CIVIL AVIATION AUTHORITY OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

Advisory Circular AC102-1

Revision 1

16 December 2024

Unmanned Aircraft – Operator Certification

General

Civil Aviation Authority (CAA) Advisory Circulars (ACs) contain guidance and information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rules and legislation.

Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable, they will be added to the appropriate AC.

Purpose

This AC describes an acceptable means of compliance to meet the requirements for certification of unmanned aircraft operators under Civil Aviation Rule Part 102.

Related Rules

This AC relates mainly to Part 102, *Unmanned Aircraft Operator Certification*, and refers to Part 101, *Gyrogliders and Parasails, Unmanned Aircraft (including Balloons), Kites, and Rockets Operating Rules*. It:

- outlines the requirement to assess risks in Part 102 operations, including developing procedures to manage those risks to achieve safe outcomes
- advises how operators can develop a risk management plan as part of their exposition, to satisfy CAA that risks to aviation safety are being adequately managed, and
- describes widely-used risk management methodologies and other tools to help operators meet the intent of this rule.

Change Notice

Revision 1 is a comprehensive revision which, among other changes:

- removes the FAQ section and out-of-date transition provisions (rule 102.27)
- focuses on the intent of the rule – for operators to assess and manage aviation safety risks in their operation, and
- adds three appendices:

Published by
Civil Aviation Authority
PO Box 3555
Wellington 6140

Authorised by
DCE Aviation Safety

- Appendix I – Guide to ISO: 31000 – Risk Management
- Appendix II - Specific Operations Risk Assessment (SORA), and
- Appendix III – Examples of sets of exposition documents.

Version History

The version history is outlined below:

Revision No.	Effective Date	Summary of Changes
AC102-1, Rev 0	27 July 2012	Initial issue of this AC.
AC102-1, Rev 1	16 Dec 2024	Removes the FAQ section and out-of-date transition provisions (rule 102.27). Focuses on the intent of the rule – for operators to assess and manage aviation safety risks in their operation. Adds three appendices: • Appendix I – Guide to ISO: 31000 – Risk Management • Appendix II - Specific Operations Risk Assessment (SORA), and • Appendix III – Examples of sets of exposition documents.

Table of Contents

Introduction

Rule 102.1, *Purpose*, sets out the requirements for applicants to be granted a Part 102 Unmanned Aircraft (UA) Operator Certificate (a Part 102 certificate or UAOC). Applicants need to have:

(1) '… conducted an adequate assessment of the risk to safety of conducting the proposed unmanned aircraft operation; and

(2) … developed procedures to adequately manage the risks and to ensure that the operation is conducted safely.'

CAA will assess whether the applicant has adequately identified the hazards and risks associated with their operation and developed controls, processes and procedures to manage risks appropriately.

When considering a Part 102 application, CAA inspectors want to ensure applicants are aware of hazards and risks not just to their own operation, but also to other aircraft and to people and property on the ground. Demonstrating an understanding of the latter risks will help operators show CAA that they appreciate their responsibilities as part of the wider aviation system.

There are many models to identify hazards, then analyse and manage associated risks. This AC covers some of the more common methods and tools. However, it is up to applicants to demonstrate how they will manage risks, while ensuring staff have adequate training and resources to do this effectively.

This AC will help applicants:

- determine whether a Part 102 certificate is required
- understand the requirements for applying for a Part 102 certificate
- identify hazards and assess associated risks to aviation safety
- develop systems to manage risks (also known as a risk management process), and
- understand some common risk management tools.

There is also more information on the CAA website at this link:

https://www.aviation.govt.nz/drones/regulations/part-102-certification-for-drones/

Abbreviations

AC	advisory circular
AIP	Aeronautical Information Publication
BVLOS	beyond visual line of sight
CAA	Civil Aviation Authority

COTS	Commercial Off the Shelf
DG	Dangerous goods
ETU	Emerging Technology Unit
FPP	Fit and Proper Person
HSWA	Health and Safety at Work Act (2015)
IFR	Instrument Flight Rules
JARUS	Joint Authorities for Rulemaking on Unmanned Systems
NAAs	National Aviation Authorities
OCA	Operational Competency Assessment
OSO	Operation Safety Objectives (used in JARUS guidelines)
RMA	Resource Management Act (1991)
SAIL	Specific Assurance and Integrity Level/s (used in JARUS guidelines)
SMS	Safety management system
SOP	Standard operating procedures
SORA	Specific Operations Risk Assessment (used in JARUS guidelines)
UA	Unmanned aircraft
UAOC	Unmanned (or uncrewed) aircraft operator certificate
UAS	Unmanned aircraft system
VTAs	Vertebrate toxic agents

Note: *In this AC, CAA refers to UAS, rather than RPAS (remotely piloted aircraft systems), to align with Part 102. Other organisations quoted, notably JARUS, refer to RPAS.*

Definitions

In addition to more specialised definitions, some definitions from Part 1, *Definitions and Abbreviations*, have also been provided for ease of reference.

Agricultural chemical: Defined in Part 1 as:

'Any substance or mixture of substances intended for:

(1) preventing, destroying, repelling, or mitigating any insects, rodents, nematodes, fungi, weeds or other forms of plant, animal life or viruses (except viruses on or in living man or other animals) which have been declared by the appropriate authority to be a national or regional pest or noxious plant, or

(2) use as a plant regulator, defoliant or desiccant.'

Note: *Like traditional aircraft, UA can be used to disperse other types of chemicals, e.g. fire-fighting foam. Operators need to be aware of the potential hazards and risks of all substances they plan to disperse, and their potential effect on people or property.*

Certification team: The CAA inspectors who assess, in this case, applications for Part 102 certificates, including amendments and renewals.

Concept of Operations (CONOPS): A detailed summary of what an operation intends to do, and how it will do it. This term is used in JARUS guidelines. Operators with simpler lower-risk operations can describe what they plan to do in plain language.

Controls: The measures or mitigations put in place to manage or mitigate the adverse consequences of a hazard. They can be designed to:

- prevent the unwanted event or reduce the loss of control of the hazard (e.g. reduce or contain energy release), and/ or
- reduce the effects (e.g. provide shield from hazard, where an event has happened, but emergency response and medical treatment reduce the severity and duration of consequences).

Exposition: One or more documents that describe/s the operation, what it plans to do and how, and how it will meet the intent of civil aviation rules. This could range from a single document for very simple operations, to a range of connected documents for larger and more complex operations. A successful exposition will be tailored to an operator's specific operation.

Hazard: Anything that can cause harm[1]. A source or a situation with the potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these. In the context of Part 102, any condition or object with the potential to cause or contribute to an aircraft incident or accident, whether to staff, clients, the public or any property, whether related to the UA operation or not.

Hazard register: As per rule 102.11(b)(4), part of an exposition which identifies the known and likely hazards of the operation, assesses the associated risks and describes how they will be managed or mitigated. Since the outcome of a hazard is potential harm, the risk management process aims to reduce the likelihood and consequences of hazards to reduce the likelihood of harm.

Pilot: Similar to a pilot-in-command:

'pilot-in-command, in relation to an aircraft,—

a. means the pilot on board the aircraft who is responsible for the operation and safety of the aircraft; and

b. in the absence of a pilot on board the aircraft, means the person who the rules specify as responsible for the operation and safety of the aircraft in accordance with the rules; and

[1] https://www.worksafe.govt.nz/the-toolshed/definitions-and-acronyms/#lf-doc-29563

c. in all other circumstances,—

i. means an individual nominated by the operator to be responsible for the operation and safety of the aircraft; and

ii. if no individual is nominated by the operator, means the operator.'[2]

Prime Person: The person with primary responsibility for the organisation's UA operations, who CAA assesses to ensure they are fully aware of their responsibilities and have the knowledge and capabilities to perform the role.

Reasonably practicable[3]: While not defined in civil aviation legislation, CAA's interpretation is drawn from HSWA, section 22, *Meaning of reasonably practicable*:

'that which is, or was, … reasonably able to be done in relation to ensuring health and safety, taking into account … all relevant matters, including—

a. the likelihood of the hazard or the risk concerned occurring; and

b. the degree of harm that might result from the hazard or risk; and

c. what the person concerned knows, or ought reasonably to know, about—

i. the hazard or risk; and

ii. ways of eliminating or minimising the risk; and

d. the availability and suitability of ways to eliminate or minimise the risk; and

e. after assessing the extent of the risk and the available ways of eliminating or minimising the risk, the cost associated with available ways of eliminating or minimising the risk, including whether the cost is grossly disproportionate to the risk.'

For the purposes of UA operations, CAA is concerned with the safety of the wider aviation system, not just the operation itself.

Risk: The effect of uncertainty on objectives. Since safety is a key objective in the civil aviation system, in this context, the effect of uncertainty on the safety of operations conducted under Part 102. Also, the chance of something happening that will have a negative effect on safety, assessed by the likelihood and potential consequences of the unwanted event.

Risk management: Planned activities to eliminate or mitigate the likely consequences of hazards and improve safety.

Risk management process: A method for identifying and evaluating risks, developing measures for eliminating or mitigating them, monitoring how effective these measures are, and demonstrating how risks are being adequately managed over time.

---

[2] Section 5, *Interpretation*, Civil Aviation Act (2023).

[3] Also explained in the Introduction of: https://www.worksafe.govt.nz/assets/dmsassets/839WKS-5-HSWA-identifying-assessing-managing-work-risks.pdf

Risk management plan: A document or series of documents, which records how the process will be run and records results of mitigations, audits and other checks.

Safety: The condition of being protected from harm. In the context of Part 102, ensuring that risks associated with a UA operation are managed and mitigated to an acceptable level.

UA: Defined in Part 1 as 'an aircraft designed to operate with no pilot on board and includes unmanned balloons, control line model aircraft, free flight model aircraft and remotely piloted aircraft'.

UAS: Defined in Part 1 as 'an aircraft and its associated elements which are operated with no pilot on board'.

Elements include IT components, ground control systems, a reliable connection with the UA, and anything whose malfunctioning could cause a safety hazard.

Note: *For more complex operations, the use of applicable industry standard(s) and/or alignment with other NAAs' requirements may be appropriate.*

When Part 102 certification is required

An operator who plans to operate a UA in a way not permitted under Part 101 needs a Part 102 certificate. Part 102 operations include any of the activities listed below, though this is not an exhaustive list:

(1) flying over any property without the permission of the property owner or occupier

(2) flying unshielded[4] and without a barrier[5] within four kilometres of an uncontrolled aerodrome without the permission of the aerodrome operator

(3) operating an aircraft that is 25 kg or larger

(4) flying at night, outside and unshielded

(5) operating BVLOS, or

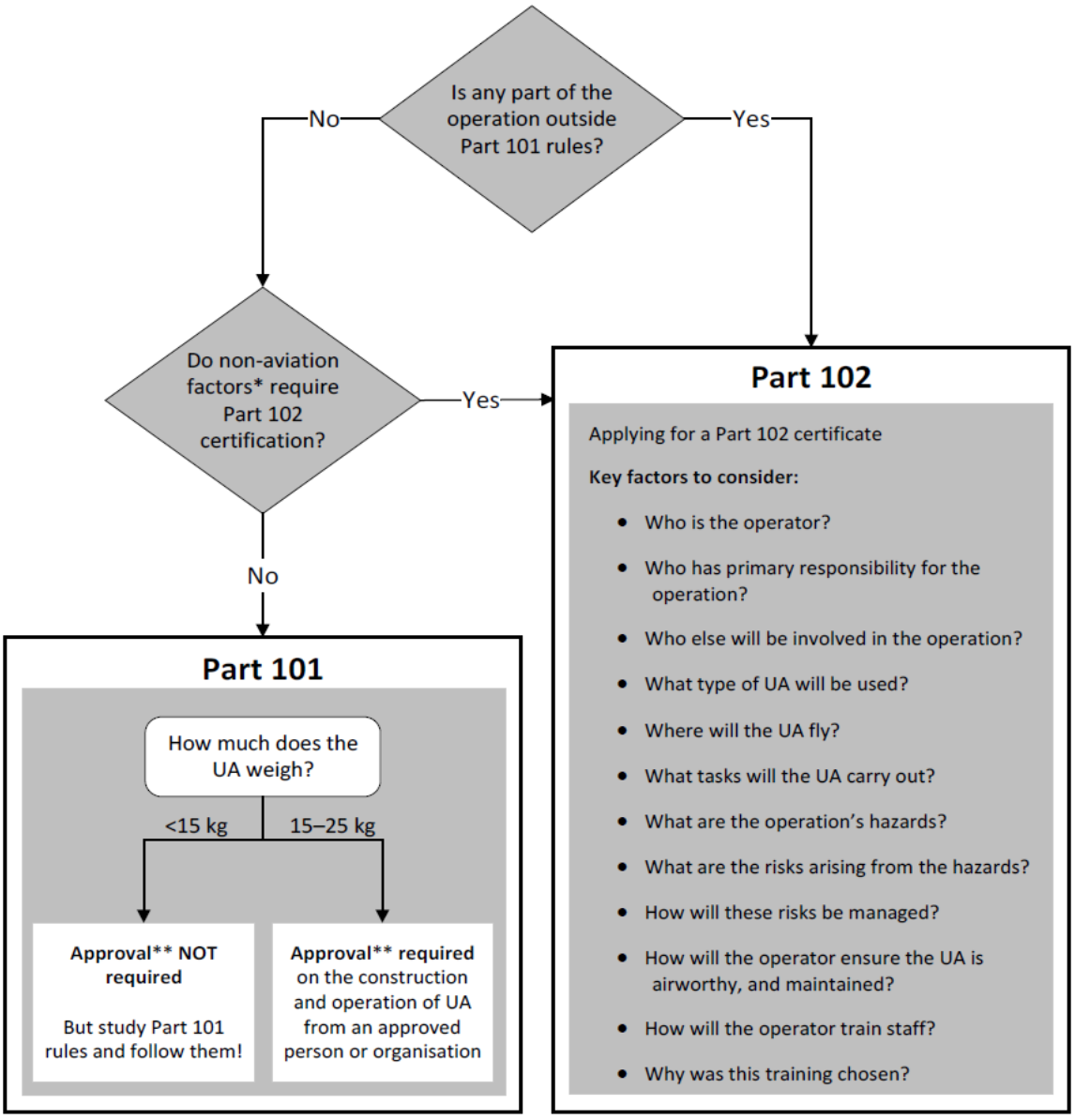
(6) agricultural operations involving the aerial dispensing of agricultural chemicals, fertilisers, or VTAs.

This list does not substitute for a full reading of Parts 101 and 102 or other relevant rules. Operators still need to assess their operation and identify the rules that apply, to decide whether they can operate under Part 101 or need to apply for a Part 102 certificate. Figure 1 shows a decision process to work out if an operation sits under Part 101 or Part 102:

[4] In this context, shielded means a flight that is within 100m laterally and below the height of a natural or constructed obstacle.

[5] In this context, a barrier means a physical object capable of halting the flight of an UA.

Figure 1: Whether to operate under Part 101 or Part 102



*Examples could include: insurance requirements, contractual stipulations, or property owner stipulations
**Approvals, from an approved third party person or organisation, are not the same as a CAA certification

How to work with a performance-based rule

Part 102 is a performance-based rule, so is not based on prescriptive requirements. Organisations need to have a hazard register in which they assess their operation's hazards and associated risks, then assess risks, and propose risk mitigations. While Part 102 describes the desired outcome, the operator is responsible for deciding the best way of achieving it and outlining it in their exposition.

This gives operators more flexibility to develop a risk management plan that best manages the risks associated with what they are trying to accomplish. To do so, operators must:

- understand their operation well enough to identify hazards and risks and develop a robust and ongoing risk management plan, and
- be able to explain to CAA how this plan will work in practice.

Note: *A Part 102 organisation's risk assessment should only cover aviation safety-related risks, as these are the risks that CAA will examine when assessing an exposition, not non-aviation risks such as risks to an organisation's reputation. Non-aviation risks would ideally have their own risk management processes as part of ordinary business planning. Organisations[6] who document all risk assessment activities in the one document need to organise that document in such a way that the distinction between safety and other risks are clear.*

Applicants for a Part 102 certificate need to be able to show CAA they:

- have identified the hazards in their intended operation
- have adequately assessed the associated risks
- have identified appropriate mitigations
- have an ongoing plan, with associated processes, to identify, assess and manage any new or changing risks, and monitor the effectiveness of risk mitigations
- can ensure staff are adequately trained and resourced to carry out the plan and its processes on an ongoing basis, and
- can ensure the operation's UAS are checked frequently and thoroughly enough to mitigate risks of them not being airworthy.

This AC includes advice about risk management based on ISO 31000:2018, a widely-used standard, and the Australasian version, AS/NZS ISO 31000:2018, outlined in more detail in Appendix I. There are other materials in the *Further Resources* section to help operators planning lower complexity operations to develop a good understanding of risk management.

While operators working on new or complex operations may find this AC a useful introduction, higher complexity operations are likely to need a more detailed risk assessment. The SORA, which was developed by the Joint Authorities for Rulemaking in Unmanned Aviation Systems (JARUS), is one risk assessment method that CAA recognises for more complex operations. While the SORA is not the only way to meet requirements, it is the one that CAA inspectors are most familiar with and is also widely accepted by other NAAs.

Appendix II of this AC summarises SORA requirements. If using a SORA, CAA strongly recommends that applicants check the JARUS website for the latest SORA revision and read the supporting documents. Applicants can also:

- check the 'Forms' section of the CAA website, for a Part 102 SORA assessment workbook, using the 'Part 102' filter or searching under 'SORA' and

[6] In this AC, CAA has tried to use the term 'organisation' where CAA is referring to the business entity/ hierarchy as a whole and 'operation' where CAA is referring mainly to the UA activity.

- seek advice from the Certification team, through the email certification@caa.govt.nz, about using SORA before submitting their application.

Applicants considering genuinely innovative and novel technology are encouraged to check the CAA website for information about the Emerging Technology Programme and how it works with innovators. CAA's Emerging Technology Unit (ETU) can be contacted at:

https://www.aviation.govt.nz/licensing-and-certification/emerging-technologies-programme/contact-us/

How to adequately manage risk in an aviation operation

Applicants seeking Part 102 certification need an exposition, which includes the information set out in rule 102.11(b). When assessing an application for a Part 102 certificate, a CAA inspector will consider:

- the people involved
- the UAS (i.e. the UA and its associated operating systems)
- the scope of the operation, and
- hazards identified and associated risk management plan.

Under rule 102.11(b)(4) operators must have a hazard register that records all potential and developing hazards, what risks each hazard poses, and the measures to be taken to manage these risks.

Risk management is often done by working through a series of steps:

- defining the scope and purpose of the operation, i.e. the key things it will do, then
- using this information to identify any known hazards to the safety of the operation
- analysing hazards to identify and assess risks to aviation safety, including conflict with any other airspace users, both manned and unmanned aircraft, and people and property on the ground
- analysing these risks, and the likelihood and consequence of them happening
- developing plans to mitigate or eliminate any risks, and then
- developing processes for managing risks through training, auditing and review, and maintenance and checks of the UAS
- creating a monitoring plan to assess how effective risk mitigations are, and
- deciding how often these will be done, to ensure risks are being managed on an ongoing basis.

While the scope and purpose of the operation may not change much over time, risks are more likely to change. Operators need to ensure they have a current and accurate understanding of their risks and how they will be managed. In doing so, operators need to consider factors that impact on how an operation is carried out, including:

- technical issues that might affect the UAS
- human factors, e.g. fatigue and over-confidence
- organisational factors, e.g. how the operation is staffed and who is in charge
- environmental aspects
- financial or legal aspects, and
- all other possible influences.

Risk management is an ongoing process that is most effective when integrated through all levels of the organisation, and where risks and any lessons learnt are communicated to all personnel, and where appropriate to stakeholders and customers. When done well, this will improve awareness and understanding of the risks in the operating environment.

Operators must develop a deep understanding of their operation's risks and the risk management controls they decided. This involves being able to:

- describe their approach and the steps taken, and
- show that staff:
    - understand this approach and know how to run the risk management process
    - are adequately resourced to carry out this part of their jobs, and
    - are trained in risk management and their skills kept current.
- show how they will measure the effectiveness of risk management activities, and
- explain how they will communicate key points about risks to their staff, clients, potentially affected parties and so on.

There are many resources to help operators develop their skills, some in the *Further Resources* section and the first two appendices of this AC. AC100-1, *Safety Management*, contains advice about identifying hazards and managing associated risks, even though the scope is broader. Lastly, although an operator's obligations under HSWA are outside the scope of this AC, resources on risk management on the WorkSafe New Zealand website, listed in the *Further Resources* section, are another useful starting point.

Note: *It is important not to downplay the risks posed by UA. For example, even though UA used in agricultural aviation usually carry smaller loads than traditional aircraft, accidents will have the same consequences. A UA dropping 250gr of insecticide into a waterway causes as much damage to the environment and New Zealand's international reputation as would a helicopter discharging a few kgs of insecticide into a waterway.*

Developing a workable and effective risk management plan

To demonstrate the safety of the proposed operation, the exposition should document a set of standard operating procedures (SOPs)[7], including the process for risk management.

CAA appreciates that it is not feasible to eliminate all risks from an operation, but does, however, expect operators to have a realistic plan to manage their risks to as low as is reasonably practicable.

A risk management plan needs to be specific to each operator and set realistic methods and processes for analysing, mitigating and monitoring risks.

Operators must ensure that their personnel are adequately trained, supported and resourced to carry out their work as per the risk management plan. Operators need:

- to carry out realistic assessments of their staff's skill level in these areas, and
- a plan for increasing staff capability, if necessary, e.g. by external training courses or thorough on-the-job training.

Elements of a risk management plan

Note: *For more information refer to Appendix I.*

Documenting hazards and risks

Operators need to set up a register to document hazards and risks as:

- operators identify and then assess them, and
- existing ones change on an ongoing basis.

This document should be reviewed regularly. The exposition needs to cover how it is used, who maintains it and how often. Useful methods to keep this document current include:

- having regular risk meetings
- brainstorming at meetings
- soliciting feedback from staff, for example, by an anonymous suggestions inbox
- sharing articles and information about aviation safety with staff
- publishing updates on risks management on the operator's website or in staff newsletters
- running desktop exercises (i.e. acting out an aviation incident or accident) and analysing how well the exercise went afterwards
- sharing ideas and common issues at industry forums, and
- asking trusted clients and suppliers for feedback.

[7] There is more advice on how to do this in the section *Writing Standard Operating Procedures (SOPs)* in this AC.

Not all of these actions will be needed for all organisations: a larger organisation, particularly one with more than one site, would probably benefit from regular meetings and updates. A smaller organisation, on the other hand, could probably manage their hazards and risks effectively by keeping themselves updated on risk management tools, and regularly assessing their hazard and risk register. Keeping the register current, adaptable and open to input across the organisation is the most important thing.

Organisations need to brief all staff, including any casual or part-time staff and/or contractors, so anyone associated with the organisation is primed to notice hazards and risks and suggest mitigations.

Analysing hazards and risks

There are many ways to do this, but whatever method is used, it must be repeatable. It must also enable operators to drill deeper, beyond the initial reason for a risk or potential weakness, to the real underlying reason(s). Popular methods include:

- a risk matrix, where risks are assessed based on likelihood and consequence and ranked as minor to major
- a bowtie risk assessment, that visualises a risk in one easy-to-understand picture, that allows users to add extra causes, creating a clear differentiation between proactive and reactive risk management.

There are examples and analysis of the pros and cons of each method in Appendix I.

Whatever methods are used, the important thing is that all users understand how it works and how to use it to assess the risks.

Controls

Deciding suitable controls or mitigations is a vital part of the risk management process.

Risks can change over time, so operators need to be continuously assessing how well controls are working, and whether new or different ones are needed. Operators are ultimately responsible for ensuring controls are being carried out, even if someone else is doing the work, so must regularly check these are being done and have not been forgotten over time.

Communications

Risk-related SOPs and the exposition are key places where operators communicate their risk management plan. Other recommended ways include:

- internal communication about managing risks in staff meetings, during staff training sessions and/or posted on noticeboards, and
- encouraging staff and clients to report issues they have noticed, by feedback forms on the website, or asking for feedback.

Like the risk management process itself, this is a scalable system. Communicating information about risk management is more straightforward in an organisation with only two or three staff, than it would be in larger organisations with more staff and multiple sites.

Monitoring risk on an ongoing basis

Learning what works over time and keeping an eye out for changes is key to maintaining an effective risk management plan over the longer term.

Because organisations, operations and the world around them change, monitoring risks is an ongoing task. Organisations need to stay alert for what has changed in their operations and wider environment and update the risk management plan to reflect that.

Encouraging ongoing monitoring and discussion, and continually looking for opportunities to improve the organisation's risk management plan, is one of the Prime Person's key responsibilities in the risk management process.

Note: *The Prime Person does not have to be an expert in risk management, but if not, should have a sound understanding of risk management and have access to a risk management practitioner who can advise them.*

Developing procedures to manage safety risks.

The risk management section in an exposition should outline any processes or documents used for managing risk, such as:

- developing SOPs
- briefings before jobs to remind everyone of potential hazards before they start a job
- use of risk matrices
- feedback processes and how feedback is followed up
- debriefing post flights
- engineer and other technical checks
- job safety assessments, for jobs that are high-risk or rarely carried out, to ensure safety measures are followed, and
- incident reporting and how that is followed up.

Training

Organisations need to document how they will train their staff and assess them as competent to operate safely.

There is currently no prescribed licensing regime for UA pilots in New Zealand, so it may be appropriate for UA pilots to complete a Part 102 training course, delivered by an approved Part 141 training organisation.

CAA may require pilots to complete additional training, e.g. for night, agricultural, or BVLOS operations.

Pilots are not, however, the only staff who need training. Ground crew, such as engineers or IT staff, also need to be appropriately trained in their roles and how to recognise and manage operational risks. Support staff will also benefit from understanding how the operation is being run, the technology being used and any associated hazards and risks.

Higher-complexity operations involving increased integration with the traditional aviation system, e.g. plans for flight into controlled airspace under IFR or equivalent, using air traffic services, or landing at aerodromes, usually have increased risk. Staff are likely to need more advanced training, qualifications and competencies. When planning these types of operations, organisations are encouraged to:

- review the Emerging Technology Programme pages on the CAA website
- decide how best to communicate what their operation will do, to share with other airspace and users and authorities, and
- decide which agencies they need to communicate with, e.g. Airways, if the operation involves controlled airspace.

There is more information about training on the CAA website at:

https://www.aviation.govt.nz/drones/training-to-fly-unmanned-aircraft/

Operators with very complex or bespoke operations are advised to contact the Certification team, through the email address, to discuss suitable training, well before they start to put an application together.

Training for agricultural operations

Due to the risks relating to agricultural operations, specific training is required. Qualifications that may be needed, include a Certified Handler Certificate for highly toxic agrichemicals or a Controlled Substance Licence (CSL) for VTAs. Operators should ensure that training providers can provide approved qualifications and ratings, e.g. that meet WorkSafe requirements, where relevant. The New Zealand Agricultural Aviation Association (NZAAA) recommends a Growsafe Standard certificate or equivalent.

Ground crew should also be trained in the safe handling of agrichemicals, particularly mixing and loading.

Staff members with extensive experience and training in applying agrichemicals in traditional aviation or land vehicles may not need to repeat introductory courses. It may be more useful for them to receive training on the specific elements of piloting UA and running the UAS.

Applicants can discuss any training staff have already completed, and whether that training is sufficient for the proposed operations, with the assigned CAA inspector during the application assessment.

Competency/Currency

Organisations must document how they will ensure their staff remain competent following initial training. One common way of doing this for pilots is completing an Operational Competency Assessment (OCA) through a Part 141 training organisation every 12 months.

For in-house pilot training or OCA using the organisation’s own instructors, CAA would need to be satisfied that the person(s) employed for that purpose have the appropriate skills and experience, e.g. previous experience as a UA flight instructor and examiner.

CAA will also need to establish that the proposed in-house training syllabus is sufficient for the types of operations the organisation will conduct.

Organisations should be aware that by keeping training in-house, they won't have the benefit of an independent instructor looking at their operations and risks with outside eyes, potentially raising issues that people too close to an operation might overlook.

It is recommended that organisations considering in-house training or assessment discuss this with the Certification team. The greater the complexity and risk of the intended operations, the more robust the ongoing competency and currency requirements need to be.

The scope of ongoing training will need to match the scope of operations, e.g. regular refresher training in agrichemical operations if appropriate.

Airworthiness

The exposition's procedures must describe how they will determine that the UAS has been checked and found to be airworthy and safe.

Checks need to take into account:

- the weight of the aircraft
- all components of the UAS
- whether it is new or used
- whether it is a COTS UAS procured from a reputable dealer
- whether the UAS:
    - has been tested or is already in use in the New Zealand environment or
    - is a first of its kind/ type, and
- whether it has any modifications, and
- whether it was designed for the operation being performed.

CAA may require aircraft that are first of their type in New Zealand, home built, and/ or over 25 kg to be inspected by an appropriately qualified and experienced inspector. Operators planning to use or develop any UAS falling within these categories should seek advice from the Certification team about inspection and other requirements.

Note: *Most operators need to use an independent inspector to inspect the airworthiness of the UAS. In cases involving large organisations who have suitably skilled staff in-house or who are doing unique work, it may be appropriate for them to use an in-house inspector. Operators should check first with CAA whether in-house inspections will be acceptable.*

Maintenance

Ongoing maintenance mitigates the risk of malfunction, so operators need procedures that demonstrate how their UAS will be maintained.

For COTS UAS, following the manufacturer's recommended maintenance schedule is often acceptable. Not all UAS come with a manufacturer's recommended maintenance schedule, however, and the robustness of manufacture's schedules also vary. An alternative for smaller COTS UAS that have not come with an acceptable maintenance plan would be:

- a pre-flight check
- a post-flight check, and
- an annual inspection (by someone suitably skilled and experienced) to check all aspects of the UAS.

Many operators nominate an external maintenance provider for the annual inspection. The UA sales agent or other industry experts can often help operators find one, as can CAA.

For large or complex UAS that have:

- more perishable components (filters, hoses)
- more mechanical parts (oil or fuel systems, retractable arms and landing gear), or
- separate and exchangeable role equipment

the manufacturer usually provides a more detailed recommended maintenance schedule that may have lifed components or timed checks (e.g., every 50 hours).

When a robust manufacturer's maintenance plan is provided, CAA expects it to be followed. If an alternative is proposed, CAA expects the operator to demonstrate why that will give an equivalent or higher level of assurance.

For UAS that are not COTS (i.e. homebuilt or modified UAS) the applicant will need to provide maintenance procedures proportionate to the risks and scope of the intended operations. Operators who do not have experience in designing an acceptable UAS maintenance programme are strongly recommended to engage an appropriately qualified and experienced consultant.

Writing Standard Operating Procedures (SOPs)

An SOP explains what the pilot and crew must do to plan, prepare, conduct, and complete an operation, or part of an operation.

There is no one right way to write an SOP, though in most cases SOPs are written in chronological order of actions. They should also:

- be written in plain language that will be easily understood by their users, and
- be formatted so they can be easily followed, and
- include all the risk mitigations needed to conduct that operation safely.

In all cases, however, SOPs must be clear on:

- who does what
- when the SOP is to be used, and
- any conditions that limit the use of the SOP (e.g. operations that can only be done during daylight, or that can only be done when visibility is at least 5km).

Common SOPs used in UA operations include, but are not limited to, those for:

- pre-flight planning and checklists
- night flying
- flying within 4km of an aerodrome
- flying over property without permission

- dispersing agricultural chemicals, fertilisers or VTAs[8]
- flying above 400ft
- post-flight checklist, and
- reporting an incident.

Operators may need to address other obligations when drafting SOPs. For example, agricultural UA operators will also need to check regional plans in accordance with the RMA, any EPA Notices, as well as any DG rules or Hazardous Substances regulations for the substances they are carrying.

Contingency and emergency procedures

Operators need to develop SOPs for any contingency or emergency situations that may occur. Like all SOPs they are expected to be proportionate to the operations being conducted.

Emergency procedures are often written as a separate SOP, to provide emphasis, and so the SOP can easily be referenced. Some operators print their emergency procedures on a laminated card or poster and stick them up somewhere prominent. Having emergency procedures in each SOP is also acceptable.

SOPs for emergency procedures must:

- define the trigger for the emergency (when the procedure will be actioned)
- be clear
- be concise, and
- explain who does each action.

These procedures need to be easily accessible. It is highly recommended the SOP for each emergency procedure is contained in one document, so readers do not have to refer to a lot of other manuals to complete the procedure (in what might be a very stressful moment).

Organisations need to plan how they will train all staff on emergency procedures and keep staff knowledge current. Since these plans need to work in practice, organisations also need a programme to test that the procedures work, that the estimated time frames are accurate, and that staff know what to do in these situations. CAA highly recommends regular dry runs and simulated or desk top exercises. Organisations should include outlines or links to these plans and testing procedures in their exposition, as CAA inspectors will want to be assured that operators and their staff are well prepared for emergencies.

Carriage of dangerous goods (DG)

If operators plan to carry DG as part of their operation, they need to manage these risks. The exposition must cover the DG they plan to use, and how they will meet the requirements of Part 92, *Carriage of Dangerous Goods*.

[8] There is more information about this in NZS 8409: 2021, *Management of Agrichemicals*, in the *Further Resources* section.

Operators do not need a DG approval for any DG that powers the aircraft while in flight, e.g. any batteries that are fitted to the aircraft or the fuel in the aircraft manufacturer's approved fuel tanks. They do, however, need an approval to transport DG as cargo, including spare batteries not fitted to the aircraft, or extra fuel not contained in the aircraft's fuel tank, but set aside to power the aircraft at some later time (e.g. for a return flight).

DG regulations change regularly, so operators must be proactive in keeping up to date with the latest DG requirements and ensuring their staff remain appropriately trained. There are links to the Part 92 ACs in the *Further Resources* section.

Agricultural chemicals

Many agricultural chemicals are DGs, so operators must be aware of the risks of carrying DG and the precautions to follow, as outlined above and in the ACs for Part 92.

Operators do not need a DG approval to carry agricultural chemicals for immediate dispersal during an agricultural aircraft operation. They do, however, need DG approval if transporting those same chemicals by air for later use (e.g. a delivery to a job site).

Operators who are unsure if they need to declare the carriage of DG, should consult the DG materials in the *Further Resources* section. If still unsure, operators can email DG@caa.govt.nz for advice. CAA also run courses on DG: there is a schedule on these webpages: https://www.aviation.govt.nz/safety/education/courses-and-workshops

Operators need to bear in mind that civil aviation regulations are not the only ones that apply to agrichemicals. Some products that are not classed as DGs in civil aviation rules may be classified as hazardous substances or have controls applied by other regulations, notably:

- the Agricultural Compounds and Veterinary Medicines (ACVM) Act 1997, which the Ministry for Primary Industries (MPI) administers, or
- the Hazardous Substances and New Organisms Act 1996 (HSNO), which the Environmental Protection Agency (EPA) administers, or
- National Environmental Standards and National Planning Standards, which the Ministry for the Environment administers, or
- Regional plans, which regional councils, or Territorial Authorities (TAs), manage.

All relevant regulations and standards, except for regional plans, are compiled in Standards New Zealand's *NZS 8409: 2021 Management of agrichemicals*. While this is not a free resource, holders of a current Growsafe certificate can access an online version of the standard for free through a portal on the Growsafe website.

To disperse agricultural chemicals safely under Part 102, staff need:

- training, as noted in the *Training* section of this AC, above, and
- specific procedures to mitigate these risks.

Specific Operations Risk Assessment (SORA)

SORA is a specialised risk assessment process that has been developed for UA activities. Completing a SORA helps operators determine what mitigations are needed in their proposed operations. Those mitigations are then factored into the operator's procedures in

the exposition. There is more information about SORA in Appendix II, and on the JARUS website.

Although CAA considers the SORA methodology an acceptable means of compliance as a risk assessment method under Part 102, not everyone applying for a Part 102 certificate needs to use SORA. While SORA can be used to assess risk for any UA operations excluding the carriage of people, in New Zealand, CAA have chosen to require it only for higher complexity applications.

There is more information about the SORA methodology in Appendix II of this AC.

Writing an exposition

Rule 102.11 (b) sets out what needs to be in an exposition. As noted earlier, an exposition is one or more documents that describes: the operator's activities, the operations they do, and how they do them. This could range from a single document, for simple and small-scale operations, to a range of connected documents for larger, more complex operations or organisations.

Appendix III sets out what should be included in the expositions for different types of operations, depending on their complexity. As outlined below, CAA can accept expositions created and managed through various means. Operators can check Applying for a Part 102 certificate | aviation.govt.nz for more details.

CAA-developed sample expositions

Although every applicant must do an initial operational risk assessment, some approaches outlined in the appendices may be too in-depth for very small-scale or low-complexity operations.

CAA has published a sample exposition for lower-complexity operations, which includes some acceptable safety mitigations within SOPs. CAA may develop other sample expositions over time. Operators can refer to Applying for a Part 102 certificate for the latest available sample(s).

If there is a sample exposition with acceptable safety mitigations relevant to their operation, operators can use it as a starting point to develop their own exposition, as it will prompt writers to provide much of the information that would be needed.

Even for lower-complexity operations, however, the sample exposition is only the first stage in developing an acceptable exposition. Operators will need to add specific information about their operations to the sample exposition for it to be accepted. Expositions must be specific to each operation, and operators must be familiar with the contents.

Third party exposition management tools and writers

CAA accepts expositions created and managed through online tools or written by third party providers. Applying for a Part 102 certificate has the latest details of the tools available.

If using an exposition writer, the operator still needs to fully understand the contents of their exposition, the scope of their operations, the risks their operations may pose and how those risks will be managed. Using a third party does not absolve the operator of their responsibilities.

Person with Primary Responsibility – Prime Person

Organisations must nominate a person who has primary responsibility for their operations – the Prime Person. CAA will assess the person to ensure they meet Fit and Proper Person (FPP) requirements, are fully aware of their responsibilities and have the appropriate knowledge and capabilities to perform the role. The exposition will need to list the responsibilities that this person will have.

There is further guidance in the Senior Persons GAP book and on CAA's website about the Fit and Proper Person (FPP) process.

Note: *The Prime Person does not have to be a UA pilot, but needs a sound understanding of the rules, risk management and the operation's exposition.*

Person having control

In some organisations, the Prime Person may report to someone higher than them in their organisation's hierarchy. Examples would be a Prime Person who:

- is head of UA operations, but reports to the organisation's CE or head of operations, or
- is head of the New Zealand operations but reports to the owner of the parent organisation in another country.

This is particularly relevant if the Prime Person is dependent on that person to authorise expenditure and/ or operations beyond a certain level.

CAA describes anyone the Prime Person reports to as a 'person having control'. Applicants must name any persons having control on the Part 102 application form.

Persons having control do not need to meet FPP requirements, but CAA needs to know who they are and needs to understand the organisation's chain of command. This is because, as part of assessing an application, CAA inspectors need to be satisfied that the Prime Person has either the authority or support from the person having control to adequately fund and support measures that will best manage safety risks in the operation, such as training or machinery checks.

Note: *An organisation is not required to nominate a person having control where the person with primary responsibility is not accountable to someone higher in the organisation's hierarchy.*

Completing the application

Operators need to apply to CAA on the form, *Application for issue or renewal of an unmanned aircraft operator certificate*. This can be found by going to the 'Forms' tab on the CAA website and searching under Part 102.

The form guides operators as to what other information is required, at a minimum:

- an exposition
- a completed form *Part 102 compliance matrix* form, which can be found on the same tab on the CAA website, and

- an FPP application and associated documents for the Prime Person.

It may also include documents such as UAS manufacturer manual(s) or training manuals.

The application form is comprehensive as it needs to cover a wide range of very different operations. If there are sections that are not relevant to their operation, applicants should write N/A. However, the more information an operator provides, the easier CAA's assessment of the application will be and consequently the time taken can be reduced.

Applicants who are unsure about the level of detail needed can contact CAA for a pre-certification meeting, as outlined in the *Before submitting* section below. This should be done once they are ready to apply, have read the rule parts and this AC and have a clear concept of what operations they want to do, and with what UA.

After the application is received, CAA will check that all required documents have been included, then assign an inspector. Applicants may also be asked for more information or to meet with specialist CAA personnel or teams. The inspector(s) will review the proposed operation, using the exposition as a guiding document for this assessment.

Submitting the application

Although not all applications are the same, all applicants will need to meet at least the steps set out below. Applicants are encouraged to review these steps, so they know what to expect when they engage with CAA and can prepare appropriately.

Before submitting:

1. **Before submitting, do the research:** A poor quality or incomplete application will be returned.

2. **Consider requesting a pre-application meeting/discussion:** CAA offers up to one hour of non-chargeable time to discuss the intended application. This is not mandatory, but it is highly recommended. Operators can request a meeting by emailing certification@caa.govt.nz

3. **Check the application includes everything CAA has asked applicants to supply.** It is very important to submit a complete application, with all the documentation needed for CAA to complete an assessment. Incomplete applications will be returned.

When submitting:

4. Email the complete application to certification@caa.govt.nz with all required documents and supporting information attached.

How CAA assesses an application

1. CAA checks for completeness and, if complete, opens a Work Request (WR) file. (If the application is incomplete or incorrect, CAA will return it. A WR will not be created until a complete application has been provided.)

2. CAA emails the applicant, confirming that a WR has been opened and is awaiting assignment to an inspector.

3. CAA assigns an inspector to lead the assessment. (More than one inspector may be assigned for higher-complexity applications.)

4. The inspector contacts the applicant to introduce themselves, provide contact details and discuss the application. The inspector will be able to estimate how long the assessment is likely to take, including likely timeframes for reaching a decision.

Note: *Inspectors need to go through an application and supporting documents before they can estimate how long it will take to assess.*

5. The inspector reviews the documents and provides feedback to applicant.

6. Applicant responds to feedback as appropriate, e.g. by implementing any changes or providing additional information.

Note: *Steps 5 and 6 may be repeated multiple times, until the exposition and any supporting documentation is acceptable.*

7. The inspector schedules an FPP interview of the Prime Person, if needed. The interview may be in person or online.

Note: *The applicant will be charged for the time it takes to do the interview but will not be charged additional fees for CAA's travel costs, unless international travel is required.*

8. The inspector completes the assessment and prepares a draft copy of the Part 102 certificate and operations specification documents.

9. CAA conducts an internal peer review.

10. The inspector makes a recommendation to the Director (or delegate) to:

    - issue a certificate (if approved), or
    - decline the application and explain the reasons to the applicant.

11. The certificate is issued (if approved) or the applicant is informed of the decline (if declined).

Note: *Certificates can be issued for up to five years. To help with future workload scheduling, however, CAA may reduce the validity period by up to six months, e.g. to avoid a certificate expiring over the Christmas holiday period.*

Amending, renewing, or surrendering certificates

Amending a Part 102 certificate

Once an organisation has a Part 102 certificate, they must conduct their operations as per the accepted procedures in their exposition and as stated on the operations specification document (including any conditions or limitations).

In time, operators may need to change the way they operate. Common changes include:

- expanding the types of operations
- improving a procedure, or

- adding a new type of UAS.

These types of changes require operators to make an amendment to the exposition and operation's specification documents.

CAA strongly recommends that applicants keep amendment applications separate from renewal applications. The reasons for this are discussed in the section, *Renewing a Part 102 certificate*, below.

Amendment Procedure

There are two types of amendments: minor amendments (such as fixing typos) which are not assessed, and more substantive amendments, which CAA has to assess. For either type of amendment, operators need to notify CAA.

Determining whether an assessment is minor or substantive

Applicants need to fill in the *Exposition amendment summary sheet*[9], which will help them decide whether the change they are proposing is a minor or a substantive amendment. Operators can find this form by going to the 'Forms' tab on the CAA website and searching under Part 102.

Minor amendments:

These amendments involve minor changes to the exposition that do not change the scope of operations and the operations specification document. Common examples include:

- correcting spelling mistakes or grammar
- changing the pre-flight checklist form after discovering the text boxes aren't large enough
- adding a step in the procedure for pre-flight planning requiring all company vehicles to be fuelled the night before an operation, and/ or
- splitting a section into two parts to make it easier to read, resulting in the page numbers changing.

Operators need to amend the exposition and email it to certification@caa.govt.nz with the completed summary form, referred to above.

CAA will email to acknowledge that the amended exposition has been received, accepted and that the operator's records have been updated. Once this has been received, operators can start using the amended exposition.

The operator is responsible for distributing the amended exposition within the organisation and ensuring continued compliance with the conditions of the Part 102 certificate.

Note 1: *Minor amendments do not incur assessment costs or fees.*

[9] Currently CAA Form 24102-12

Note 2: *Operating with an amended exposition that operators have not provided to CAA, even for a minor change, is an offense, as an operator's approval is based on the accepted exposition. Operators must ensure the amendment procedures in the exposition are followed.*

Substantive amendments:

This type of assessment usually results in some change to the operations specification document and/or exposition. Common examples of substantive amendments include adding:

- a new procedure and Part 102 privilege to operate unshielded at night
- a new type of aircraft, or
- a new maintenance or trading provider.

These amendments do need to be assessed by CAA, so require an application form to be submitted.

A CAA inspector will review the proposed changes to ensure they continue to comply with CAA rules and that any new risks will be managed.

CAA inspectors assess amendments by focusing on changes to key elements:

- **People** – What additional training or staffing might be needed? Have any key personnel, such as the Prime Person, changed?
- **Machine** – What additional inspections, checks or maintenance might be needed?
- **Environment** – What new procedures or controls might be needed to ensure the operation will still be conducted safely?

If operators consider the changes they are proposing through this lens, it can help them ensure they have covered everything they will need to include in their exposition. Proposed amendments which change any of these elements should be treated as substantive.

Operators need to fill out the form, *Application for amendment of an unmanned aircraft operator certificate,* and submit it to certification@caa.govt.nz as per the form's instructions with any required documents (such as the amended exposition).

Applications for a substantive amendment, such as adding more complex operations, may require additional documentation, such as a new hazard and risk management plan. The CAA inspector assigned to the amendment will discuss this with the operator at the start of the assessment.

CAA encourages applicants to submit a substantive amendment request as early as possible, to improve the chances of it being assessed before they are required. As complex amendments will take longer to complete, operators planning these should contact the Certification team well before submitting their application.

Note 1*: Unlike non-assessed applications, assessed applications do incur assessment fees.*

Note 2: *Operators must continue to fully comply with the existing approved operations specifications and exposition until the amendment has been assessed and an approval issued.*

Renewing a Part 102 certificate

Renewals give CAA assurance that an operator is currently, and will continue to be, operating safely and securely, and managing their aviation safety risks.

An operator is responsible for submitting their renewal application and supporting documents in enough time for CAA to process their application before their current certificate expires.

CAA encourages applicants to submit renewal applications at least 60 days before a certificate expires. It is also very important to submit a complete application, with all the documentation that is needed for CAA to complete an assessment. An incomplete application will be returned.

A certificate may be issued for up to five years. To help with future scheduling, CAA may reduce the validity period, e.g. to avoid a certificate expiring over the Christmas holidays.

Operators need to complete the form, *Application for issue or renewal of an unmanned aircraft operator certificate*, which they can find by going to the 'Forms' tab on the CAA website and searching under Part 102, and submit it with all required documents to certification@caa.govt.nz.

CAA strongly recommends that renewal and amendments applications are not submitted together. When applicants submit a renewal application and try to include amendments, this can greatly increase the time it takes to process the renewal. What might have been a straightforward renewal application will be delayed as CAA needs to assess the amendment application as well. This increase the risk that the application won't be assessed by the time the initial certificate expires.

Note: *Failure to submit the renewal application in time may result in the certificate expiring before a new certificate can be issued and disrupting operations. It is an offence to operate without a current Part 102 certificate. Organisations are advised to submit applications to renew certificates in sufficient time.*

The time taken to assess a renewal application varies. CAA's assessment focuses on aviation risk, so inspectors consider:

- the nature and scope of the aviation activity
- the type of aviation risks being managed
- how much the operator and their operation has changed
- the operator's previous performance, and
- their attitude towards safety and security

when working out how detailed the assessment needs to be. Some factors that CAA will consider include whether the operator has been actively reporting accidents or incidents that have happened, has investigated those accidents or incidents well, and if appropriate, implemented appropriate changes to reduce the chances of a recurrence.

Surrender of a certificate

An operator who no longer wishes to hold a Part 102 certificate is required to surrender their certificate by sending CAA the original certificate and a letter, signed by the Prime Person.

CAA will acknowledge receipt of the request to surrender the certificate and send confirmation when the certificate has been cancelled. This does not incur costs.

Part 102 and other legal obligations

Like all aviation participants, Part 102 certificate holders have other legal obligations. For example, workplaces have obligations under HSWA. While this AC does not cover those obligations, organisations need to be aware of them. In addition, resources from other agencies can be useful for setting up a robust hazard and risk management plan. Many of the work tools and suggestions about how to meet HSWA obligations can be used in an aviation safety context.

There are links to some of these resources in the *Further Resources* section.

Further resources

Pages on the CAA website (https://www.aviation.govt.nz/) including:

- CAA's SMS pages, including the four SMS Resource kit booklets.
- https://www.aviation.govt.nz/licensing-and-certification/emerging-technologies-programme/
- https://www.aviation.govt.nz/safety/safety-advice/transporting-dangerous-goods/
- https://www.aviation.govt.nz/drones/regulations/part-102-certification-for-drones/

These may change over time: if they do, search under the applicable terms, e.g. Emerging Technologies; Part 102 certification.

Other CAA resources:

- AC100-1 – Safety Management
- AC61-5 – Pilot licences and ratings – Commercial pilot licence
- AC61-15 – Pilot licences and ratings – Agricultural ratings
- AC61-16 – Pilot licenses and ratings – Pilot chemical ratings
- AC61-17 – Pilot licences and ratings – Instrument Ratings
- AC92-1 – Dangerous Goods Training
- AC92-2 – Carriage of Dangerous Goods
- AC92-3 – Dangerous Goods Packaging approval
- AC92-4 – Dangerous Goods Manuals

Resources on the RMA, National Planning Standards and National Environmental Standards:

- https://environment.govt.nz/publications/understanding-national-direction/about-national-direction/#national-environmental-standards

- https://environment.govt.nz/acts-and-regulations/national-planning-standards/
- https://www.groundrules.mpi.govt.nz/

Resources on HSWA:

- https://www.worksafe.govt.nz/assets/dmsassets/839WKS-5-HSWA-identifying-assessing-managing-work-risks.pdf
- https://www.worksafe.govt.nz/laws-and-regulations/acts/hswa/
- https://www.worksafe.govt.nz/managing-health-and-safety/managing-risks/how-to-manage-work-risks/
- https://www.maritimenz.govt.nz/media/modbqka5/hswa-hazards-risks.pdf

Resources on management of and training options for agrichemicals:

- NZS 8409: 2021 Management of agrichemicals (not available for free)
- Controlled substance licences (WorkSafe)
- https://www.mpi.govt.nz/agriculture/agricultural-compounds-vet-medicines/
- https://www.epa.govt.nz/hazardous-substances/how-we-manage-hazardous-substances/about-hazardous-substances-and-hsno/
- https://www.epa.govt.nz/hazardous-substances/rules-notices-and-how-to-comply/epa-notices-rules-you-must-follow/
- https://www.nzgap.co.nz/

More information on risk management:

- AS/NZS ISO 31000:2018 (not available for free)
- ISO 31000, Risk management
- ISO 31000:2018, Risk management — Guidelines (not available for free)
- ISO 31000:2018 Risk management – Principles and Guidelines
- JARUS – Joint Authorities for Rulemaking on Unmanned Systems (jarus-rpas.org)
- https://www.nzta.govt.nz/roads-and-rail/rail/operating-a-railway/risk-management/
- https://www.dmp.wa.gov.au/Safety/What-is-a-hazard-and-what-is-4721.aspx

For an introduction to recommended UA training providers:

- https://www.uavnz.org/

For introductions and guides to common risk analysis tools, such as bowtie and risk matrices:

- https://shahrdevelopment.ir/wp-content/uploads/2020/03/ISO-31000.pdf
- You Tube video: Principles of ISO 31000 risk management

- https://cdn.auckland.ac.nz/assets/auckland/health-safety-wellbeing/health-safety-topics/risk-assessments/hsw-risk-assessment-template-matrix-only-v3-2021-07-01.pdf
- https://www.auditboard.com/blog/what-is-a-risk-assessment-matrix/#:~:text=As%20part%20of%20the%20risk,or%20at%20the%20enterprise%20level.
- https://www.nzta.govt.nz/roads-and-rail/rail/operating-a-railway/risk-management/risk-matrix-likelihood-and-consequence-tool/
- https://intesafety.co.nz/bowtie-risk-analysis-model/
- https://www.nzta.govt.nz/roads-and-rail/rail/operating-a-railway/risk-management/risk-matrix-likelihood-and-consequence-tool/
- https://www.wordstream.com/blog/ws/2017/12/20/swot-analysis
- https://en.wikipedia.org/wiki/Bow-tie_diagram
- https://www.wolterskluwer.com/en/solutions/enablon/bowtie/expert-insights/barrier-based-risk-management-knowledge-base/the-bowtie-method
- https://www.wolterskluwer.com/en/solutions/enablon/bowtie/bowtiexp
- https://en.wikipedia.org/wiki/Swiss_cheese_model
- https://phw.nhs.wales/services-and-teams/improvement-cymru/improvement-cymru-academy1/resource-library/academy-toolkit-guides/reasons-swiss-cheese-safety-model-toolkit/

Appendix I – Summary of ISO 31000:2018

There are several methods for developing and running an effective risk management plan. This appendix summarises material from ISO: 31000:2018, and the Australasian version, AS/NZS ISO 31000:2018, a widely used methodology. The main process steps are:

Establish Context

Operators need a good understanding of the context in which they are operating and to be able to describe that context within their exposition. This includes:

- the size and complexity of the operation
- the nature and complexity of the UAS
- whether the operation is novel
- whether the operator has experience with this type of operation
- how the organisation will keep the operation safe and develop a safety culture
- the extent and nature of the interface with other individuals and organisations
- the future positioning of the organisation and the planned rate of growth, if any
- the fiscal sustainability of the organisation, and
- the environment that operation will be working in, such as:
    - relevant local regulations, such as regional plans
    - any challenging aspects of local geography or weather
    - whether the locations are urban or rural, and
    - whether the local community supports the operation.

Hazard identification

Hazards can be identified through many sources, including in-house safety reporting systems, inspections, audits, and information sharing. External sources of information could include professional research, industry publications, and published accident and incident data.

Reactive (or research-based) analysis involves research about events, serious incidents or accidents that have already happened, particularly in operations with similar scope and technology. This involves analysis of past outcomes or events. Hazards are identified through investigations of safety occurrences, incidents or events, or quality audits, in the operator's organisation. Incidents and accidents are an indication of system deficiencies, so can be used to determine which hazard(s) contributed to the event. Sharing safety-critical data can mean that an event in one operation or part of an organisation, can become a learning opportunity for others.

Proactive analysis highlights potential hazards in the operation's environment, technology, activities and processes. It is especially applicable to new or changing parts of the operation, or very innovative operations. This involves collecting safety data of lower-consequence events or process performance, often from safety reporting systems or audits to help

operators determine if a hazard could lead to an accident or incident. Proactive hazard identification can also be achieved through systematic reviews of operational processes and procedures as well as during planning for change that the operation may considering.

Examples of hazards posed by Part 102 activities include:

Hazard	Risk	How this could be mitigated
Flight over any property without the permission of the property owner or occupier	Damage or disturbance to people, property or the environment	Developing a process to identify any hazards posed by the property to your operation, hazards your operation poses to the property, and how to mitigate the risks from those hazards.
Flight unshielded and without a barrier within 4 km of any aerodrome without the permission of the aerodrome operator	Damage or disruption to other aerodrome traffic, e.g. collisions Damage or disruption to civil aviation system	Developing a process to gain thorough knowledge of the NZ AIP details of the aerodrome, as well as knowledge of any local procedures. Developing procedures to detect and remain well clear of other aircraft to mitigate the risk of a collision.
Operating an aircraft that is 25 kg or larger	UA falling or colliding with objects damaging or disturbing people, property or the environment Damage or disruption to civil aviation system	Ensuring operators understand the likelihood and consequences of an impact, either with the surface, an aircraft, or a person Investigating proposed mitigations and how they affect the weight of aircraft.
Flight at night, outside and unshielded		Demonstrated processes to mitigate risk from hazards at night, such as visual illusions, lack of depth perception, disorientation, lack of spatial awareness etc.
BVLOS flight		Developing adequate procedures to maintain control of the UA/s and to detect and avoid other aircraft and objects.
Carrying out agricultural operations involving the aerial dispensing of agricultural chemicals, fertilisers or VTAs	UA dropping load in the wrong place or by accident, damaging or disturbing people, property or the environment	Ensuring all staff involved with handling and dispensing of agricultural chemicals have appropriate qualifications/ ratings, and adequate training and competency.

Risk identification and analysis

Once hazards have been identified, the operator needs to identify and analyse the associated risks, in particular what the consequence(s) might be and how likely they are to occur.

There are several risk assessment tools available. A risk matrix combines consequence and likelihood into a risk level. This may work well for more formal risk assessments, such as a risk management plan. However, for smaller-scale assessments, an operator might just rank risks, and proposed actions to mitigate them, based on pre-agreed criteria, such as how effective the mitigation is likely to be, and how much it will cost or time it will take to carry out.

The more complex an operation, the more detailed risk assessments will need to be, as more complex operations involve more things that could go wrong. The analysis could be very detailed, ranking a range of risks against pre-defined criteria (such as likelihood of injury to the public or damage to property, likelihood of technical failure over a period of time or number of flights). It would then contain a similar ranking of proposed mitigations, based on how much it will take or cost to do them against how effective they are expected to be.

A more complex tool, such as a bow-tie diagram, might also be useful, for more detailed analysis that seeks to go beyond the first likely causes and preferred mitigation. While risk matrices assessments are easy to use and quick to fill in, they can fall short in analysing complex risks, and the difference between elements such as consequence and likelihood. Bow-tie assessments are more difficult and take longer to work through, but this can result in deeper analysis and better solutions.

Bow-tie methodology builds on Reason's Swiss Cheese model[10], and has the advantage of being more visual than a matrix, so users can clearly see the relationship between hazards, risks and controls. In addition, the bow-tie tool is fundamental to the SORA methodology, so operators who need to do a SORA will benefit from learning about bow-tie analysis.

The *Further Resources* section has some links to examples. These may change over time and are quite generic, so more complex or larger operations may wish to invest in ISO standards or contract a risk management consultant.

Whatever tools are used, if an operation plans to change, its risk profile is also likely to change. Operators may find more detailed approaches better reflect the needs of their operation as it grows, or they do more complex operations.

Also, if an operation decided to change its risk management methodology, that would be considered a material change. In both cases, the operator would need to apply for an amendment to its Part 102 certificate, which CAA would assess.

[10] There are links to examples in the *Further Resources* section.

Examples of risk tools

Risk matrix[11]

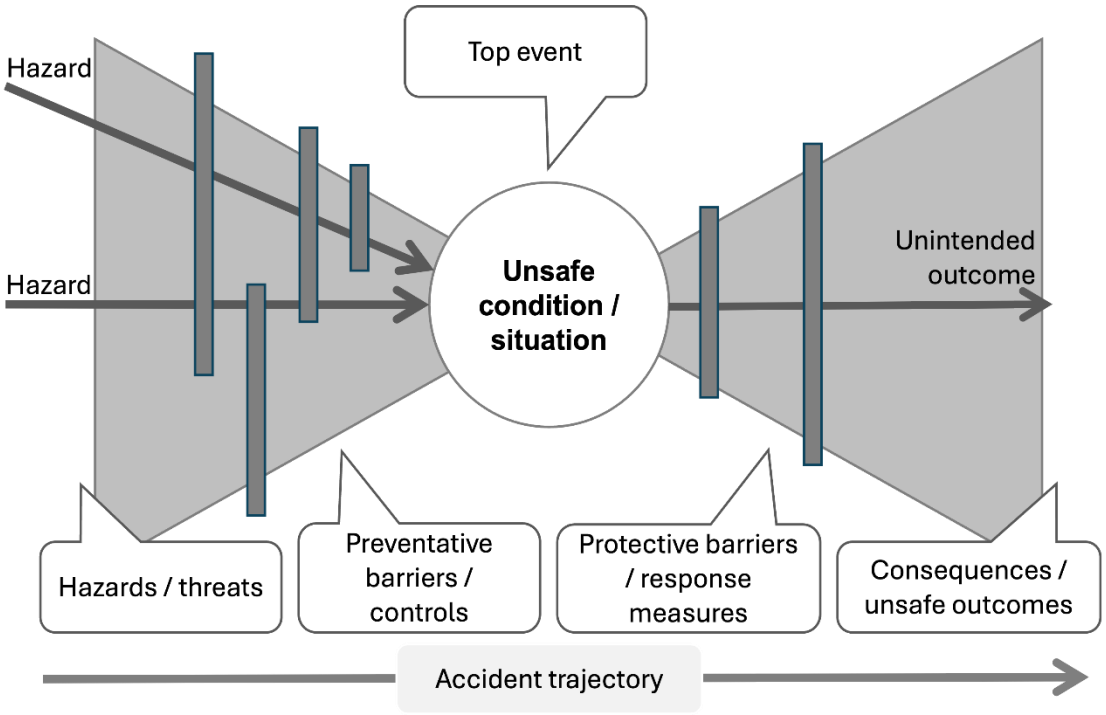
Likelihood	Impact / Consequence				
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Catastrophic
5 Almost certain	5	10	15	20	25
4 Likely	4	8	12	16	20
3 Possible	3	6	9	12	15
2 Unlikely	2	4	6	8	10
1 Rare	1	2	3	4	5

Extreme risk (20-25)	The process, task or activity in question **must not occur or must cease** until actions are taken to eliminate the hazard or minimise the risk. CE/Board oversees specific review of effectiveness of new or additional controls before process, task or activity can commence or recommence.
Very high risk (15-16)	Actions are to be taken to eliminate the hazard or minimise the risk. The relevant Executive Manager oversees action plans and receives reports on progress. Specific consideration of control effectiveness and new or additional control options to be considered.
High risk (10-12)	Actions are to be taken to eliminate the hazard or minimise the risk. General Manager oversees action plans and receives reports on progress. Periodic consideration of control effectiveness and new or additional control options to be considered.
Moderate risk (4-9)	Actions are to be taken to eliminate the hazard or minimise the risk. Relevant Business Unit Manager oversees action plans and receives reports on progress. Periodic consideration of control effectiveness and new or additional control options to be considered.
Low risk (1-4)	The process or activity in question continues with existing controls. Ongoing monitoring of existing control effectiveness (within agreed business as usual (BAU) arrangements). Continue to reduce the risk by adopting any improvements in safety the business becomes aware of.

[11] https://www.nzta.govt.nz/roads-and-rail/rail/operating-a-railway/risk-management/risk-matrix-likelihood-and-consequence-tool/

Bow tie

The process starts by defining the 'Top event'. SORA calls this 'Loss of control', but operators may develop a more useful picture by being more specific, or focusing on other hazards, such as 'Unsafe condition or circumstance'[12]:



Keeping a hazard and risk register

The hazard and risk register could be as simple as a word or excel document, recording what is being done to follow the risk management plan. It should be treated as a living document, updated as hazards and risks change.

It is important that the operator involves the pilots, technical and other staff and where appropriate, stakeholders and clients, to help determine appropriate risk controls. Ensuring the right people are involved helps develop risk mitigations that work best and have as few unintended consequences as possible. A determination of any unintended consequences, particularly new hazards, should be made before implementing any controls.

The register can store background, such as:

- description of risk or hazard
- what causes the hazard
- assessment of associated risks
- identification date
- where it happens

[12] Thanks to Navigatus Consulting for sharing this diagram.

- who identified it and how
- what controls have been put in place to mitigate the risk/s
- who is monitoring each risk and making sure the controls are being carried out
- who owns each risk, so is responsible for making sure it is being managed
- what happened after controls have been put in place
- what has changed since the register was last reviewed.

It could also be a place to store discussions on factors affecting hazards and risks, such as:

- the ongoing competency and fitness of staff involved in the operation
- the ongoing airworthiness of the UA
- the reliability of the UAS
- the interface (if any) with the traditional aviation system, including possible conflict with manned aircraft
- any changes to:
    - environmental hazards
    - local support for the operation, and
    - local legislation, such as regional plans.

The register should be tailored to the scale of the operation.

Evaluating and treating risks

Managing risks also involves assessing and determining the right mitigation control measures for eliminating or minimising the risk.

Firstly, consider eliminating the risk. Secondly, if and only if it is not practical to do so, consider other ways to minimise the risk. When minimising the risk, operators should take reasonably practicable steps to do so.

'Reasonably practicable' is a concept that is well understood in New Zealand context, drawing from sections 22 and 33 of HSWA. The Director has deemed the concept as being applicable and appropriate when determining whether an organisation is adequately managing aviation safety risk.

In considering whether steps are reasonably practicable, CAA expects the operator to consider all relevant matters and do what is reasonable at any time to ensure safety. When determining what is reasonable, operators should consider:

- the likelihood of the hazard or the risk concern occurring
- the degree of harm that might result from the hazard or risk
- what the person concerned knows, or ought reasonably to know about:

- the hazard or risk, and
- ways of eliminating or minimising the risk, and

- the availability and suitability of ways to eliminate or minimise the risk, then
- after assessing the extent of the risk and the available ways of eliminating or minimising the risk:
  - the cost of available ways of eliminating or minimising the risk, including
  - whether the cost is grossly disproportionate to the risk.

Evaluating controls and identifying new hazards or risks

Hazard and risk management need to be continuous and ongoing to be effective. The register should evolve over time and the operator's risk management approach should monitor its operational activities, not only to determine if the controls are working as desired, but also to identify new or emerging hazards and risks.

The operator needs to document processes for keeping the register current, and to:

- enable staff, contractors, suppliers, clients or other interested parties to raise or report safety concerns or issues, and consider how they will be reported to the regulator
- assess risks arising from those issues, and review the mitigations to manage them
- reach decisions on appropriate controls for hazards and risks
- investigate incidents or accidents, particularly if unexpected or new
- engage with staff and contractors and other interested parties, where useful, to identify and assess new hazards and determine risk mitigations, and
- carry out systematic reviews or audits of the operational activities being conducted to manage risk, to assess the effectiveness of these controls.

Appendix II - Specific Operations Risk Assessment (SORA)

Relationship between SORA and risk management plan

CAA may require operators planning to work on new or complex technology to complete a SORA or similarly more detailed risk assessment. This appendix outlines the key processes of SORA, but applicants are strongly recommended to check the JARUS website, for documents and background.

For most applicants the SORA model is more complex than what they need to satisfy CAA. Operators who don't need a SORA, however, can still learn from the JARUS website about developments in UA. Applicants who are not sure if they need a SORA should contact the certification team.

Applicants who are considering genuinely innovative and novel technology are encouraged to approach CAA's Emerging Technology Programme which works with innovators developing cutting-edge and complex technology.

What JARUS is and how they developed the SORA

JARUS is a group of experts from NAAs and regional aviation safety organisations, who recommend technical, safety, and operational requirements to safely integrate UAS (which they refer to as RPAS) into the aviation system. Members work together to develop material to help NAAs create their own guidance.

JARUS developed the SORA model as a risk assessment methodology to analyse and assess the ground and air risks of a proposed UA operation and establish confidence it can be conducted with an acceptable level of risk.

The SORA has evolved through an iterative process, and immediate and near-term use cases. As UA become more commonplace and UAS more complex, the SORA tools will continue to develop to address these changes in the industry. For example, currently SORA calculations do not consider UAS to UAS collision risk, but this is likely to be a feature of future documents, as UA become more common.

SORA methodology

CAA views the SORA methodology as one, but not the only, acceptable means of compliance, with the risk assessment required by Part 102.

JARUS SORA documentation is freely available on the Publications tab on the JARUS website.

JARUS regularly updates the SORA, so it is important to check the JARUS website for the latest version before starting the process. Applicants should use the latest version of SORA available, if they decide to use this methodology.

The following guidance is intended for proposed operations that can achieve a Specific Assurance and Integrity Levels (SAIL) of I-IV under the SORA assessment. For any proposals that fall into SAIL V or above, it is recommended the applicant contact CAA before applying to discuss the proposal.

When SORA is used, a stand-alone SORA safety portfolio should be submitted in three phases:

Phase One

The applicant submits the SORA safety portfolio with data developed from SORA steps 1-6. CAA reviews and agrees with (or rejects) the CONOPS, ground and air risks, mitigations, and SAIL determination. Acceptance of this phase allows applicants to proceed to Phase Two.

Note: *It is extremely important for applicants to spend the time to develop a detailed and thorough CONOPS document when submitting a SORA, as failure to do this well usually results in extra assessment, significant delays and additional certification costs. JARUS Annex A contains guidance on what is need for a CONOPS.*

There is a spreadsheet on CAA's 102 forms page, the Part 102 SORA assessment workbook, which acts like a matrix for SORA. It allows applicants to work through the steps, listing what they have claimed and where the evidence for claims can be found in the documentation. If the CAA matrix differs from the latest version of SORA, the SORA takes precedence,

CAA strongly recommends that operators who need to do a SORA use this tool as it helps speed up CAA's assessment.

Phase Two

After the SAIL determination (Step 7), the applicant proposes how they will comply with the required mitigations (Step 8) and the Operation Safety Objectives (OSOs) at the agreed robustness levels based on the SAIL outcome (Step 9).

Methods of compliance can be shown in several ways, including by:

- indicating where evidence is found in another compliance document, such as the exposition or a procedure document
- identifying an industry standard that will be met to show compliance
- identifying third-party verification plans, and/or
- any other proposal by the applicant.

Applicants should summarise how they intend to meet the OSOs in matrix form as in the example below, using the SORA workbook:

OSO Number	OSO Description	Robustness Level (O, L, M, H)	Means of Compliance	Evidence Location
01	Ensure the operator is competent and/or proven		Comply with standard, demonstrate through procedure, etc.	Document Name and Number
02	UAS manufactured by competent and/or proven entity		Comply with standard, demonstrate through procedure, etc.	Document Name and Number
…				
24	UAS designed and qualified for adverse environmental conditions		Comply with standard, demonstrate through procedure, etc.	Document Name and Number

CAA will review and agree with (or reject) the proposals for SORA steps 8 and 9. Acceptance of this phase allows applicants to proceed to Phase Three.

Phase Three

The applicant develops the data proposed in Phase Two and submits the final safety portfolio (Step 10), including documents used in showing compliance, as part of the process for approval and issuing of the Part 102 certificate.

Submitted data should be released and under revision control. Draft or uncontrolled data will not be accepted. Applicants need to track document revisions between phases and may have to address comments from CAA within phases. Some form of change tracking (e.g. change bars) should be used in these revisions.

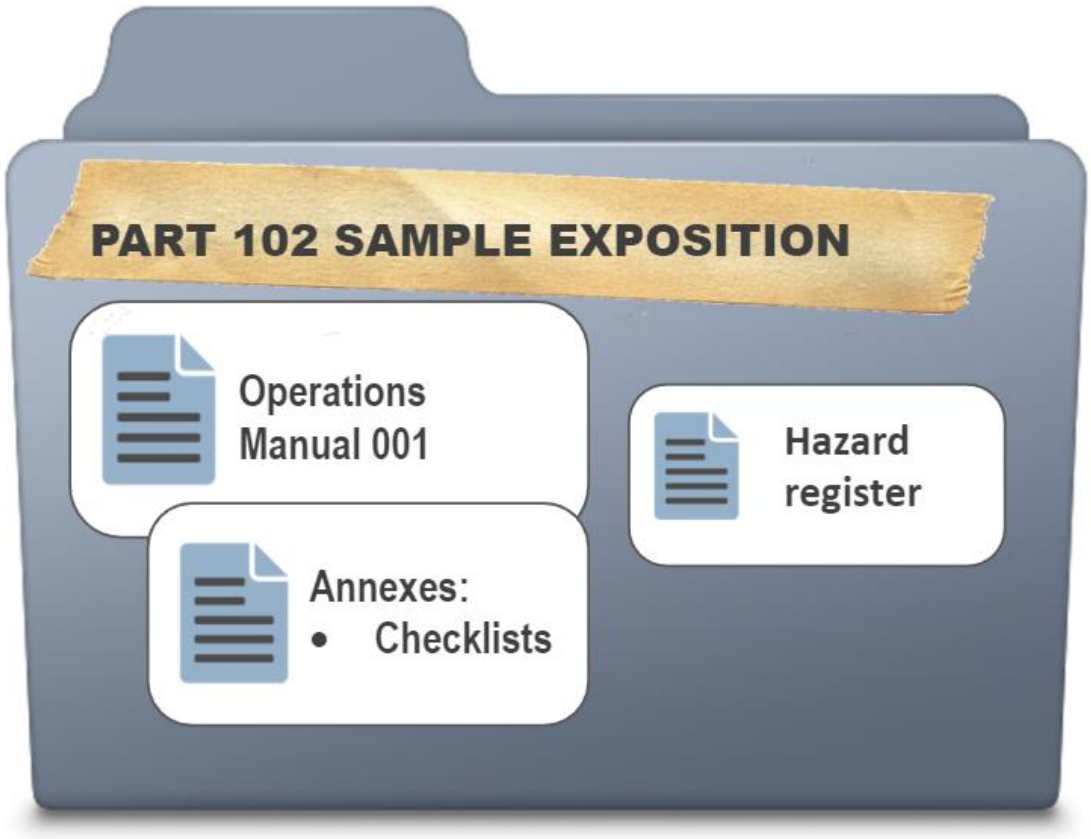
When preparing an exposition, applicants may wish to, or be required to, meet other civil aviation rules (for example, Part 91, *General Operating and Flight Rules*, or for an agricultural operation, Part 137, *Agricultural Aircraft Operations*) where this would help provide assurance to the Director that the operation will be conducted according to the highest possible safety standard.

Appendix III – Examples of sets of exposition documents

An exposition is several controlled documents that CAA assesses as part of the certification process. This could range from a single document, for very simple operations, to a range of connected documents, for larger and more complex operations.

Example 1: Operations that fit the sample exposition

The applicant's operation matches the description of a sample exposition. Alongside the required application forms, the applicant must send CAA:

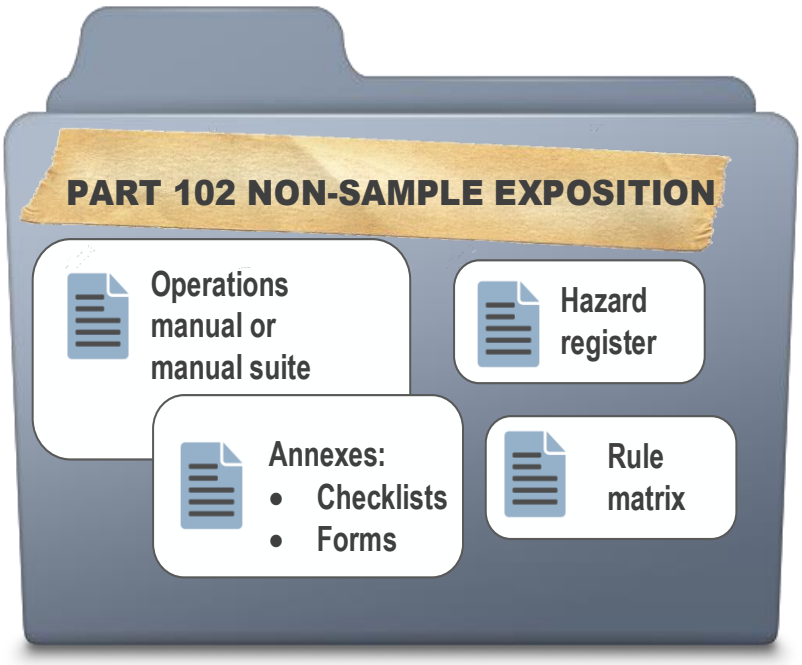


'Operations manual' is the provided sample document with the checklists annexed, and any relevant company information inserted.

A start point hazard register is given, so the participant does not need to create a format, just ensure the content is relevant to their operations.

Example 2: More complex operations that do not match the sample but do not need a SORA

The applicant's operation does not match a sample exposition description, but it does not require a SORA. This also applies to an operator that can match a sample exposition but chooses not to use the CAA sample format. Alongside the required application forms, the applicant must send CAA:



The operations manual may follow a sample exposition that addresses some of the required rules and contains relevant risk mitigations and procedures for other privileges being sought under other rules.

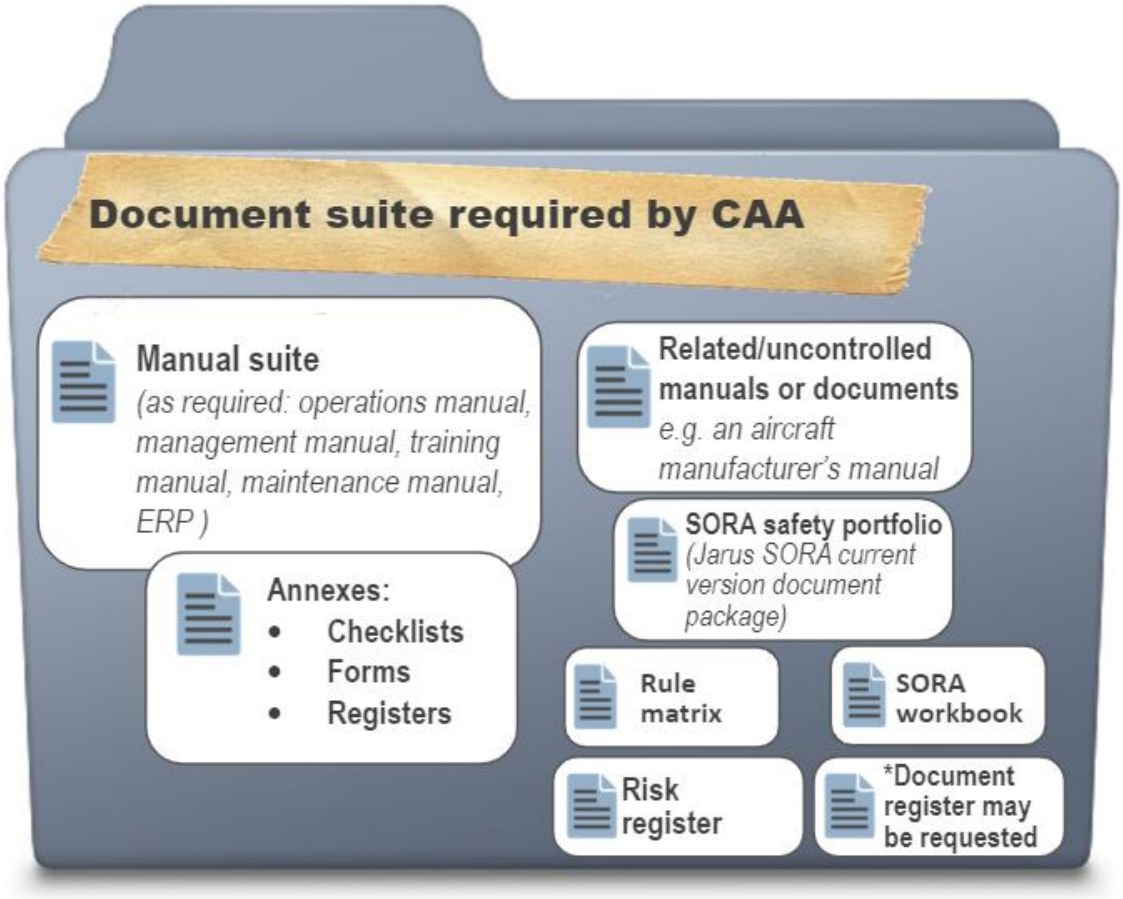
Alternatively, any format of operations manual can be provided at the applicant's choice.

A Part 102 compliance matrix (which may also be known as a rules checklist) is required.

Some applicants may choose to provide more than one manual as relevant to the scale of their operations, e.g. a maintenance manual.

Example 3: Complex operations that do not match the sample and need a SORA

The operation is unique and/or first of type. Appendix II provides more information about risk assessments, the JARUS SORA methodology and the SORA process, including links to templates and other documents. The figure overleaf outlines requirements if applicants need to do a SORA risk assessment. (If using another risk assessment method, speak to CAA to discuss requirements.)



This scenario may not require all documents to be produced at the time of application, as several feedback points exist. In some cases, the SORA assessment may be provided at a later stage in the application process: please see Appendix II, above, for more information.

An indication of the different stages in the process is provided below: