.19	**GNSS Performance and Integrity Monitoring**
	Users of the aviation system that rely on GNSS shall confirm and monitor performance and availability of the GNSS service for the duration of the operation.
3.AN.20	**ATS Communications**
	ATS shall have sufficient communication systems available to ensure continuity of communication with aircraft.

Sub-system Level Criteria – Software, Data, Information

03 Sub-System Criteria	
Software, Data, Information	
3.SD.1	**Data Management**
	Any aeronautical data used in the aviation system shall be current, digital where practicable, from a certified source where appropriate, accessible and to required information standards.
3.SD.2	**Software Assurance**
	Software utilised in the aviation system is to be developed, tested and be maintained to the correct system certified status and be protected from interference.
3.SD.3	**Information Management**
	Aeronautical information must be accessible, usable, managed and correct.

Sub-system Level Criteria – Human Factors

03 Sub-System Criteria	
Human Factors	
3.HF.1	**Training of Personnel**
	People participating in the aviation system are to be trained and qualified to the level appropriate for the role they will perform for both normal and contingency operations.
3.HF.2	**Competency of Personnel**
	All people participating in the aviation system must be competent in the skills required for their role including both normal and contingency operations.
3.HF.3	**Human Systems Interface**
	The design of equipment that is to be used by people operating in the aviation system should optimise human performance and minimise the likelihood and consequence of human error.
3.HF.4	**Human Fallibility and Bias**
	The design of the aviation system should recognise human fallibility and biases and be configured to minimise the likelihood and consequences from them.
3.HF.5	**Fatigue Risk Management**
	All people performing safety critical roles or functions in the aviation system should fall under an appropriate fatigue risk management framework.

Appendices

Appendix A Detailed Description of ASSC (Supporting Assumptions at Appendix D)

01

Top Level Criteria

1.1 NZ Alignment with ICAO

CRITERION: NZ's aviation system and its constituent elements will be based on the relevant ICAO standards, recommended practices and documents (when available). Alternatives and variations will be tested to ensure safety is maintained in the New Zealand environment.

THREAT: Incompatibility with international equipage and standards, infrastructure and operations.

RATIONALE:

- NZ aviation policy includes adherence to ICAO standards, recommended practices and documents, as described through the ICAO publications. Variations are permitted, but must be supported by a Safety Case acceptable to the CAA, setting out how an equivalent or better level of overall system safety is achieved.
- NZ seeks to benefit from international knowledge and experience.
- International and national interoperability of operations, equipment and practices.
- Elements will be informed by ICAO guidance and other international best practice.

TYPE: Interoperability, System Design, Infrastructure

MAIN SUPPORTING ASSUMPTIONS: GEN 2

1.2 Regulatory Framework

CRITERION: The regulatory requirements of the NZ Civil Aviation Act and Rules will apply.

THREAT: Conflict with existing aviation system.

RATIONALE:

- The aviation regulatory framework shall provide for safe aviation in NZ and apply to all parts of the system.
- Any proposed change to the aviation system should consider NSS Safety Criteria and may inform rule changes through the normal rule making process.
- Emerging technologies may require regulatory discretion and agility.
- Activities within the aviation system may require compliance with other New Zealand legislation and international rules adopted by New Zealand.
- The regulatory system shall have sufficient agility to match the changing nature of the industry. This includes the ability to make new rules.
-

TYPE: Procedure, System Design, Infrastructure, Human Factors

MAIN SUPPORTING ASSUMPTIONS: GEN 1

01

Top Level Criteria

1.3 Performance Monitoring

CRITERION: The performance of the aviation system is monitored and assessed against the applicable requirements.

THREAT: Actual performance does not meet required and assumed performance.

RATIONALE:

- The performance of the aviation system should be monitored to ensure it meets the standards.
- Assure ourselves the system will be/is safe.

Note: Degraded performance may not be readily apparent.

TYPE: Interoperability, System Design, Procedure.

MAIN SUPPORTING ASSUMPTIONS: N/A (Inherent in performance based philosophy)

1.4 Aviation Cooperation for Safety

CRITERION: All stakeholders in the aviation system shall work cooperatively and share safety information to ensure their elements and the overall system operates safely and holistically.

THREAT: Poor cooperation results in the system not being as safe as it could be and opportunities for improvement are missed.

RATIONALE:

- The aviation system consists of interoperating elements.
- The requirement to communicate system changes between stakeholders (including participants). This requires cooperation at the strategic, tactical and operational level.
- If each stakeholder considers only the safety of their element, overall system safety may not be achieved. A system wide view of safety is essential to enable pre-emptive interventions.
- Safety information needs to be shared system wide, not just by function to give fully featured picture and account for interdependences.
- Aligns to ISO 31000 Risk Management - Principles and guidelines; including that effective risk management is part of decision making, is based on best available information and is transparent and inclusive.

TYPE: Interoperability, System Design, Procedure, Data, Infrastructure HF.

MAIN SUPPORTING ASSUMPTIONS: GEN 4

01

Top Level Criteria

1.5 Aviation System Robustness and Resilience

CRITERION: The aviation system must be robust and resilient in order to safely respond to events and disruptions.

THREAT: Events and disruption undermine system capability, safety and performance.

RATIONALE:

- The system includes infrastructure, personnel and procedures. It must be able to protect against and respond to events, disruptions and failures with the aim of maintaining safety.
- The aviation system should be adequately resourced.
- Contingency operations must achieve an acceptable level of safety through appropriate mitigations.

TYPE: Infrastructure, Procedure, Interoperability, System Design.

MAIN SUPPORTING ASSUMPTIONS: N/A. Essential requirement to maintain system safety.

02

System Level Criteria

2.1 Terrestrial Infrastructure

CRITERION: All terrestrial infrastructure covered by aviation regulation (including facilities, airports, operating surfaces, ground based navigation and surveillance structures etc.) shall be compliant and suitable for the required purpose.

THREAT: Reduced resilience, aviation and public safety due to inadequate or non-compliant aviation terrestrial infrastructure.

RATIONALE:

- The physical infrastructure must fulfil its required purpose.
- Designed, constructed, operated and maintained to required standards.
- Required level of system safety is delivered in part through appropriate system safety design standards.

Note that remote pilot stations may have physical infrastructure associated with them.

TYPE: Infrastructure, Interoperability, System Design, Human Factors.

MAIN SUPPORTING ASSUMPTIONS:

2.2 Aircraft Equipage

CRITERION: Aircraft Equipment performs in accordance with required regulatory standards and is compatible with the aviation system.

THREAT: Equipment failure, Incompatibility, Substandard performance.

RATIONALE:

- Meet compliance and the applicable level of safety.
- Suitable for the air navigation, communication and surveillance architecture in normal and reversionary modes.
- Address resilience in degraded performance.
- Required level of system safety is delivered in part through appropriate system design and equipage capability and performance.

Note 1: Equipage may be remote.

Note 2: Includes installed hardware, firmware and software.

Note 3: Regulatory system will define the actual standards and level of performance.

TYPE: Equipage, Human Factors, System Design, Data.

MAIN SUPPORTING ASSUMPTIONS:

02

System Level Criteria

2.3 Air Navigation

CRITERION: The ATM, airspace design and air navigation architecture systems, processes and capacity shall provide for the safe and efficient operation of current and future approved airspace users.

THREAT: Compromised safety due to system design weaknesses, component failures, failures of supporting or critical systems, or lack of capacity. Airspace design does not meet the needs of users.

RATIONALE:

- Should possess an appropriate level of system integrity, redundancy and resilience to ensure operational safety and recovery.
- System failures should not lead to unacceptable safety situations.
- Adequate resilience to allow an acceptable minimum level of operations.
- Airspace design should allow safe recovery of aircraft following unintended events.
- Airspace design may need to adapt to best enable efficient use of the system to reflect industry changes.
- Required level of system safety is delivered in part through fully integrating all elements of the system and meeting standards.

Note: Air Traffic Management; the dynamic, integrated management of air traffic and airspace including air traffic services, airspace management and air traffic flow management – safely, economically and efficiently – through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.

TYPE: Human Factors, System Design, Interoperability, Procedure, technology.

MAIN SUPPORTING ASSUMPTIONS:

02

System Level Criteria

2.4 Software, Data, Information

CRITERION: NZ's aviation system and its constituent elements will be based on the relevant ICAO standards, recommended practices and documents (when available).

THREAT: Essential data not available, incorrect data used, misunderstanding of aeronautical data, errors in data or software system functionality. Intentional corruption of data/software.

RATIONALE:

- Aeronautical data and software systems are essential elements of the aviation system and users need ready access to approved information.
- The system interfaces must enable data to be readily understood by users to promote correct and safe decision making.
- Errors in data, firmware and software may not be apparent.
- Incorrect or corrupt data could lead to threats or errors with significant consequences.
- Digital navigation equipment needs firmware and software to run correctly as certified.
- Data and information should be digital where practicable and; appropriate, adequate, comprehensive, complete and fit for the intended purpose.
- Meeting appropriate software, data and information design standards is a critical component for delivery of system safety.

TYPE: Data, System Design, Human Factors, Interoperability, Equipage, Cyber and Digital.

MAIN SUPPORTING ASSUMPTIONS:

02

System Level Criteria

2.5 Human Factors

CRITERION: All aspects of system design shall aim to protect against human fallibility and maximise human capability.

THREAT: Compromised safety due to human error, bias, competence or behaviour caused by the design, human interface or operation of systems.

RATIONALE:

- Human error can affect every stage from system design through to system operation.
- The design of Human System Interface (HSI) remains a major cause of safety events.
- System design should minimise potential human error and promote performance.
- New, changing and evolving systems create conditions for human factors risk. Change management should include consideration of unintended consequences.
- Optimising human performance is a key component to enable and deliver the required level of system safety.
- The spectrum of human behaviours and capabilities should be considered.
- New technology may increase the distance from the human to the machine or system.

Note 1: some behaviour may not be well intentioned.

Note 2: System design also includes applicable industry standards.

TYPE: Human Factors, System Design, Procedure.

MAIN SUPPORTING ASSUMPTIONS:

03TI

Sub-System Level Criteria

3.TI.1 Aerodrome

CRITERION: The suitability and safety of an aerodrome should be assessed and maintained as appropriate for the nature of intended operations.

THREAT: Aerodrome unsuitable for intended operations.

RATIONALE:

- Emerging technologies will require a variety of aerodromes and operating surfaces.
- Some Unmanned Aircraft (UA) may require specific aerodrome design.

Note1: An aerodrome is the defined area on land or water including buildings, installations and equipment intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Note2: This criterion includes UA and rocket activity inside the CAA regulatory framework.

TYPE: Procedure, Infrastructure, System Design.

MAIN SUPPORTING ASSUMPTIONS: N/A

3.TI.2 Non-Aerodrome Terrestrial Infrastructure

CRITERION: The suitability and safety of a non-aerodrome terrestrial infrastructure should be assessed and maintained as appropriate for the nature of intended operations.

THREAT: Supporting infrastructure unsuitable for intended operations.

RATIONALE:

- Emerging technologies will require a variety of infrastructure and operating surfaces.
- Some UA may require specific infrastructure design.
- This includes non-aerodrome facilities, ground based navigation and surveillance structures.

Note1: Remote aerodrome ATC may be located at a non-aerodrome location.

Note2: Doesn't exclude operation of any aircraft. Includes rocket activity inside the CAA regulatory framework.

TYPE: Procedure, Infrastructure, System Design.

MAIN SUPPORTING ASSUMPTIONS: N/A

03TI

Sub-System Level Criteria

3.TI.3 Reliability and Resilience

CRITERION: Physical infrastructure associated with aviation facilities is designed, constructed and maintained to meet the reliability and resilience needs of the aviation system.

THREAT: Loss of critical services.

RATIONALE:

- The CNS system should meet its defined design performance capability including for accuracy, detection rate integrity and system resilience.
- Aviation infrastructure requires adequate integrity, availability, and reliability.
- Physical infrastructure should support the continuity of operations and services.
- The security and integrity of infrastructure, and it's ability to withstand natural disasters should meet the availability needs of aviation continuity.

Note: The NZ aviation system is a key component of national infrastructure and resilience that falls within the National Security System.

TYPE: Infrastructure, System Design, technology.

MAIN SUPPORTING ASSUMPTIONS: SUR 3, COM 3

3.TI.4 Compliance

CRITERION: Aviation infrastructure should be designed, constructed and maintained in accordance with all relevant compliance requirements.

THREAT: Reduction in safety, reduced service or sub-standard performance from loss of system availability or due to non compliance or failure.

RATIONALE:

- Including but not limited to New Zealand earthquake, environmental, material and other building codes etc.
- Includes international rules adopted by New Zealand.
- Where there is no applicable regulation, applicable standards should be followed.
- Required level of system safety is delivered through appropriate system safety design standards.

Note: non-compliance may in itself present a risk to occupants.

TYPE: Procedure, Infrastructure, System Design.

MAIN SUPPORTING ASSUMPTIONS:

03AE

Sub-System Level Criteria

3.AE.1 PBN Navigation Capability

CRITERION: All aircraft navigating to PBN standards are to be equipped with a functioning non-GNSS navigation system sufficient to allow safe navigation to an appropriate recovery aerodrome.

THREAT: Loss of GNSS (full, partial or aircraft system).

RATIONALE:

- Provides alternative navigation in the event of the loss of GNSS navigation capability.
- Provides alternative navigation if suitably equipped and supported by infrastructure such as GBNA and/or equipment such as IRU.

Note: A non-GNSS (back up) surveillance system may not replicate the ADS-B system coverage area for recovery operations.

TYPE: Equipage, Infrastructure, Human Factors.

MAIN SUPPORTING ASSUMPTIONS: AN 5, AN 6, EQI 1, EQI 3, NAV 1, NAV 3, NAV 4, NAV 5, NAV 6, NAV 9, GEN 7.

3.AE.2 Non-PBN GNSS Navigation Capability

CRITERION: All aircraft navigating using GNSS not performing to PBN standards are to be equipped with an alternative means of navigating safely to a safe operating surface.

THREAT: Inability to navigate due to loss of GNSS (full, partial or aircraft).

RATIONALE:

- Safe navigation includes consideration of other aircraft, passenger and crew and public and property.
- Provides alternative navigation in the event of the loss of GNSS navigation capability.
- Provides alternative navigation if suitably equipped and supported by infrastructure or equipment.

Note1: public safety is an outcome of reduced impact force.

TYPE: Equipage, Infrastructure, Human Factors

MAIN SUPPORTING ASSUMPTIONS:

03AE

Sub-System Level Criteria

3.AE.3 Contingency Operations Following Loss of PBN

CRITERION: Aircraft using the contingency network following loss of PBN capability should be equipped with a means of navigating safely.

THREAT: Reduced safety due to loss of means of navigation

RATIONALE:

- Safe navigation includes consideration of other aircraft, passenger and crew and public and property.
- Requires aircraft operating on the contingency network after the loss of GNSS navigation to have the capability to navigate to an accuracy appropriate to the operation.
- Provides contingency navigation if suitably equipped for conventional means.

Note1: A non-GNSS (back up) surveillance system may not support contingency operations.

TYPE: Equipage, Infrastructure, Human Factors.

MAIN SUPPORTING ASSUMPTIONS:

3.AE.4 New Entrant Integration

CRITERION: UA and other new participants or users must be equipped to integrate safely into the existing aviation system.

THREAT: New entrants reducing overall system safety.

RATIONALE:

- The system can only be safe if all participants or users are integrated into the existing system.
- Integration includes an ability avoid other aircraft.
- New users are likely to stimulate development of routing strategies.
- It is anticipated that new users may require new technologies to comply with the rules of the air and the class of airspace in which they are operating

Note 1: the existing system refers to the aviation system at the time of entry to the aviation system.

Note 2: Integration does not mean replication of current capabilities.

Note 3: This area is under development and will be risk and performance based.

TYPE: Equipage, Infrastructure, technology, cyber & digital, interoperability.

MAIN SUPPORTING ASSUMPTIONS:

03AE

Sub-System Level Criteria

3.AE.5 Communication Equipment

CRITERION: Aircraft shall have sufficient communication equipment for the class and designation of airspace in which they are operating and to support safe integration into the aviation system.

THREAT: Direct hazard or prevention of safe integration caused by communication failure or inadequate equipment performance.

RATIONALE:

- Reliable and effective primary and secondary communication is an essential requirement for safe integration.

Note 1: This includes conventional and UA command and control communication systems.

Note 2: VHF is the primary means of communication for manned aircraft.

Note 3: Other means of communication would need to achieve an acceptable measure of performance for that operation.

Note 4: The operation will determine the level of communication required.

Note 5: the operation may be influenced by the integrity of the communications available.

TYPE: Equipage, Infrastructure, Human Factors, System Design, Cyber and Digital, Technology.

MAIN SUPPORTING ASSUMPTIONS:

3.AE.6 Surveillance Equipment

CRITERION: To enable the required level of ATM, aircraft must have suitable equipment to integrate into the surveillance system for the airspace in which it is operating.

THREAT: Loss of ATC/ATM track and conflict management reducing overall system safety.

RATIONALE:

- ADS-B includes mode S: this is required for the contingency surveillance system.

Note1: ADS-B is mandated above FL245 and at the time of writing is proposed to be mandated in controlled airspace.

Note2: Exemptions may be issued provided the required level of ATM is achieved.

Note 3: At the time of writing, it is unknown whether there will be different classifications of airspace and what the surveillance equipage requirements will be.

TYPE: Equipage, Infrastructure, system design, Technology.

MAIN SUPPORTING ASSUMPTIONS:

3.AN.1 Airspace Design Complexity

CRITERION: Airspace design and procedures are optimised to minimise complexity.

THREAT: Complexity affects human performance at design and operational levels, leading to reduced safety.

RATIONALE:

- Overly complex airspace design and procedures add risk to the aviation system and increase the likelihood of threats and errors.
- Incremental changes over time increase complexity. Whole-of-system design will allow for an overall view of airspace and procedures. Airspace design changes should consider the whole system, rather than just one change or area.

Note 1: Examples of instrument flight procedure (IFP) design to reduce complexity include; minimising crossing paths and restriction of altitude changes to low complexity areas where possible.

Note 2: VFR operations will remain a significant element of aircraft operations in NZ. VFR operators need to be confident that their needs have been considered. Suitable allocation of airspace should promote safety of VFR operations.

Note 3: To optimise complexity, a strategic design approach will ensure all stakeholder needs are considered, moderated and incorporated as appropriate.

TYPE: Procedure, system design, Human Factors, Interoperability.

MAIN SUPPORTING ASSUMPTIONS: GEN 4, AIR 1

03AN

Sub-System Level Criteria

Part 1

3.AN.2 Strategic Level Airspace Design

CRITERION: Airspace and associated procedures are designed to a strategic airspace plan take account of stakeholder needs and capabilities.

THREAT: Reduced safety due to a mismatch between capability and design

RATIONALE:

- Strategic level design approach will allow for an overall view of airspace and procedures; Airspace design needs to consider the whole system, rather than just one change or area.
- Strategic level design approach to ensure all stakeholder needs are considered and incorporated as appropriate.
- Adequate number of alternate aerodromes are suitable equipped and are available to support the various operational modes of the aviation system
- Strategic design should moderate and balance the needs and capabilities of all users.

Note: Change should be explicitly assessed through regulatory impact statements.

TYPE: Procedure, System Design, Interoperability

MAIN SUPPORTING ASSUMPTIONS: GEN 4, AIR 1,

03AN

Sub-System Level Criteria

Part 1

3.AN.3 Performance Based Procedures

CRITERION: Performance based (PBN) procedures are preferred for normal IFR operations.

THREAT: Mismatch in procedure design and airspace design. PBN and non-PBN separation standards.

RATIONALE:

- Airspace and instrument flight procedure design should be planned together to ensure efficient use of air space
- Procedure design and airspace design should allow ATC capacity to match the airspace complexity and level of risk.
- PBN and non-PBN procedures/routes may be different, with PBN waypoints unlikely to align with GBNA locations; airspace design needs to accommodate both types of procedures/routes.
- VFR operations will remain a significant element of aircraft operations in NZ. VFR operators need to be confident that their needs have been considered. Suitable allocation of airspace should promote safe VFR operations.

Note: On-ground constraints include terrain, noise sensitive areas, obstacles, Special Use Airspace and airspace boundary definitions.

TYPE: System Design, Procedure.

MAIN SUPPORTING ASSUMPTIONS: GEN 2, NAV 6, EQI 4.

3.AN.4 Airspace is designed to realise the safety benefits of PBN

CRITERION: Airspace design realises safety benefits of PBN procedures for IFR taking account of aircraft and on ground constraints, and consideration of VFR operations.

THREAT: Mismatch in procedure design and airspace design. PBN and non-PBN separation standards.

RATIONALE:

- Airspace design should ensure there is sufficient space for all PBN routes and instrument flight procedures planned.
- Procedure design and airspace design should allow ATC capacity to match the airspace complexity and level of risk.
- PBN and non-PBN procedures/routes may be different, with PBN waypoints unlikely to align with GBNA locations; airspace design needs to accommodate both types of procedures/routes.
- VFR operations will remain a significant element of aircraft operations in NZ. VFR operators need to be confident that their needs have been considered. Suitable allocation of airspace should promote safe VFR operations.

Note: On ground constraints include terrain, noise sensitive areas, obstacles, Special Use Airspace and airspace boundary definitions.

TYPE: System Design, Procedure.

MAIN SUPPORTING ASSUMPTIONS:
GEN 2, NAV 6, EQI 4.

03AN

Sub-System Level Criteria

Part 1

3.AN.5 Approach Design

CRITERION: All instrument approaches must be designed to be as efficient as practical while maximising safety as assessed on available evidence.

THREAT: Collision with terrain, unstable approach.

RATIONALE:

- Studies on the effect of straight in approaches have been shown to increase the safety margin by a factor of 25 compared to a circling approach (FSF European Advisory Committee Draft Edition 24 Jan 11).
- Instrument approaches with vertical guidance provide an effective aid to maintaining the correct vertical path and an excellent mitigation against collision with terrain
- Studies on the effect of some form of vertical guidance on instrument approaches have been shown to increase the safety margin by a factor of 8 (FSF European Advisory Committee Draft Edition 24 Jan 11)
- Consideration of SBAS, GBAS and Baro-VNAV – as far as reasonably practicable.

TYPE: Procedure, System Design, Human Factors.

MAIN SUPPORTING ASSUMPTIONS: N/A

3.AN.6 Airspace Designed to Accommodate all Users

CRITERION: Airspace design shall ensure all users can be safely accommodated taking account of aircraft and on-ground constraints.

THREAT: Reduced safety caused by the design of airspace not adequately catering for the requirements and capabilities of users.

RATIONALE:

- Airspace needs to accommodate a wide variety of users safely.
- Significant complexity in the range of aircraft capabilities.
- Considered airspace allocation should encourage safe practices.
- Controlled airspace design should provide containment of IFR routes/ procedures only to the minimum extent necessary so as to facilitate safe operations by other users.

Note 1: While the design will allow all user types, other constraints may mean it is not possible to accommodate all users in a given airspace block. However, the needs of all potential users should be met so far as is reasonably practicable.

Note 2: On ground constraints include terrain, noise sensitive areas, obstacles, Special Use Airspace and airspace boundary definitions.

TYPE: System Design, complexity.

MAIN SUPPORTING ASSUMPTIONS: GEN 4, AIR 1, NAV 5, NAV 6, NAV 7

03AN

Sub-System Level Criteria

Part 1

3.AN.7 Surveillance System

CRITERION: There must be a suitable surveillance system to enable the required level of ATM.

THREAT: Loss of separation in controlled airspace or airborne conflict outside controlled airspace

RATIONALE:

- Fully effective ATM is not possible without a surveillance system.
- The requirement for a surveillance system is based on factors such as density and complexity.
- The surveillance system comprises all components of surveillance, including, but not limited to, infrastructure and aircraft systems.

Note: Other criteria address required levels of resilience.

TYPE: Procedure, Infrastructure, Technology, system design.

MAIN SUPPORTING ASSUMPTIONS: SUR 1, SUR 2, SUR 3, AN 8, AN 9, AN 10.

3.AN.8 Cooperative surveillance system

CRITERION: A cooperative surveillance system must be provided in controlled airspace where a surveillance service is required.

THREAT: Loss of separation, incomplete surveillance picture and excessive ATC workload for ATM of aircraft in Controlled Airspace.

RATIONALE:

- The cooperative surveillance system enables an ATC surveillance service, aircraft identification and predictive tools required by the normal mode of operation.
- Enables greater traffic density and airspace efficiency.

TYPE: Infrastructure, Technology, HF, Data, Cyber & Digital, Equipage, UA.

MAIN SUPPORTING ASSUMPTIONS: SUR 1, SUR 2, SUR 3, AN 8, AN 9, AN 10

03AN

Sub-System Level Criteria

Part 1

3.AN.9 Non-Cooperative Surveillance

CRITERION: Controlled Airspace with a high density of regular passenger air transport must have a non-cooperative surveillance system enabling separation from unidentified traffic.

THREAT: Mid-air collision, loss of separation, intruder or incursion into controlled airspace.

RATIONALE:

- An intruder or transponder failure increases the probability of an air to air collision. A non-cooperative system allows traffic avoidance and establishment of separation.
- Cooperative surveillance systems rely on the aircraft having a functioning transponder operating. Intruders may not have a functioning transponder so a non-cooperative surveillance system is required.

Note: Non-cooperative surveillance is a critical risk control if the core cooperative surveillance system is unavailable.

TYPE: Infrastructure, Technology, Procedure, Cyber & Digital, System Design

MAIN SUPPORTING ASSUMPTIONS: COM 3

3.AN.10 Non-GNSS Cooperative Surveillance Capability

CRITERION: There must be a non-GNSS-dependent cooperative surveillance capability to enable ATM for recovery and contingency operations in the event of the loss of the GNSS-dependent cooperative surveillance capability.

THREAT: Mid-air collision or loss of separation due to unavailability of GNSS.

RATIONALE:

- The envisaged main surveillance system is dependent on GNSS.
- A non-GNSS surveillance system will assure continued service in the event of the loss of GNSS.

Non-GNSS surveillance will support safe recovery and contingency on the main trunk.

Note: A cooperative back up surveillance system may not support contingency operations.

Note: Surveillance may or may not be interrupted when switching from normal to non-normal modes of operation.

TYPE: Infrastructure, Technology, Data.

MAIN SUPPORTING ASSUMPTIONS: AN 5, AN 1, COM 3

03AN

Sub-System Level Criteria
Part 2

3.AN.11 GBNA coverage for aircraft recovery using the MON

CRITERION: There will be GBNA coverage to provide a minimum operational network (MON) for safe recovery of aircraft if GNSS navigational capability is not possible.

THREAT: Inability to navigate and land safely

RATIONALE:

- MON is also available for navigation by non-GNSS equipped aircraft flying IFR at all times, but this is not it's primary purpose.
- On failure of GNSS, aircraft may have to climb to a suitable altitude and/or fly for a distance using an extraction procedure to acquire a safe GBNA service and join an en-route Instrument Flight Procedure (IFP).
- GBNA enables aircraft to navigate and land safely from an instrument approach in the event of the loss or degradation of GNSS navigation capability; through either aircraft capability or the GNSS service itself.
- GBNA-based Instrument Flight Procedures should enable straight-in approaches where possible, to a minima appropriate to the safety requirements of the type of aircraft.

Note 1: The MON is for non-GNSS recovery and is enabled by the GNBA network

Note 2: The MON will include, but is not limited to, controlled aerodromes

TYPE: Infrastructure, Procedure, System Design

MAIN SUPPORTING ASSUMPTIONS:
GEN 6, NAV 1, NAV 2, NAV 5,
EQI 2

03AN

Sub-System Level Criteria

Part 2

3.AN.12 Re-establishment of Navigation Capability Following Loss of GNSS

CRITERION: Aircraft flying to PBN standards and out of GBNA coverage are to be able to continue safe flight in order to re-establish their navigation capability to enable recovery, and as required, contingency operations following loss of GNSS navigation.

THREAT: Loss of GNSS (full, partial or aircraft).

RATIONALE:

- Aircraft may fly in en-route and terminal areas using sole means GNSS navigation for limited periods.
- However, those aircraft need to be able to be safely extracted in the event of the loss of GNSS-based navigation.
- Aircraft then need to be able to safely acquire suitable non-GNSS navigation aids to re-establish navigation and continue recovery operations.

TYPE: Procedure, system design, infrastructure, Human Factors.

MAIN SUPPORTING ASSUMPTIONS: NAV 1, NAV 5, NAV 6, EQI 1, EQI 2, COM 3

3.AN.13 GBNA coverage for contingency operations

CRITERION: There will be GBNA coverage to enable contingency operations.

THREAT: Inability to navigate and land safely due to limited navigation capability.

RATIONALE:

- Contingency operations enable approved air transport and essential services to be conducted on the main trunk using the GBNA network when GNSS is not available.
- GBNA-enabled sustainable contingency operations allow aircraft to depart, navigate and land safely from an instrument approach
- GBNA-based contingency includes Instrument Flight Procedures (IFP) for conventional departure, en-route, arrival and approach operations. The IFP include straight-in approaches where possible, to a minima appropriate to the operations and safety requirements of the type of aircraft.
- Further development work is required to determine the extent of the MON in support of contingency operations. The capability enabled by contingency operations will be determined by societal and economic requirements.

TYPE: Infrastructure, Procedure, System Design

MAIN SUPPORTING ASSUMPTIONS: GEN 7, NAV 1, NAV 2, NAV 5, EQI 2

3.AN.14 GBNA Instrument Approach and Departure Procedures

CRITERION: Aerodromes equipped with GBNA are to have at least one suitable GBNA instrument approach and departure procedure (not including ILS) for each instrument runway end where practicable. The procedures should be published.

THREAT: Approaches and departures following loss of GNSS do not achieve required levels of safety

RATIONALE:

- This provides safe options for recovery, contingency and non-contingency operations for all IFR aircraft.
- GBNA procedures should include arrival, approach and departure procedures for all regular-use operating surfaces.
- VOR and VOR/DME approaches shall be available to allow for the different equipage of GA and RPT aircraft.
- The aircraft should be able to land from the straight in approach without conducting a circling procedure.
- GBNA departure procedures will provide a contingency, if required, for loss of GNSS during a GNSS departure.

TYPE: Procedure, infrastructure, equipage

MAIN SUPPORTING ASSUMPTIONS: GEN 6, NAV 1, NAV 2, EQI 2.

03AN

Sub-System Level Criteria

Part 2

3.AN.15 Air Traffic Management System Capability and Capacity

CRITERION: The Air Traffic Management system shall have the capability and capacity to manage the density and complexity that can be reasonably envisaged during normal, disruption, recovery and contingency operations.

THREAT: Overload of system leads to loss of separation.

RATIONALE:

- The ATM system must be able to handle the density of aircraft envisaged for normal, disruption, recovery situations and contingency operations.
- The ATM system must be sufficiently resourced with suitably competent and current personnel to allow for effective control of the density of aircraft envisaged for normal, disruption, recovery situations and contingency operations.
- The ATM system design must allow for new aircraft types, new operating contexts, emerging technologies and capabilities.

Note: this criterion refers to all elements of ATM, not just the ATM Information System platform.

TYPE: Infrastructure, Procedure, Human Factors, System Design, Technology.

MAIN SUPPORTING ASSUMPTIONS: AN 1, AN 5, AN 6, AN 11, AN 12

3.AN.16 ATM Reliability and Resilience

CRITERION: ATM, including internal and external networks, should be resilient enough to ensure effective traffic management in normal, disruption, recovery and contingency operations.

THREAT: Loss or degraded aviation system safety.

RATIONALE:

- The individual elements of the ATS (aerodrome, approach, area and FIS) must be able to communicate effectively with other parts of the ATM system to provide safe ATM.
- Reliability and resilience assures continuity of service
- ATM shall be as resilient as reasonably practicable to the effects of natural disasters.
- ATM shall be as secure as reasonably practicable against external interference.
- External suppliers shall not reduce system reliability or resilience.

TYPE: Infrastructure, System Design, Cyber Digital.

MAIN SUPPORTING ASSUMPTIONS: AN 1, AN 2, AN 5, AN 6, AN 12, COM 3

03AN

Sub-System Level Criteria

Part 2

3.AN.17 ATS Procedures for non-normal situations

CRITERION: ATS shall publish procedures for foreseeable non-normal events.

THREAT: Loss of GNSS, aircraft equipment fault, inability to navigate, ATS and operational failures.

RATIONALE:

- ATS service is a primary mitigation for loss of GNSS or failure of aircraft equipment.
- ATS shall have procedures for a response to a request for assistance.
- The procedures shall be published in the appropriate aviation document (e.g. AIP) so all ATS personnel and users are aware of the response in advance.
- The procedures shall be suitable for all scenarios that are reasonably possible. This includes the capacity to provide an Air Traffic Services to all airborne aircraft in controlled airspace affected by GNSS outage.

TYPE: Procedure; Human Factors, System Design, Cyber & Digital

MAIN SUPPORTING ASSUMPTIONS: AN 1, AN 5, AN 6, AN 11, AN 12

3.AN.18 ATC Access to Meteorological Information

CRITERION: Significant meteorological information shall be available and integrated with ATS and ATM.

THREAT: When avoiding weather, aircraft executes unplanned deviation from track and flies into unsuitable weather.

RATIONALE:

- The provision of appropriate weather information will allow controllers to see where bad weather is and so anticipate pilot requests for route deviation.
- The provision of appropriate weather information will allow controllers to advise pilots of unsuitable weather in their path.

Note: Integrated significant meteorological information may be forecast or real-time

TYPE: Infrastructure, Procedure, Cyber & Digital, Technology, Human Factors, Interoperability, UA.

MAIN SUPPORTING ASSUMPTIONS: AN1, AN 8

03AN

Sub-System Level Criteria
Part 2

3.AN.19 GNSS Performance and Integrity Monitoring

CRITERION: Users of the aviation system that rely on GNSS shall confirm and monitor performance and availability of the GNSS service for the duration of the operation.

THREAT: Degradation of aviation system safety due to GNSS or equipment performance.

RATIONALE:

- GNSS availability and integrity predictions will need to be from acceptable suppliers.
- The prediction system requires pre-flight evaluation and by the person responsible for the safety of flight.
- GNSS requires monitoring for availability and performance to ensure appropriate use of GNSS in ATS operations, including reporting status to users of the navigation and surveillance system.
- Operators and ATS shall be able to respond safely to degraded GNSS service.

TYPE: Procedure, Human Factors, Cyber & Digital, Data, Technology, UA

MAIN SUPPORTING ASSUMPTIONS: NAV 5, EQI 1

3.AN.20 ATS Communications

CRITERION: ATS shall have sufficient communication systems available to ensure continuity of communication with aircraft.

THREAT: ATS cannot provide services due to loss of communication.

RATIONALE:

- VHF radio is the primary means of communications between ATS and aircraft
- There shall be appropriate contingency communications according to the operation and class of airspace.

Note: Alternative communication options may be introduced depending on the capabilities and requirements of new technologies.

TYPE: Infrastructure, Procedure, equipage, technology, System Design, Cyber & Digital, Human Factors.

MAIN SUPPORTING ASSUMPTIONS: AN 1, AN 2, AN 5, AN 6, COM 3

03SD

Sub-System Level Criteria

► 3.SD.1 Data Management
► 3.SD.2 Software Assurance
► 3.SD.3 Information Management

3.SD.1 Data Management

CRITERION: Any aeronautical data used in the aviation system shall be current, digital where practicable, from a certified source where appropriate, accessible and to required information standards.

THREAT: Loss of aircraft due to essential data not available, incorrect or corrupt data used, or misunderstanding or misuse of aeronautical data.

RATIONALE:

- Aeronautical data is an essential element of the aviation system. The data must be readily understandable by the users to promote safe decision making.
- Users need ready access to correct and complete data within the defined scope.
- The handling of data from certified origin to user must be secure and retain integrity commensurate with the level of risk.
- Automated and real-time data transmissions must retain security and integrity commensurate with the level of risk.
- Errors in data may not be readily apparent.
- Incorrect or corrupt data could lead to errors in aircraft operation with significant consequences.
- Safety-critical data should be protected from interference by open source or insecure systems and digital channels; and must have isolated redundancy modes.

TYPE: Equipage, Infrastructure, Data, System Design.

MAIN SUPPORTING ASSUMPTIONS:
N/A

03SD

Sub-System Level Criteria

3.SD.2 Software Assurance

CRITERION: Software utilised in the aviation system is to be developed, tested and be maintained to the correct system certified status and be protected from interference.

THREAT: Out of date, incorrect or corrupt software.

RATIONALE:

- Aviation systems should be assessed to determine their design assurance level.
- Increasing automation, distance from operator, and networked systems make safety-critical software increasingly vulnerable.
- Use of software that does not meet the correct specification or update status can lead to errors that may not be readily apparent.
- Interference includes malicious, natural and inadvertent corruption.
- Safety-critical software and systems should be protected from interference by open source or insecure systems and digital channels, and must have isolated redundancy modes.

Note1: Software includes firmware.

Note2: Most systems are software driven and are therefore vulnerable.

Note3: Growing challenges of cyber security and software integrity.

TYPE: Equipage, Infrastructure, Data, System Design, Cyber and Digital.

MAIN SUPPORTING ASSUMPTIONS:
N/A

03SD

Sub-System Level Criteria

3.SD.3 Information Management

CRITERION: Aeronautical information must be accessible, usable, managed and correct.

THREAT: Use of out of date or incorrect aeronautical information.

RATIONALE:

- Users need ready access to current and correct aeronautical information.
- Change management processes are required to ensure that information is amended and version controlled. Not necessarily just driven by human, may also be automation and built-in system checks.
- There will be ever-increasing information volumes and complexity. Changes will be made more often and should be readily apparent to the user.
- Automated compatibility between formats to suit the end user. A move toward user-experience (UX) and the most assimilable layout regardless of channel-to-user
- Effectiveness of the information interface with the user.
- Rate of change of information is increasing in complexity and volume of aeronautical information.
- Likelihood of technology being used to check the integrity of associated technology.

TYPE: Procedure, Data, Cyber and Digital, Human Factors.

MAIN SUPPORTING ASSUMPTIONS:
N/A

03HF

Sub-System Level Criteria

3.HF.1 Training of Personnel

CRITERION: People participating in the aviation system are to be trained and qualified to the level appropriate for the role they will perform for both normal and contingency operations.

THREAT: Insufficient skill and knowledge; potential Human Factors errors.

RATIONALE:

- People working in the aviation system should be trained in positive cultures: safety culture; reporting culture; learning culture; just and fair culture.
- Training includes initial qualification and ongoing training and development, including approved synthetic training.
- The safety outcomes of the regulatory system will increasingly require higher standards from Senior Persons, supervisors and license-holders.
- Training includes normal and non-normal procedures and should include human capacity factors and fatigue risk management.
- Training should be on operationally representative equipment with the correct software, hardware, processes and procedures.

TYPE: Procedure, Human Factors.

MAIN SUPPORTING ASSUMPTIONS: NAV 5, GEN 4

03HF

Sub-System Level Criteria

3.HF.2 Competency of Personnel

CRITERION: All people participating in the aviation system must be competent in the skills required for their role including both normal and contingency operations.

THREAT: Reduction in safety or harm is caused by people who are unable to perform their role to the required standard.

RATIONALE:

- All people fulfilling a role should be current and have performed the function sufficiently frequently to maintain competence. Their competence should be assessed periodically.
- Contingency and reversionary procedures remain a significant mitigation for all aviation activities.
- A safe aviation system requires people to swiftly convert to recovery and contingency operations.
- Competency is maintained by regular operational and synthetic practise and exposure to normal and non-normal scenarios.
- Operational roles will need currency and recency requirements to ensure qualified people can always deliver the skills and standards required.

Note: Currency is defined as a time period within which a skill must have been used or demonstrated in order to be practised without supervision. Recency is defined as the period since the skill was last practised. If a skill is current but has not been used recently, additional supervisory steps might be required.

TYPE: Human Factors.

MAIN SUPPORTING ASSUMPTIONS:
N/A

03HF

Sub-System Level Criteria

3.HF.3 Human Systems Interface

CRITERION: The design of equipment that is to be used by people operating in the aviation system should optimise human performance and minimise the likelihood and consequence of human error.

THREAT: Incidents or accidents from human error caused by poor system design.

RATIONALE:

- Change management should include human factors consideration.
- HSI should enable monitoring of system performance and assimilation of information.
- New technologies will introduce greater variety of human systems interface (HSI) challenges.
- In some circumstances, the human may be remote from the system but HSI considerations will still apply.
- Human response to degraded system operations should be considered.
- Increased automation makes human interaction through HSI more detached and less frequent.
- Consideration of complexity and avoidance of information saturation.

TYPE: Human Factors, Interoperability, Procedure, System Design.

MAIN SUPPORTING ASSUMPTIONS: N/A

3.HF.4 Human Fallibility and Bias

CRITERION: The design of the aviation system should recognise human fallibility and biases and be configured to minimise the likelihood and consequences from them.

THREAT: Incidents or accidents from human error caused by sub-optimal human performance.

RATIONALE:

- Increasing system complexity makes human error more likely.
- Awareness and training of human bias reduces the likelihood of occurrence.
- The fatigue effect of new technologies and their use should be considered.
- Organisational, culture, capability, performance.
- The system should be considerate of degraded human performance.
- Human fallibility due to environmental effects.
- Reliance on information, less able to respond in the event of an outage.

TYPE: Human Factors, system design.

MAIN SUPPORTING ASSUMPTIONS: N/A

03HF

Sub-System Level Criteria

3.HF.5 Fatigue Risk Management

CRITERION: All people performing safety critical roles or functions in the aviation system should fall under an appropriate fatigue risk management framework.

THREAT: Incidents or accidents from human error caused by unmanaged human fatigue.

RATIONALE:

- The change in the technological environment and other system changes mean a new approach to fatigue risk management may be required.
- Degraded human performance due to fatigue is a precursor to unsafe events.

TYPE: Human Factors, data, procedure.

MAIN SUPPORTING ASSUMPTIONS:
N/A

Appendix B Changes: 2016 Safety Criteria to 2018 Safety Criteria

2016 ID	2018 ID	2016 Title	2018 Title	2016 Criterion	2018 Criterion	Rationale for changes from 2016 to 2018
1.1	1.1	NZ Alignment with ICAO	NZ Alignment with ICAO	New Zealand's aviation system and its constituent elements will be based on the relevant ICAO standards, recommended practices and documents. Variations will be tested to ensure safety is maintained in the New Zealand environment.	NZ's aviation system and its constituent elements will be based on the relevant ICAO standards, recommended practices and documents (when available). Alternatives and variations will be tested to ensure safety is maintained in the New Zealand environment.	No change.
1.2	1.2	Current Rules	Regulatory Framework	The regulatory requirements of the NZ Civil Aviation Act and Rules will apply.	The regulatory requirements of the NZ Civil Aviation Act and Rules will apply.	No change.
1.3	1.3	Performance Monitoring	Performance Monitoring	The performance-based elements of the aviation system are monitored and assessed against their applicable design requirements.	The performance of the aviation system is monitored and assessed against the applicable requirements.	Broadened to all applicable requirements, rather than specifying to design requirements.
1.4	1.4	Aviation Cooperation for Safety	Aviation Cooperation for Safety	All stakeholders in the aviation system are to work cooperatively to ensure their elements and the overall system operates safely and holistically.	All stakeholders in the aviation system shall work cooperatively and share safety information to ensure their elements and the overall system operates safely and holistically.	Incorporated sharing of safety information from previous 1.6.

1.5	1.5	Aviation System Robustness and Resilience	Aviation System Robustness and Resilience	The aviation system must be robust and resilient in order to safely respond to foreseeable events and situations.	The aviation system must be robust and resilient in order to safely respond to events and disruptions.	Removed 'foreseeable' - respond to events and disruptions.
1.6		Shared Safety Performance Information		Users of the aviation system are to share safety and performance information, including the reporting of hazards and occurrences and other indicators of technical and human performance.		Removed - incorporated into 1.4.
-	2.1		Terrestrial Infrastructure		All terrestrial infrastructure covered by aviation regulation (including facilities, airports, operating surfaces, ground based navigation and surveillance structures etc.) shall be compliant and suitable for the required purpose.	Created new level 2 to align with level 3 categories..
-	2.2		Aircraft Equipage		Aircraft Equipment performs in accordance with required regulatory standards and is compatible with the aviation system.	
-	2.3		Air Navigation		The ATM, airspace design and air navigation architecture, systems and capacity shall provide for the safe and efficient operation of current and future approved airspace users.	

-	2.4		Software, Data, Information		NZ's aviation system and its constituent elements will be based on the relevant ICAO standards, recommended practices and documents (when available)..	
-	2.5		Human Factors		All aspects of system design shall aim to protect against human fallibility and maximise human capability	
2.1	3.HF.2	Competency of Personnel	Competency of Personnel	All personnel involved in the use of contingency and disruption functions or capabilities are to be trained, competent and current to fulfil their role.	All people participating in the aviation system must be competent in the skills required for their role including both normal and contingency operations.	Tightened wording.
2.2	3.SD.1	Aeronautical Data Management	Data Management	Any aeronautical data used in the aviation system is :a. Current. b. Digital where practicable. c. From a certified source. d. To required information standards. e. To consider human factors principles.	Any aeronautical data used in the aviation system shall be current, digital where practicable, from a certified source where appropriate, accessible and to required information standards.	Added 'where appropriate', and added link to human factors.
2.3	3.AN.5	Vertical Guidance on Instrument Approaches	Approach Design	Where reasonably practicable, all instrument approaches must have continuous vertical guidance such as: Instrument Landing System RNP APCH with Baro-VNAV Augmented GNSS (e.g. SBAS or GBAS)	All instrument approaches must be designed to be as efficient as practical while maximising safety as assessed on available evidence.	Rephrased to state the objective rather than specifying the design.

2.4		Straight-In Instrument Approaches		Where reasonably practicable, all instrument approaches must be designed as straight-in approaches.		Removed - covered by 3.AN.5
2.5	3.SD.2	Equipment Software (Ground or Aircraft Systems)	Software Assurance	The software in navigation, transponder, communication and ATM equipment for airborne and ground systems is to be kept to the correct system certified status.	Software utilised in the aviation system is to be developed, tested and be maintained to the correct system certified status and be protected from interference.	Broadened to all software utilised in the aviation system. Now includes development, testing and protection from interference.
3.Air.1	3.AN.1	Strategic Level Airspace Design	Airspace Design Complexity	Airspace and associated procedures are designed at a strategic level to reduce complexity and allow users to have access to a practical alternate airfield.	Airspace design and procedures are optimised to minimise complexity.	Covers part of 2016 criteria, wording changed to minimise rather than reduce.
	3.AN.2		Strategic Level Airspace Design		Airspace and associated procedures are designed to a strategic airspace plan take account of stakeholder needs and capabilities.	Broadened second part of 2016 criterion to consider stakeholder needs and capabilities (which may include access to alternate).

3.Air.2	3.AN.3	Controlled Airspace Designed to Realise the Safety Benefits of PBN	Performance Based Procedures	Controlled Airspace design is to realise safety benefits of PBN procedures for IFR taking account of aircraft and on ground constraints, and consideration of VFR operations.	Performance based (PBN) procedures are preferred for normal IFR operations.	Additional criterion.
	3.AN.4		Airspace is designed to realise the safety benefits of PBN		Airspace design realises safety benefits of PBN procedures for IFR taking account of aircraft and on ground constraints, and consideration of VFR operations.	Minor changes to wording.
3.Air.3	3.AN.6	Airspace Designed to Accommodate all Users	Airspace Designed to Accommodate all Users	Airspace design is to ensure all users can be safely accommodated taking account of aircraft and on ground constraints.	Airspace design shall ensure all users can be safely accommodated taking account of aircraft and on ground constraints.	Minor changes to wording.
3.Air.4		Changes to Airspace		Proposed changes to Airspace are to be assessed to ensure the airspace remains fit for purpose from a safety perspective. Post implementation the changes are to be reviewed from a safety perspective.		Removed - self-evident and covered by existing 'Review' criteria
3.ATM.1	3.AN.15	Air Traffic Management System Capacity	Air Traffic Management System Capability and Capacity	The Air Traffic Management system (including personnel) must be able to handle the density and/or complexity that can be reasonably envisaged during normal, disruption, and recovery situations and contingency operations.	The Air Traffic Management system shall have the capability and capacity to manage the density and complexity that can be reasonably envisaged during normal, disruption, recovery and contingency operations.	Removed '(including personnel)' as specifying examples may be leading to the audience. Added specification of capability and capacity.

3.ATM.2	3.AN.16	Network Reliability	ATM Reliability and Resilience	The ATM internal and external networks should be resilient enough to ensure sufficient information flow and communications (data and voice) to allow for effective air traffic management in normal, disruption, recovery and contingency operations.	ATM, including internal and external networks, should be resilient enough to ensure effective traffic management in normal, disruption, recovery and contingency operations.	Removed specifics on how, just stating objective.
3.ATM.3	3.AN.17	ATC to have Published Procedures for contingency situations	ATS Procedures for non-normal situations	ATC are to have published sufficient normal and non-normal procedures to cover foreseeable events, including loss of GNSS, and aircraft loss of navigation or communications systems.	ATS shall publish procedures for foreseeable non-normal events.	Removed examples as specifying may lead audience to narrow view of what is included.
3.ATM.4	3.AN.19	ATC Monitoring of Aircraft Track and Position	GNSS Performance and Integrity Monitoring	Where ATC provide a surveillance service, ATC are to monitor aircraft track and position and are to take appropriate action to advise of aircraft track non-adherence.	Users of the aviation system that rely on GNSS shall confirm and monitor performance and availability of the GNSS service for the duration of the operation.	Changed to reflect that there are many users of GNSS and that each must monitor integrity
3.ATM.5	3.AN.18	ATC Access to Meteorological Information	ATC Access to Meteorological Information	Where a surveillance service is provided, ATC must have access to meteorological systems to allow for effective visualisation of significant weather so that they can respond appropriately.	Significant meteorological information shall be available and integrated with ATS and ATM.	Wording amended with SME input to be tighter and more precise
3.Com.1	3.AN.20	ATS Contingency Communications	ATS Communications	ATS personnel are to have sufficient contingency VHF communication systems available to ensure continuity of communication with aircraft.	ATS shall have sufficient communication systems available to ensure continuity of communication with aircraft.	Removed specifics on how, just stating objective.

3.Nav.1		GBNA at Controlled Aerodromes		All controlled aerodromes will have a GBNA for instrument approach/departure procedures.		Removed. Include some elements with old 3.Nav.2
3.Nav.2	3.AN.13	GBNA Coverage to support MON	GBNA coverage for contingency operations	There are to be sufficient ground based navigation aid coverage to provide a ‘minimum operational network’ (MON) sufficient to allow for safe recovery and contingency operations in the NZ FIR in the event of the loss of GNSS navigational capability.	There will be GBNA coverage to enable contingency operations.	Removed specifics on how, just stating objective.
3.Nav.3	3.AN.14	GBNA Instrument Approach and Departure Procedures	GBNA Instrument Approach and Departure Procedures	Aerodromes equipped with GBNA are to have at least one suitable GBNA instrument approach (not including ILS) and departure procedure. Where practicable, these procedures should be published for each runway end.	Aerodromes equipped with GBNA are to have at least one suitable GBNA instrument approach and departure procedure (not including ILS) for each instrument runway end where practicable. The procedures should be published.	Minor changes to wording.
3.PBN.1		Aircraft PBN Equipage		Aircraft PBN equipage is to be in accordance with ICAO Doc 9613 PBN Manual.		Removed - Not required as covered by ICAO criteria (Level 1).

3.PBN.2	3.AE.1	Aircraft Non-GNSS Navigation Capability	PBN Navigation Capability	All IFR aircraft navigating to PBN standards are to be equipped with a functioning non-GNSS navigation system sufficient to allow safe navigation to an appropriate recovery aerodrome and as required, contingency operation following the loss of GNSS navigation capability.	All aircraft navigating to PBN standards are to be equipped with a functioning non-GNSS navigation system sufficient to allow safe navigation to an appropriate recovery aerodrome.	Same as 2016, contingency operations split into different criterion.
	3.AE.2		Non-PBN GNSS Navigation Capability		All aircraft navigating using GNSS not performing to PBN standards are to be equipped with an alternative means of navigating safely to a safe operating surface.	Additional criterion for non PBN.
	3.AE.3		Contingency Operations Following Loss of PBN		Aircraft using the contingency network following loss of PBN capability should be equipped with a means of navigating safely.	Additional criterion in event of loss of PBN.
3.PBN.3	3.HF.1	Training of Personnel in PBN	Training of Personnel	Pilots and ATS staff are to be trained in Performance Based Navigation to the level appropriate for the navigation specification they will be expected to operate.	People participating in the aviation system are to be trained and qualified to the level appropriate for the role they will perform for both normal and contingency operations.	Broadened to cover all people participating in the aviation system and appropriate for their role. Now specifies both normal and contingency.
3.PBN.4	3.AN.11	GNSS Functionality and Integrity	GBNA coverage for aircraft recovery using the MON	If using GNSS-based navigation aids, pilots are to confirm that the GNSS is expected to support the required navigational performance for the duration of their flight.	There will be GBNA coverage to provide a minimum operational network (MON) for safe recovery of aircraft if GNSS navigational capability is not possible.	Reworded and tightened to better align with other new ASSC

3.PBN.5	3.AN.12	Re-establishment of Navigation capability following loss of GNSS	Re-establishment of Navigation Capability Following Loss of GNSS	Aircraft flying to PBN standards and out of GBNA coverage are to be able to continue safe flight in order to re-establish their navigation capability to enable recovery, and as required, contingency operations following loss of GNSS navigation.	Aircraft flying to PBN standards and out of GBNA coverage are to be able to continue safe flight in order to re-establish their navigation capability to enable recovery, and as required, contingency operations following loss of GNSS navigation.	No change.
3.Sur.1	3.AN.7	Surveillance System	Surveillance System	There must be a suitable surveillance system to enable the required level of ATM.	There must be a suitable surveillance system to enable the required level of ATM.	No change.
3.Sur.2	3.TI.3	Reliability of Surveillance System	Reliability and Resilience	The combined surveillance system and supporting systems are to have sufficient availability and continuity of service to meet the requirements of the ATM for that airspace.	Physical infrastructure associated with aviation facilities is designed, constructed and maintained to meet the reliability and resilience needs of the aviation system.	More clearly specified physical infrastructure component, including design, construction and maintenance. Broadened to meet needs of aviation system as a whole.
3.Sur.3	3.AN.8	Cooperative surveillance system	Cooperative surveillance system	A cooperative surveillance system must be provided in controlled airspace where a surveillance service is required.	A cooperative surveillance system must be provided in controlled airspace where a surveillance service is required.	No change.
3.Sur.4	3.AN.9	Non-Cooperative Surveillance	Non-Cooperative Surveillance	Controlled Airspace with a high density and exposure of people must have a non-cooperative surveillance system enabling separation from unidentified traffic.	Controlled Airspace with a high density of regular passenger air transport must have a non-cooperative surveillance system enabling separation from unidentified traffic.	Minor changes to wording.

3.Sur.5	3.AN.10	Non-GNSS Cooperative Surveillance Capability	Non-GNSS Cooperative Surveillance Capability	There must be a non-GNSS dependent cooperative surveillance capability to enable ATM for recovery operations in the event of the loss of the GNSS-dependent cooperative surveillance capability.	There must be a non-GNSS-dependent cooperative surveillance capability to enable ATM for recovery and contingency operations in the event of the loss of the GNSS-dependent cooperative surveillance capability.	No change
-	3.TI.1		Aerodrome		The suitability and safety of an aerodrome should be assessed and maintained as appropriate for the nature of intended operations.	New
-	3.TI.2		Non-Aerodrome Terrestrial Infrastructure		The suitability and safety of a non-aerodrome terrestrial infrastructure should be assessed and maintained as appropriate for the nature of intended operations.	New
-	3.TI.4		Compliance		Aviation infrastructure should be designed, constructed and maintained in accordance with all relevant compliance requirements.	New
-	3.AE.4		Communication Equipment		UA and other new participants or users must be equipped to integrate safely into the existing aviation system.	New

-	3.AE.5		Communication Equipment		Aircraft shall have sufficient communication equipment for the class and designation of airspace in which they are operating and to support safe integration into the aviation system.	New
-	3.AE.6		Surveillance Equipment		To enable the required level of ATM, aircraft must have suitable equipment to integrate into the surveillance system for the airspace in which it is operating.	New
-	3.SD.3		Information Management		Aeronautical information must be accessible, usable, managed and correct.	New
-	3.HF.3		Human Systems Interface		The design of equipment that is to be used by people operating in the aviation system should optimise human performance and minimise the likelihood and consequence of human error.	New
-	3.HF.4		Human Fallibility and Bias		The design of the aviation system should recognise human fallibility and biases and be configured to minimise the likelihood and consequences from them.	New
-	3.HF.5		Fatigue Risk Management		All people performing safety critical roles or functions in the aviation system should fall under an appropriate fatigue risk management framework.	New

Appendix C Forecast and Strategy Trends Analysis (FaSTA)

Appendix C1. Forecast and Strategy Trends Analysis (FaSTA)

C1.1 Process

The 2018 FaSTA describes a strategic change context for those in the New Zealand Aviation System who are involved with developing long-term plans, policies and capabilities. This work used SME input and a wide review of credible literature to identify trends and discernible patterns of change. The scope of this work undertaken by Navigatus specifically to support the ASSC 2018 project undertaken for CAA gives the main trend description statements only. The FaSTA creates a context so that capability developers may assume a future with less risk that old models or preconceived thoughts and assumptions might be inadvertently applied.

The FaSTA enabled a scene to be set on which the ASSC could be reviewed and provided a contextualised focus for the project team. The three cycles of analysis were limited to high-level statements but were sufficient to create new insights and stimulate deeper intellectual debate. The first forecast cycle comprised professional and personal opinions from SMEs. The second forecast cycle was more evidence-based and was supported by an extensive literature review and strategic trends analysis. The third cycle was an iterative refinement of the FaSTA statements as the detailed ASSC development work revealed deeper understanding. The rigorous approach added confidence to the relevance and accuracy of the final statements. Basic principles of forecasting were used, including: simplicity, conservativism, and the requirement for verifiable evidence. The sources were selected for the proven integrity of their data sets and their reputation for unbiased critical reasoning.

The FaSTA statements surfaced possible future conditions. They were based on the continuation of recent observed trends alongside new and emerging trends. They formed a comprehensive view of the future derived through the workshops attended by New Zealand aerospace experts and a global aerospace literature review. The FaSTA statements do not attempt to predict the future, instead they describe plausible outcomes on the basis of rigorous trends analysis. The global aviation industry is increasingly complex, competitive and connected and we must assume that what is known today will continue to evolve and change.

C1.2 Method and sources

The three-cycle method described above (SME, literature review, iteration) enabled the FaSTA statements to be developed during the project. Traditional forecasting and trends analysis methods were used to identify current and emerging patterns that suggest potential future outcomes. For a statement to be included in the FaSTA there needed to be sufficient information from a range of credible sources to reach a threshold of relevance, salience, and probability. This process included SME professional input and minimised individual personal opinion, assumption, bias and group think. That said, the statements were not intended to be predictions, rather they are descriptions of possible future states derived from verified observations and patterns from the recent past and current time.

The SMEs who contributed to the FaSTA were from the following organisations:

- Ministry of Transport NZ
- CAA NZ
  - Aerospace Programmes Unit
  - Aeronautical Service Unit
  - GA Flight Operations
  - Airworthiness
  - Deputy Director Civil Aviation and Senior Manager input as available
- Airways New Zealand
- A General Aviation Industry representative
- Navigatus Consulting independent aviation professionals

The literature review included, but was not limited to, the following sources:

- FAA Aerospace Forecast 2018-2038;
- World Economic Forum Global Risks Report 2018;
- DCDC Strategic Trends Analysis out to 2045;
- IATA Safety Report 2017;
- ICAO Cargo Strategy 2018;
- ICAO Long-term traffic forecasts July 2016;
- PWC 2018-19 Industry trends: Aerospace and Defence;
- PWC Industry 4.0: Building the digital enterprise;
- Aerospace, Defence & Security key findings;
- PW Strategy Industry 4.0 Global Digital Operations 2018;
- IOSA Digital Transformation - strategic paper;
- Unmanned Aircraft Systems Market: Global Trends Analysis, Market Analysis, Industry Analysis and Forecast to 2023_ Market.biz [synopsis];
- Unmanned Aircraft Systems 2017 Global Market Growth, opportunities, Industry applications, analysis and forecast to 2022_ ABNEWSWIRE [synopsis];
- Multiple other on-line professional and credible sources: including; FAA, CAA, EASA.
- Objective and subjective information from multiple project workshops and discussions with project stakeholders

C1.3 Value and accuracy

To warrant inclusion in the FaSTA charts there had to be sufficient confidence and evidence that the future states described in the statements were relevant, realistic and probable. For example, the conditions described may already have occurred in leading countries; they may already be a well-established trend; they may be stated objectives of primary regulators and industry manufacturers (Boeing, Airbus), or; the condition may have already begun to emerge in New Zealand.

Forecasting is inherently uncertain and determining probability can be very subjective. The FaSTA tables show a percentage probability assessment based on the reviewed sources, an independent review by project SME representatives, separate CAA review and finally, a collective group ratification. Nonetheless, the probability scores should be taken only as a measure of SME confidence of the likelihood of the condition occurring.

Not all FaSTA statements relate to hazards and risks that might reduce safety – some relate to innovations and changes to the aviation system that might improve safety. To indicate the potential for increasing or reducing risk, the FaSTA employs the colour-coded risk trend arrow method used by the World Economic Forum in the annual Global Risks Report.

C1.4 Discussion on global and national trends

The FaSTA work emphasised how challenging it is for aviation professionals and organisations to keep up with the pace and rate of change. The greatest change is currently apparent in the digital and technology areas where miniaturisation, machine learning and artificial intelligence (AI) are set to disrupt long-established traditional systems and processes across most areas of aviation including ATM, aeronautical information management and ATS. Unmanned Aircraft (UA) are evolving at pace across a widening front of capability and many of the UA capabilities that enter service have short life spans. The imbalance between many UA technology development cycles and in-service introduction-to-exit obsolescence times can be compared to the development of jet aircraft from 1945 to 1960.

The development of ultra-long endurance UA systems is likely to see increased use of the upper atmosphere as a low-cost alternative to satellites. In sub-orbital and orbital altitudes, the trend of increasing numbers of manned, unmanned, satellite and multiple micro-satellites is expected to grow. Recoverable and non-recoverable commercial space operations are expected to increase, and this will add additional complexity to: national airspace systems; regulatory systems; international space law; demands for airspace segregation; the militarisation of space, and; modelling the impact of space debris.

It is difficult for traditional institutions such as international aviation organisations and associations, national regulators, ANSPs, training organisations and operators to keep pace with the speed and agility of technology development and innovation. This is apparent in gaps in design and certification standards and rules to guide some airworthiness pathways beyond experimental and developmental operations. There are pockets of innovation excellence emerging around the world, but these depend on the tolerance of the various regulatory systems to experimental and development risk. This means that the international institutions mentioned above may become more networked and interconnected in order to strike a balance between innovation energy and the need to maintain the integrity of aviation safety. The criticality of incorporating Human Factors (HF) principles into the earliest stages of design (including digital technology) is increasing as human-system interfaces become more complex, sophisticated, automated and remote.

C1.5 FaSTA groups and statements: 2018

The FaSTA research identified statements that naturally fell into five broad groups. The groups were not exclusive and many of the statements applied across more than one group and were closely interconnected. The FaSTA groups were described as:

- Unmanned Aircraft;
- Technology;
- Cyber and Digital;
- Human Factors;
- Operational Factors.

The list of statements could easily have grown significantly longer. For ease of use and management, the project team restricted the list to the elements sufficient to guide the review of ASSC.

Table C1: Unmanned Aircraft

Key	
↓	Significantly decreasing risk
↘	Somewhat decreasing risk
→	No Change
↗	Somewhat increasing risk
↑	Significantly increasing risk

C1.6 Unmanned Aircraft

Unmanned Aircraft		Risk Trend	Est. Prob %
UA1	Rapid growth in all classes of UA leading to high traffic densities		95
UA2	There will be dense low-level operating zones for UAs over urban areas requiring new methods of control and avoidance		50
UA3	Non-model aircraft UA numbers estimated to increase four-fold by 2022: primarily for agriculture, sensor, industry, utility, govt and emergency uses		80
UA4	Increased risk of intentional use of UA to cause harm to individuals, society, environment and economy		20
UA5	There will continue to be rapid growth in all classes of UA, including self-piloted, autonomous, VLOS, and BVLOS		95
UA6	ICAO will continue to lag behind on UA and this will lead to increased state independence and differences		60
UA7	The distance between humans and operations with UA will increase, leading to remote and indirect operational control		95
UA8	UA airspace integration in all classes of airspace will trigger technology innovations		70

UA9	Increased participation by non-traditional-aviation actors and companies will disrupt the aviation industry, ATS and regulator		70
UA10	New technologies and actors will create pressure on regulatory systems		80
UA11	Increasing influence, pressure and lobbying from large business and multinationals will disrupt traditional safety models		60
UA12	There will be increased automation dependency with UA		95
UA13	Requirements for UA assured safety during airspace contingency operations or in CNS reversionary modes will increase		95
UA14	UTM for performance-based and risk-based management of UA will be standalone at first then merge with ATM over time		80
UA15	The risks from increasing dependency or sole reliance on GNSS will lead to innovations and alternative technical CNS solutions		70
UA16	More states will introduce registration for most types of UA. It is likely that NZ will adopt this trend.		80

C1.7 UA Summary

All trends and forecasts indicate a significant increase in all classes of UA over the next five years. The most authoritative source for future UA numbers is the FAA assessment that predicts a fourfold increase in non-model aircraft UA by 2022 (UA3). This figure is assessed as reasonable and relevant to New Zealand. The UA sector with the greatest growth in the last 12 months throughout the US and Europe has been for agriculture, remote sensing and mapping (spectral, thermal and LiDAR), security, government and emergency services (UA3).

Growth in New Zealand generally lags the US and Europe by 2-5 years, so these information sources are a reliable indicator of a near-term increase in traffic density within New Zealand's lower airspace. The growing gap between UA capability and international/national regulations shows the pace of innovation is, in general, faster than regulatory adaptability. New technologies are quickly enabling viable solutions to watershed challenges such UTM, electronic conspicuity, autonomous avoidance and full BVLOS operations. Miniaturised and low-cost innovations of current technologies – such as ADS-B and spectral/thermal imaging – are accelerating the utility of UA (UA5,6,8-10). Many nations are beginning to consider UA registration systems and it appears likely this will become expected for certain classes of UA.

C1.8 Technology

Technology		Risk Trend	Est. Prob %
T1	Rapid innovation spirals and reduced time from conception-to-obsolescence creates complex certification pathways		70
T2	Rapid development and application of Artificial Intelligence, neural networks and robotics disrupts traditional processes		50
T3	There is an increasing likelihood of domestic or offshore ANSP competition		20
T4	Availability of automatically prepared and disseminated aeronautical information will increase; e.g. SWIM concepts		85
T5	Increased technological complexity and in-service failures leads to airline disruptions and more-frequent fleet groundings		60
T6	Growing variety and challenges of emerging propulsion systems (high bypass jet, electric, hydrogen, hybrid, hypersonic, rocket)		40
T7	The rate, capability and sophistication of surface-to-space operations will increase and require greater volumes of reserved airspace		60
T8	Introduction of space-based CNS services (e.g. Indra, ATM3)		60
T9	Remote ATS will evolve through centralised regional control hubs with the potential for remote international ATS e.g. Pacific Is		90
T10	New materials, propulsion and innovations lead to increased use of the upper airspace, upper atmosphere and sub-orbital space		95
T11	The use of safety-enhancing technology such as synthetic vision, electro-optical enhanced vision and VR will increase		90
T12	Rapid increase in fused miniaturised sensors for situational, locational and separation awareness		95

C1.9 Technology Summary

Four main technological themes became apparent during the FaSTA research. The first being that new technology innovations are highly likely to flow back to enhance safety in traditional GA cockpits (T11,12).

The second theme identified was growth in the vertical extent of airspace use. Orbital, sub-orbital, high-upper and upper airspace are being increasingly used by systems exploiting new materials, digital innovations, new propulsion systems and increasing autonomy (T2,6,7,8,10).

The third theme was the technological opportunities affecting traditional ANSPs. From remote ATC towers to automated aeronautical information, it is highly likely that traditional ATM, ATS and aeronautical information management will be disrupted in the near future (T2,3,4,8). It is expected that mature ANSPs will compete with new private providers for ATS contracts in developing nations and in countries where traditional ANSPs are inefficient (T9).

The fourth theme that became apparent is long-term investment in zero-carbon and low-carbon propulsion systems. The environmental, societal and economic drivers for reduced fossil fuel consumption are stimulating investment and innovation in technology previously believed to be unsafe or inefficient for aviation (T5,6).

C1.10 Cyber and Digital

Cyber & digital		Risk Trend	Est. Prob %
CD1	The vulnerability of strategic and safety-critical systems is increasing		90
CD2	Rapid growth in direct internet to aircraft creates the requirement for security layers between open and closed systems		90
CD3	Digital channels will increasingly become a pathway for interference and threat ingress		85
CD4	The challenges and threats of cyber security, data management and software integrity will increase		90
CD5	Use of 4G and 5G cellular networks for autonomous surveillance and situational awareness		70
CD6	There will be an increase in rapid sharing of data and information, for example through APIs and interconnected networks		95
CD7	Rapid growth in direct internet to aircraft will enable large volumes of real-time information to the cockpit		95
CD8	The ubiquity, management and application of predictive and prescriptive data analytics will improve safety		90

C1.11 Cyber and Digital

The overarching trend in the cyber and digital group is that these capabilities have the potential to significantly improve safety across most aviation activities. The challenge arising from this trend will almost certainly be the security and integrity of firmware and software. These vulnerabilities may present new pathways for hazards, threat ingress and interference. Operators will need to comply with new software management processes and disciplines to protect from malicious interference. While the cyber and digital space will bring major benefits, the digital literacy of operators will need to advance. Low-margin operators using older technology and who do not upskill core competencies may find themselves unable to continue within the system.

C1.12 Human Factors

Human Factors		Risk Trend	Est. Prob %
HF1	Increased automation will dilute traditional skills that are still required for resilience and reversionary operations		95
HF2	Rise of Human Factors challenges with increasing complexity of technology		95
HF3	Increasing demand for airline pilots will continue to exceed FTO capacity and cause a significant increase in average pilot age		90
HF4	Increasing demand for airline pilots will cause a reduction 1st/2nd officer functional handling skills through lower flight time at airline entry		90
HF5	Increasing dependency on software and system complexity will lead to critical HF errors in system design		70
HF6	The increasing average age of airline pilots will conflict with the needs for a more tech-intuitive global workforce		70
HF7	The increasing numbers and types of systems interfaces will increase HF risks faced by operators		85
HF8	Awareness of the importance and application of Human Factors will increase across the aviation industry		90
HF9	There will be improved awareness in fatigue risk management across all safety-critical areas of aviation		70
HF10	The increase in quality, effectiveness and fidelity of synthetic training will disrupt traditional training systems		80

C1.13 Human Factors Summary

The FaSTA analysis showed the importance of understanding and addressing Human Factors in improving aviation safety. While commercial air transport has now achieved extremely high levels of safety, there continues to be incidents and accidents caused by human error, human behaviour, poor ergonomics, and non-human-centric system design.

The ubiquity and variety of complex human-system interfaces will continue to increase with greater aircraft automation, increasingly connected cockpits, and improved synthetic training replacing traditional airborne flight training time. The greatest airline growth will occur in regions where steeper cross-cockpit authority gradients and hierarchical cultures are strongest (HF1,2,4,5,7,8).

The management and prevention of human error and bias across the spectrum of evolving aviation systems is likely to broaden as human operational control become more detached from the cockpit (HF5,7,10). There will be paradoxical tensions between the increasing average age of airline pilots; increasing use of sophisticated technology used in training new pilots, and; an increasing need for operators to become more software-intuitive and literate when managing new technology (HF3,5,6,10). Many traditional aircraft and ATC human interfaces will be disrupted (such as automated decision making), and this is likely to introduce unanticipated hazards, threats and risks in the Human Factors domain.

Awareness of human physiology in aviation will broaden beyond the cockpit to increasingly apply to cabin crew, maintenance personnel and air traffic controllers. Regulators are likely to increase expectations for better management of fatigue and mental health across all categories of aviation, including Part 125, 135, ATC, UA and space operations.

C1.14 Operational Factors

Operational Factors		Risk Trend	Est. Prob %
OF1	Increasing frequency in extreme weather events will disrupt operations and increase meteorological hazards		90
OF2	Global environmental concerns increase carbon efficiency targets affecting ATS, routing structures and operational procedures		90
OF3	Inconsistent global aviation security environment - particularly for air cargo		75
OF4	Aviation organisations with weak economic profiles will be slow to adopt new technologies		90
OF5	Aviation fuel will double in price over next 10 years making inefficient operators unprofitable and stimulating propulsion innovation		90
OF6	Due to increasing cost structures, active GA pilot numbers will remain steady or slightly decline over next 8 years		85

C1.15 Operational Factors Summary

There are a very large number of emerging changes and potential future conditions from the evolving global aviation system. If not kept to the highest-level broad trends, the Operational Factors group of the FaSTA would be too large and unwieldy for the purpose of supporting the development of the ASSC. The six statements on Operational Factors are headlines for major strategic themes. While it is outside the scope of this report, each headline statement at OF1-6 could be unpacked to reveal layers of detailed factors and forces that will reshape the industry over the next 20 years. The FaSTA statements on Operational factors fall into four main dimensions:

- *Climate change:* an emerging pattern of different environmental hazards and operating conditions around the world, such as; cyclones, precipitation rates, unseasonal temperature variations; unexpected and unusual weather events.
- *Reducing carbon emissions and fossil fuel burn*: IATA emissions targets to 2050 are stimulating innovation in alternative fuels and propulsion sources. Operational efficiencies from new technologies are increasingly critical to airline competitiveness and viability.
- *Aviation security*: traditional passenger and cargo security processes and systems are facing disruption from a broader spectrum of threats and hazards. Growing effectiveness and variety of responses will rely on increased use of digital systems, AI, machine learning, and tightly networked secure and automated information sharing.

- *Key skills - supply and demand:* Many GA sectors are declining or simply not growing at the rate required to supply the numbers of pilots required to enable airline growth. The supply and demand gap also applies to key skills in ATS, aviation maintenance and engineering.

It is clear that there are many close correlations between OF1-6 and the other FaSTA categories. The interrelationships and systemic nature of the FaSTA statements should be considered when forming views on possible future states of the aviation system of 2023.

Appendix C2. Test of ASSC against FaSTA

The FaSTA statements were used to inform and guide the iterative review and development of the 2018 ASSC. The FaSTA is a global analysis of global aviation trends and therefore will not directly match or correlate in fine detail across to the ASSC. However, the relevance of the 2018 ASSC can be tested against the 2018 ASSC to provide confidence that the criteria are reflective of the current understanding of the future aviation industry of 2023.

C2.1 Correlation table of FaSTA and ASSC by ID code

The purpose of the correlation table below is to align FaSTA groups with ASSC criteria. If there is a FaSTA statement that is relevant to a particular safety criterion, the FaSTA group ID code is inserted in the right-hand column. If considering the broader definition of the FaSTA group titles, all of them will apply to each criterion. However, the ID is only inserted if a particular FaSTA sub-group statement relates to the criterion. See Appendix C for the FaSTA group lists.

FaSTA Group Titles		ID
1	**Unmanned aircraft**	**UA**
2	**Technology**	**T**
3	**Cyber & Digital**	**CD**
4	**Human Factors**	**HF**
5	**Operational Factors**	**OF**

01 Top Level Criteria		FaSTA ID				
1.1	**NZ Alignment with ICAO**	**UA**	**T**	**CD**	**HF**	**OF**
1.2	**Regulatory Framework**	**UA**	**T**	**CD**	**HF**	**OF**
1.3	**Performance Monitoring**	**UA**	**T**	**CD**	**HF**	**OF**
1.4	**Aviation Cooperation for Safety**	**UA**	**T**	**CD**	**HF**	**OF**
1.5	**Aviation System Robustness and Resilience**	**UA**	**T**	**CD**	**HF**	**OF**

02 System Level Criteria		FaSTA ID				
2.1	**Terrestrial Infrastructure**	**UA**	**T**	**CD**		
2.2	**Aircraft Equipage**	**UA**	**T**	**CD**	**HF**	
2.3	**Air Navigation**	**UA**	**T**	**CD**	**HF**	**OF**
2.4	**Software, Data, Information**	**UA**	**T**	**CD**	**HF**	
2.5	**Human Factors**	**UA**	**T**	**CD**	**HF**	**OF**

03 Sub-System Criteria		FaSTA ID				
Terrestrial Infrastructure						
3.TI.1	**Aerodrome**	**UA**	**T**	**CD**	**HF**	**OF**
3.TI.2	**Non-Aerodrome Terrestrial Infrastructure**	**UA**	**T**	**CD**	**HF**	**OF**
3.TI.3	**Reliability and Resilience**	**UA**	**T**	**CD**		
3.TI.4	**Compliance**		**T**	**CD**		

Aircraft and Equipment		FaSTA ID				
3.AE.1	**PBN Navigation Capability**		**T**	**CD**	**HF**	
3.AE.2	**Non-PBN GNSS Navigation Capability**	**UA**	**T**		**HF**	
3.AE.3	**Contingency Operations Following Loss of PBN**	**UA**	**T**		**HF**	
3.AE.4	**Communication Equipment**	**UA**		**CD**	**HF**	
3.AE.5	**Communication Equipment**	**UA**		**CD**	**HF**	
3.AE.6	**Surveillance Equipment**	**UA**	**T**	**CD**	**HF**	

Air Navigation and Airspace		FaSTA ID				
3.AN.1	**Airspace Design Complexity**	**UA**	**T**		**HF**	**OF**
3.AN.2	**Strategic Level Airspace Design**	**UA**	**T**	**CD**	**HF**	**OF**
3.AN.3	**Performance Based Procedures**				**HF**	
3.AN.4	**Airspace designed to realise safety benefits PBN**	**UA**	**T**		**HF**	
3.AN.5	**Approach Design**				**HF**	**OF**
3.AN.6	**Airspace Designed to Accommodate all Users**	**UA**	**T**		**HF**	**OF**
3.AN.7	**Surveillance System**	**UA**	**T**	**CD**	**HF**	
3.AN.8	**Cooperative surveillance system**	**UA**	**T**	**CD**	**HF**	
3.AN.9	**Non-Cooperative Surveillance**	**UA**	**T**	**CD**	**HF**	
3.AN.10	**Non-GNSS Cooperative Surveillance Capability**	**UA**	**T**	**CD**	**HF**	**OF**
3.AN.11	**GBNA coverage for aircraft recovery using MON**				**HF**	
3.AN.12	**Re-est of Nav Capability Following Loss of GNSS**	**UA**	**T**	**CD**	**HF**	
3.AN.13	**GBNA coverage for contingency operations**					
3.AN.14	**GBNA Instrument Approach & Departure Procs**					
3.AN.15	**ATM System Capability and Capacity**	**UA**	**T**	**CD**	**HF**	
3.AN.16	**ATM Reliability and Resilience**	**UA**	**T**	**CD**	**HF**	
3.AN.17	**ATS Procedures for non-normal situations**	**UA**	**T**	**CD**	**HF**	
3.AN.18	**ATC Access to Meteorological Information**			**CD**	**HF**	**OF**
3.AN.19	**GNSS Performance and Integrity Monitoring**	**UA**		**CD**	**HF**	
3.AN.20	**ATS Communications**	**UA**	**T**	**CD**	**HF**	

Software, Data, Information		FaSTA ID				
3.SD.1	Data Management	UA	T	CD	HF	
3.SD.2	Software Assurance	UA	T	CD	HF	
3.SD.3	Information Management	UA	T	CD	HF	

Human Factors						
3.HF.1	Training of Personnel	UA	T	CD	HF	OF
3.HF.2	Competency of Personnel	UA	T	CD	HF	OF
3.HF.3	Human Systems Interface	UA	T	CD	HF	OF
3.HF.4	Human Fallibility and Bias	UA	T	CD	HF	OF
3.HF.5	Fatigue Risk Management		T	CD	HF	OF

Appendix C3. 2018-2023 FaSTA full listing

Key	
↘	Significantly decreasing risk
→	Somewhat decreasing risk
→	No Change
↗	Somewhat increasing risk
↗	Significantly increasing risk

Unmanned Aircraft		Risk Trend	Est. Prob %
UA1	Rapid growth in all classes of UA leading to high traffic densities		95
UA2	There will be dense low-level operating zones for UAs over urban areas requiring new methods of control and avoidance		50
UA3	Non-model aircraft UA numbers estimated to increase four-fold by 2022: primarily for agri, sensor, industry, utility, govt and emergency uses		80
UA4	Increased risk of intentional use of UA to cause harm to individuals, society, environment and economy		20
UA5	There will continue to be rapid growth in all classes of UA, including self-piloted, autonomous, VLOS, and BVLOS		95
UA6	ICAO will continue to lag behind on UA and this will lead to increased state independence and differences		60
UA7	The distance between humans and operations with UA will increase, leading to remote and indirect operational control		95
UA8	UA airspace integration in all classes of airspace will trigger technology innovations		70
UA9	Increased participation by non-traditional-aviation actors and companies will disrupt the aviation industry, ATS and regulator		70
UA10	New technologies and actors will create pressure on regulatory systems		80
UA11	Increasing influence, pressure and lobbying from large business and multinationals will disrupt traditional safety models		60
UA12	There will be increased automation dependency with UA		95
UA13	Requirements for UA assured safety during airspace contingency operations or in CNS reversionary modes will increase		95
UA14	UTM for performance-based and risk-based management of UA will be standalone at first then merge with ATM over time		80
UA15	The risks from increasing dependency or sole reliance on GNSS will lead to innovations and alternative technical CNS solutions		70
UA16	More states will introduce registration for most types of UA. It is likely that NZ will adopt this trend.		80

Technology		Risk Trend	Est. Prob %
T1	Rapid innovation spirals and reduced time from conception-to-obsolescence creates complex certification pathways		70
T2	Rapid development and application of Artificial Intelligence, neural networks and robotics disrupts traditional processes		50
T3	There is an increasing likelihood of domestic or offshore ANSP competition		20
T4	Availability of automatically prepared and disseminated aeronautical information will increase; e.g. SWIM concepts		85
T5	Increased technological complexity and in-service failures leads to airline disruptions and more-frequent fleet groundings		60
T6	Growing variety and challenges of emerging propulsion systems (high bypass jet, electric, hypersonic, rocket)		40
T7	The rate, capability and sophistication of surface-to-space operations will increase and require greater volumes of reserved airspace		60
T8	Introduction of space-based CNS services (e.g. Indra, ATM3)		60
T9	Remote ATS will evolve through centralised regional control hubs with the potential for remote international ATS e.g. Pacific		90
T10	New materials, propulsion and innovation increases use of the upper airspace, upper atmosphere and sub-orbital space		95
T11	The use of safety-enhancing technology such as synthetic vision, electro-optical enhanced vision and VR will increase		90
T12	Rapid increase in fused miniaturised sensors for situational, locational and separation awareness		95

Cyber & digital		Risk Trend	Est. Prob %
CD1	The vulnerability of strategic and safety-critical systems is increasing		90
CD2	Rapid growth in direct internet to aircraft creates the requirement for security layers between open and closed systems		90
CD3	Digital channels will increasingly become a pathway for interference and threat ingress		85
CD4	The challenges and threats of cyber security, data management and software integrity will increase		90
CD5	Use of 4G and 5G cellular networks for autonomous surveillance and situational awareness		70
CD6	There will be an increase in rapid sharing of data and information, for example through APIs and interconnected networks		95
CD7	Rapid growth in direct internet to aircraft will enable large volumes of real-time information to the cockpit		95
CD8	The ubiquity, management and application of predictive and prescriptive data analytics will improve safety		90

Human Factors		Risk Trend	Est. Prob %
HF1	Increased automation will dilute traditional skills that are still required for resilience and reversionary operations		95
HF2	Rise of Human Factors challenges with increasing complexity of technology		95
HF3	Increasing demand for airline pilots will continue to exceed FTO capacity and cause a significant increase in average pilot age		90
HF4	Increasing demand for airline pilots reduces 1st/2nd officer functional handling skills through lower flight time at airline entry		90
HF5	Increasing dependency on software and system complexity will lead to critical HF errors in system design		70
HF6	The increasing average age of airline pilots will conflict with the needs for a more tech-intuitive global workforce		70
HF7	The increasing numbers and types of systems interfaces will increase HF risks faced by operators		85
HF8	Awareness of the importance and application of Human Factors will increase across the aviation industry		90
HF9	There will be improved awareness in fatigue risk management across all safety-critical areas of aviation		70
HF10	The increase in quality, effectiveness and fidelity of synthetic training will disrupt traditional training systems		80

Operational Factors		Risk Trend	Est. Prob %
OF1	Increasing frequency in extreme weather events will disrupt operations and increase meteorological hazards		90
OF2	Global environmental concerns increase carbon efficiency targets affecting ATS, routing structures and operational procedures		90
OF3	Inconsistent global aviation security environment - particularly for air cargo		75
OF4	Aviation organisations with weak economic profiles will be slow to adopt new technologies		90
OF5	Aviation fuel will double in price over next 10 years making inefficient operators unprofitable and stimulating propulsion innovation		90
OF6	Due to increasing cost structures, active GA pilot numbers will remain steady or slightly decline over next 8 years		85

C3.1 FaSTA Sources:

1. NSS ASSC Workshops 2018,
2. FAA Aerospace Forecast 2018-2038,
3. World Economic Forum Global Risks Report 2018,
4. DCDC Strategic Trends Analysis out to 2045,
5. ICAO Cargo Strategy 2018,
6. ICAO Long-term traffic forecasts July 2016,
7. PWC 2018-19 Industry trends: Aerospace and Defence,
8. PWC Industry 4.0: Building the digital enterprise _
9. Aerospace, Defence & Security key findings,
10. PW Strategy Industry 4.0 Global Digital Operations 2018,
11. IOSA Digital Transformation - strategic paper,
12. Unmanned Aircraft Systems Market: Global Trends Analysis, Market Analysis, Industry Analysis and Forecast to 2023_ Market.biz,
13. Unmanned Aircraft Systems 2017 Global Market Growth, opportunities, Industry applications, analysis and forecast to 2022_ ABNEWSWIRE
14. Multiple other on-line professional and credible sources: including; FAA, CAA, EASA.
15. Objective and subjective information from multiple project workshops and discussions with project stakeholders.

Appendix D Objectives, Scope and context

(*Appendix D material drawn from Sections 3 to 5 of the 2016 ASSC report*)

Appendix D1. Existing Defined Objectives

The NSS defined safety objectives form the objective of the ASSC set. The objectives are unchanged since the 2016 ASSC Report[1].

State safety policy and objective

New Zealand’s desired outcome for civil aviation is:

- Safe flight for social connections and economic benefits.

Aviation safety goal during introduction of NSS

The NZ aviation system maintains the current level of safety or better.

Overall principle:

The performance-based (PB) approach is a means to ensure safety is maintained or improved during and post change. This approach will also;

- expedite and maximise operational benefits gained from PB technology;
- ensure global harmonisation and operational seamlessness of PB implementations, and;
- take into account the overall system design, operational capability and performance detailed in CONOPS 2.

National airspace policy of New Zealand

The following of relevant quote from the policy:

“Safety is and will continue to be a primary objective of the airspace and air navigation system in New Zealand. Any new technologies, systems or procedures will be assessed against the benchmark of the overall safety of the system being at least maintained, and ideally, improved.”

The National Airspace and Air Navigation Plan requires: the systematic introduction of new systems and technologies; the management of risks associated with technology and process change; and the provision of adequate safety nets to cover system failure events.

D1.1 NSS safety goal

The risks to the aviation system created by the implementation of technology is effectively managed to reduce the possibility of harm to persons or damage to property.

[1] Section 4.1 of NSS Establishment of Aviation Safety Criteria (Navigatus for CAA) dated 19 April 2016

NSS safety objectives

The following sets out the safety objectives of the NSS programme.

- Safety targets (quantitative and or qualitative) - NSS safety performance targets support State Safety Programme safety performance targets.
- Aviation system risk – Aviation risk is progressively reduced through all phases of flight (gate-to-gate). Operational events regarded as precursors to accidents are identified and tracked, and indicate continuous improvement in reducing these risks.
- Integration – The elements of the aviation system are integrated to provide complementary safety controls (i.e. synergistically combine and risk is managed by the part of the system best able to).
- Resilience – The design and operation of the aviation system ensures that a disruption or failure in one area does not lead to an unacceptable system safety risk.
- Compatibility – The design and operation of the system aligns with ICAO practice to promote safe and predictable international flights or operations by foreign registered aircraft in New Zealand.
- Human Factors – The design and operation of the system: enables operator competency and human performance; integrates human factors with technology and procedures; recognising the strengths and limitations of human capability; and provides for suitable safety nets in the case of human error.
- Future proof – The aviation system and associated regulatory framework is designed to allow the effective introduction of new technology to enhance safety.
- Cooperation – All participants in the aviation system not only manage risks specific to their operation but work cooperatively with other stakeholders to share safety information, identify system hazards and risks, and participate in system safety initiatives.
- System safety – A systems and risk-based approach to safety will be applied, which includes the assessment of operations being conducted as well as consideration of system availability, reliability, continuity* and accuracy.

*Note: For the purposes of this objective, ‘continuity’ is intended to mean continued safe operation for all aspects of the system and is different from the strict definition or application of PBN.

Appendix D2. Scope, Assumptions and Limitations

Scope and Key Assumptions

While the criteria are applicable at all stages of the NSS programme, the project context is the 2023 post implementation end-state. The transition phases from the existing aviation system through the NSS regime must be considered by the stakeholder users as they progress the system developments. Change in itself creates risk, and although having the criteria will clarify the required end-point in terms of the baseline safety requirements, the risks associated with the transition phases will have to be separately identified, considered and managed as part of the decision-making process and during delivery of projects.

The following lists set out the scope of the project and the key assumptions applied during the development of the 2018 ASSC. The baseline scope and assumptions are the same as those from the 2016 report unless new. New scope and assumption statements identified this project are identified by a “(2018)” suffix.

D2.1 Scope

- **Sco 1.** Only considers NZ Domestic FIR and interface with Oceanic Airspace.
- **Sco 2.** Operations primarily cover gate-to-gate operations of all IFR aircraft.
- **Sco 3**. Includes consideration of new and emerging technology such as UA (2018).

D2.2 General

- **Gen 1.** The current aviation system is ‘safe’.
- **Gen 2.** ICAO SARPS are the basis for the aviation system.
- **Gen 3.** Scenarios considered the aviation system as envisaged 2021/2023 (i.e. NSS delivered).
- **Gen 4.** Safety Criteria apply to all users of the aviation system, but the implications of threats may differ.
- **Gen 5.** Risk considers probability and consequence. The consequence is primarily a function of the number of people exposed to risk.
- **Gen 6.** By 2021, a suitable GBNA Minimum Operational Network’ (MON) and associated Instrument Flight Procedures (IFP) will have been published.
- **Gen 7.** Emerging technologies may introduce new means of navigation and communication (2018).
- **Gen 8.** Human Factors are considered throughout all elements of system design, development, implementation, operation and change (2018).

D2.3 Air Traffic Management (ATM)

- **ATM 1.** Air Traffic Control (ATC) is provided in all Controlled Airspace and an Air Traffic Service (ATS) is provided in some elements of NZ FIR.
- **ATM 2.** Air Traffic Service (ATS) and Unmanned aircraft Traffic Management (UTM) is a function of ATM (2018).
- **ATM 3.** There are no defined surface separation standards (aircraft ground movements).

- **ATM 4.** The aim is to optimise automation to support the air traffic controller rather than having an autonomous ATM system.
- **ATM 5.** After loss of system capability, the initial response is recovery operations.
- **ATM 6.** After loss of system capability and initial response (recovery), aviation activity will continue to the extent possible by contingency operations.
- **ATM 7.** Navigation is primarily the responsibility of the Pilot in Command (PIC); separation is primarily an ANSP responsibility.
- **ATM 8.** All Control Areas will have surveillance service or a procedural service (not necessarily in control zones).
- **ATM 9.** A surveillance control service is only provided by Air Traffic Control in controlled airspace.
- **ATM 10.** There will eventually be surveillance (ADS-B) approach control service to all controlled aerodromes for all IFR aircraft, but procedural separation capability will be retained.
- **ATM 11.** When the ATM system is in bypass mode, lower accuracy may require increased separation.
- **ATM 12.** Contingency ATS can be another surveillance system or procedure.
- **ATM 13**. ATM system monitors aircraft track and position and when possible advises of aircraft non-adherence (2018).

D2.4 Navigation

- **Nav 1.** GBNA will be provided at all controlled aerodromes (currently 17).
- **Nav 2.** There will be at least one GBNA approach and departure for each instrument runway at each controlled aerodrome (NZOH and NZWP require NZDF decisions). (2018)
- **Nav 3.** ILS will be retained at those aerodromes where it is currently fitted (AA, CH, OH, WN, DN, WP).
- **Nav 4.** PBN based on GNSS is the main aircraft navigation system for IFR operations
- **Nav 5.** The only alternative navigation capability available to most users will be GBNAs as opposed to on-board capability (e.g. IRU).
- **Nav 6.** PBN routes will be designed to navigation specifications and connected to PBN SIDS, STARS and approaches.
- **Nav 7.** SIDs and STARs facilitate separation by design.
- **Nav 8.** Current VOR DME infrastructure at aerodromes is sufficient to retain RNAV2 capability for a limited time for IRU equipped aircraft.
- **Nav 9.** VOR and DME allow Minimum Safe Altitude (MSA) charts within 25 nautical miles radius.

D2.5 Airspace

- **Air 1.** NZ Airspace currently comprises Classes A, C, D and G. NZ Airspace also has other special use airspace (e.g. TM, MBZ, GAA, and Restricted Airspace).

D2.6 Communication

- **Com 1.** Pilots have pre-determined Traffic Information Broadcast Area (TIBA) procedures.
- **Com 2.** VFR aircraft entering controlled airspace must call ATC to enter, so will be on the correct radio frequency before entry unless “no radio” ATC approval is given.
- **Com 3.** There are aircraft to ground VHF communications available in all controlled airspace.

D2.7 Equipage

- **Eqi 1.** By 2023 most aircraft operating IFR will be GNSS equipped.
- **Eqi 2.** All IFR aircraft have an on-board non-GNSS navigation capability in addition to a GNSS system.
- **Eqi 3.** Part 121, 125 and 135 operator aircraft will have dual independent GNSS systems to enable them to fly PBN routes and procedures.
- **Eqi 4.** Where GNSS is used for PBN, FDE will be required.

D2.8 Surveillance

- **Sur 1.** ADS-B provides coverage to the ground at all controlled aerodromes and consequently elsewhere to low levels of the NZ FIR.
- **Sur 2.** ADS-B is basis for the main surveillance system and in place by 2021.
- **Sur 3.** Transponder Mandatory (TM) applies in all controlled airspace and designated special use airspace.
- **Sur 4.** Minimum Mode S surveillance service in Controlled Airspace by 2021 (currently Mode C).

D2.9 Limitations

There is reference to risk within a number of criteria and the body of the report. The follow limitation of the work is noted:

- This project does not define the level of risk where the requirements of these criteria come in to effect. Determining the relevant risk levels is beyond the scope of the project. These risk levels will need to be determined prior to the application of these particular criteria, and it is envisaged that this will be achieved as part of the delivery of NSS projects or related stakeholder initiatives.

Appendix E Approach to reviewing the ASSC

Appendix E1. Understanding the changing context

E1.1 New Southern Sky

Approved by Cabinet in early 2014, the New Southern Sky programme gives clear strategic direction on transitioning New Zealand's aviation system from traditional terrestrial-based technology to become primarily designed around the benefits of satellite-based capabilities. This will incorporate new and emerging technologies into the aviation system to ensure the safe, cohesive, efficient and collaborative management of New Zealand's airspace and air navigation by 2023.

E1.2 The pace of change

Since the first set of ASSC were developed in 2016, the rate and pace of technological change has been very high. The most obvious growth has been in the development and application of UA. There have also been many other areas of significant growth and change. To distil and understand the rapidly changing global aviation context and to focus the review of ASSC, the project team used an iterative process to develop the FaSTA. This work guided and informed the review process.

E1.3 Application of the ASSC

The safety criteria form the safety foundation of the NSS projects and subsequent policy and Rules development. The application of safety criteria into each of the NSS projects helps to ensure that the risk and impact of each change on the aviation system as a whole is understood and can be managed. This will reduce the chance of unexpected or unplanned conditions developing.

The methodology and presentation of the 2018 ASSC have followed the 2016 criteria as much as possible. This approach should assist the application of changes arising from the 2018 review.

Appendix E2. Methodology

The 2016 methodology consisted of five steps:

1. Baseline research
2. Information gathering
3. Development of criteria
4. Review and refinement
5. Report

The 2018 methodology built on the 2016 foundation work by employing the following revision and development process:

1. Review 2016 ASSC
2. First cycle of SME FaSTA input (professional and personal opinions)
3. Review and redefine the ASSC Levels 1,2 and 3
4. Second cycle of FaSTA (extensive literature review and strategic trends analysis)
5. Review of each 2016 criterion in turn to reflect changes and new understandings
6. Third cycle of FaSTA (iterative refinement)
7. Multiple reviews with SMEs and stakeholders to achieve consensus on reviewed ASSC criterion statements and rationale.
8. Finalise 2018 FaSTA, ASSC, rationale, assumptions, and report.

Appendix E3. Project process

The project began with an orientation meeting with key CAA stakeholders, including Deputy Directors and SMEs. This meeting was pivotal to the project and significantly redefined the scope of the work. The project kick-off meeting formed the project stakeholder team of SMEs and set the scope, boundaries and process for the project.

The project plan initially anticipated two workshops, but it quickly became apparent the three or more workshops would be required to review all 2016 ASSC with sufficient rigour. After three workshops it was decided that a number of smaller and shorter meetings, including targeted engagement sessions, would be the most efficient method of refining both the final version of the FaSTA and for agreeing the revised ASSC. During the final revision stages there was temptation to contextualise the ASSC criterion statements to reflect SME individual contexts. The final criterion statements are crafted to enable all users and stakeholders to apply the ASSC a range of operating contexts.

The table below sets out the workshops and meetings completed during the project.

Date	Ser No	Topic	Notes
5 Jun 18	1	Orientation meeting	CAA – scope change
11 Jun 18	2	Kick-off meeting	SMEs present
25 Jun 18	3	Workshop 1	SMEs present: Level 1&2 ASSC
26 Jun 18	4	Workshop 2	SMEs present: Level 2&3 ASSC
12 July 18	5	Workshop 3	SMEs present: Level 2&3 ASSC
18 July	6	CAA meeting	CAA SME ASSC Level 3
26 July 18	7	CAA meeting	CAA SME ASSC Level 3, FaSTA
3 Aug 18	8	Airways review	Airways SME present: ASSC and FaSTA
27 Aug	9	CAA review Airways comment	Deliver Airways review comments
29 Aug 18	10	CAA meeting	CAA to decide on Airways comment
8 Oct 18	11	CAA meeting	Feedback on initial draft report