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The non-prescriptive approach of the Australian Space (Launches and Returns) regulations: ensuring safety while supporting space industry

Shena Howell, *Senior Systems Engineer – Space, Shoal Group Pty Ltd, Adelaide, Australia,*
shena.howell@shoalgroup.com

Abstract

Australia's Space Regulations were overhauled with the release of the *Space (Launches and Returns) Act 2018*, establishing a framework to ensure the safety of third-party people and property in line with global best practice, also establishing a flexible framework designed to support creative technologies emerging from the space launch and return commercial markets. Since then, the regulations have been successfully implemented across a wide variety of space activities, from sounding rocket launches to the world first lading of a commercial spacecraft at a commercial range.

This text will discuss the flexible nature of the Australian Space regulations, showing how the structure of the regulation ensures safety without being prescriptive in the method for meeting the requirements of the Act and its associated Rules and standards*. The Australian legislation, released before the United States Federal Aviation Administration (FAA) Regulation Part 450 commercial space launch and returns updates, underpins a space activities assessment process that is risk-based. This allows applications to be developed at a level commensurate with the risk of the space activity being proposed. Since the regulations are not prescriptive, they also support a wide variety of technologies and approaches for space activities, keeping the regulatory environment open for emerging space industry.

While the regulations have been broadly effective, there is always room for improvement in any system. The Australian Space Agency has demonstrated a willingness to collaborate and listen to the space industry, and has ushered through several updates to the legislation via addendums to the Rules. These updates have further improved the process and reduced the administrative burden for applicants, while maintaining safety for the public.

Additionally, since the regulations are not prescriptive, it can be difficult for a new applicant to understand 'what good looks like', and therefore, how to develop a comprehensive application that will match the risk of the space activity. This text will also discuss some considerations applicants can make in developing a submission to ensure the right types and level of information is include for the activity being proposed.

* *Space (Launches and Returns) (General) Rules 2019, Space (Launches and Returns) (High Power Rocket) Rules 2019, and Space (Launches and Returns) (Insurance) Rules 2019*, *Flight Safety Code*, and the *Maximum Probable Loss (MPL) Methodology*

Keywords: Legislation, Regulation, Act, Rules, Safety, Application

1 The current regulatory framework

1.1 Space activities covered under the legislation

The Australian Space legislation establish the requirements for the licencing and authorisation of Australian space activities. Space activities that require approval are:

- Space launches (above 100 km) – require an **Australian Launch Permit** (ALP)
- Establishing space launch facilities – require a **Launch Facility Licence** (LFL)
- Returns (from above 100 km) – require a **Return Authorisation** (RA)
- High power rocket launches (under 100 km, above a certain thrust capacity) – require a **High Power Rocket Permit** (HPRP)
- Australian space objects launched overseas (payloads) – require an **Overseas Payload Permit** (OPP).

At its core, the Australian Space Launches & Returns regulatory approach is straightforward – it consists of just 6 documents, as shown in Figure 1.

The Australian Space (Launches and Returns) ('L&R') legislation sits within a broader context, and the framework ensures Australia complies with its international commitments such as the:

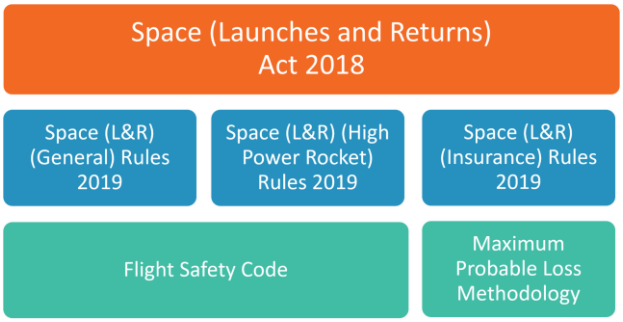

Fig. 1. The Australian Space regulatory framework

- *Convention on International Liability for Damage Caused by Space Objects,* and
- *Convention on Registration of Objects Launched into Outer Space*.

Moving from the legislation in the Act to the regulations provided in the subsequent Rules, and then into the detailed analysis methodologies invoked by the Rules establishes increasing levels of specificity to address as part of a space activity application, as described below.

The *Space (Launches and Returns) Act 2018* ('the Act') establishes the legislative framework that ensures Australia aligns to its international obligations

Three (3) sets of regulations apply in different instances – these provide the rules and requirements for addressing the Act:

- *Space (Launches and Returns) (General) Rules 2019* ('General Rules'),
- *Space (Launches and Returns) (High Power Rocket) Rules 2019* ('High Power Rocket Rules'), and
- *Space (Launches and Returns) (Insurance) Rules 2019* ('Insurance Rules')

Two (2) analysis methodology documents are invoked by the Rules, and they provide a set of detailed analysis instructions that are used to demonstrate compliance to flight safety and liability requirements, respectively:

- *The Flight Safety Code and*
- *Maximum Probable Loss Methodology*.

1.2 Overview of the Act

1.2.1 Objective of the Act

The Act is the legislation that sets the framework for regulating commercial space activities in Australia.

At the outset, the Act sets the objective of ensuring that a reasonable balance is achieved between:

1. The safety of space activities
2. The removal of barriers to participation in space activities and the encouragement of innovation and entrepreneurship in the space industry.

1.2.2 Applicability of the Act

The Act establishes that the regulation for Australian space activities applies to:

- Those seeking to conduct covered activities in Australia
- Australians seeking to conduct a covered activity overseas.

1.2.3 Scope of the Act

Regulatory administrative framework

The Act establishes the regulatory administrative framework, including identifying the scope of space activities that fall under the legislation (listed in 1.1), penalties that apply for those who do not comply, information about liabilities for parties conducting a space activity (in alignment with international treaties), what constitutes an accident, and information about investigations, appointment of a Launch Safety Officer per launch activity, and the approval of suitably qualified experts for conducting flight safety analysis.

Requirements of applications

In addition, the Act establishes the requirements for approval of a space activity application. The requirements vary slightly for each type of space activity application, but broadly, the requirements include that the Minister must be satisfied the activity:

- Is safe (i.e., reduce risk to public health, safety and property to as low as reasonably practicable)
- Is conducted by competent people
- Has environmental approval
- Is not a national concern,
- Has appropriate insurance / financial coverage,
- Meets the respective Rules.

1.3 Exploring the Rules

Fig. 2. Requirements of the Rules (broadly)

As discussed, there are three sets of regulatory Rules documents that apply for various space activity applications. While the Rules vary slightly per space activity type, broadly, they typically require an applicant address the same criteria identified in the Act, but with more specific requirements for each. An overview of the applicability and content of the rules is provided below.

1.4 General Rules and High Power Rocket Rules

1.4.1 Applicability

The General Rules and High Power Rocket Rules include similar requirements for launch activities but apply to different launch types.

General Rules

- Australian Launch Permit (ALP)

- Return Authorisation (RA)
- Overseas Payload Permit (OPP)
- Launch Facility Licence (LFL)

<u>High Power Rocket Rules</u>

- Australian High Power Rocket Permit (HPRP)

1.4.2 Scope of the General and High Power Rocket Rules

Both the General and High Power Rocket Rules broadly cover the same requirements. These include:

- Standard authorisation conditions (for an authorisation / licence / permit)
- Space activity application requirements such as:
  - applicant information
  - technical information
  - operational plans including environmental, security and emergency plans
  - financial / insurance coverage
- Approval of suitably qualified experts for safety analysis
- Mandates the use of the Flight Safety Code, and
- Transfers, variations, and other permit administration requirements.

1.5 Insurance Rules

1.5.1 Insurance Rules Applicability

The Insurance Rules are used to ensure that the space activity has the appropriate financial coverage to meet the liability requirements of the Act and international treaties. The Insurance Rules apply to all launch and returns activities, though some activities do not require insurance under the Australian legislation, since they will be required by other nation's regulations.

The Insurance Rules apply to:

- Australian Launch Permit (ALP)
- Return authorization (RA)
- Overseas Payload Permit (OPP)
- Australian High Power Rocket Permit (HPRP)

1.5.2 Insurance Rules scope

The Insurance rules cover:

- Requirements for insurance / financial coverage
- Minimum insurance requirements
- Use of Maximum Probable Loss Methodology.

1.6 Flight Safety Code (FSC)

The FSC is applicable to:

- Australia Launch Permits (ALP)
- Australia High Power Rocket Permits (HPRP)
- Return Authorisations (AU).

The FSC includes:

- Safety standards for a launch or return (quantitative safety limits)
- Quantitative safety analysis methodology.

The quantitative analysis is called the Risk Hazard Analysis (RHA) and is akin to the USA FAA Flight Safety Analysis. The RHA includes trajectory, failure mode analysis and probabilities, debris catalogue, explosive potential, casualty areas, probabilities of impact, etc.

1.7 Maximum Probable Loss (MPL) Methodology

The MPL Methodology is applicable to:

- Australian launch or return, when seeking a lesser amount of insurance than specified in the Insurance Rules.

The MPL Methodology includes:

- Methodology to conduct a risk-based analysis of the greatest potential loss for bodily injuries and property damages that can reasonably be expected to occur because of launch or re-entry activities.

2 Non-prescriptive approach of the regulatory framework

2.1 Overview

The Space (Launches and Returns) Act and Rules are non-prescriptive - they identify a broad set of criteria that should be provided, but do not specify what that criteria should look like. Each application type includes slightly different Act criteria and Rules, but the examples below broadly cover the types of information the Act and Rules require.

2.2 Safety

Under the Act, the Minister must be satisfied that the risk to public health, safety, and property is as low as reasonably practicable.

Types of Rules that apply:

- Demonstrate quality management
- Prove technical soundness (design, manufacturing, test information)
- Demonstrate appropriate operational controls
- Signed undertaking (for payload operations)
- Quantitative Safety Analysis (for launches & returns).

2.3 Competence

Under the Act, the Minister must be satisfied that the person carrying out the activity is competent to do so.

Types of Rules that apply:

- Organisation Structure & Personnel – identify who is accountable for what
- Provide qualifications and experience information for accountable people.

2.4 Environmental Plans

Under the Act, the Minister must be satisfied that the necessary Australian environmental approvals have been obtained, and an adequate environmental plan has been made.

Types of Rules that apply:

- Identify what environmental approvals are required (if any)
- Provide approval and / or environmental plan.

2.5 Insurance / Financial coverage

Under the Act, the Minister must be satisfied that:

- The insurance / financial requirements of the Act will be satisfied (launches and returns)
- There is sufficient funding to construct and operate the launch facility.

Types of Rules that apply:

- Provide Insurance certificate or evidence of financial coverage
- Contract information for related parties of the activity.

2.6 No national concerns

Under the Act, the Minister must be satisfied that there are:

- No nuclear weapons or a weapons of mass destruction
- No reasons relevant to the security, defence or international relations of Australia that the permit should not be granted.

Types of Rules that apply:

- Signed declaration – no nuclear or weapons of mass destruction
- Organisation and personnel – ownership & control information.

3 Determining 'what good looks like' for an application

3.1 Overview

While the regulations are straightforward, understanding 'what good looks like' can be a challenge for applicants since the scope and detail required to address the Rules will depend on the complexity and the risk of the activity being proposed. The 'burden of proof' to demonstrate the requirements are met necessarily increases as the complexity and risk increase.

This can best be demonstrated by using two extreme case studies:

- **CASE A**: A simple sounding rocket mission
- **CASE B**: A lunar orbit mission (like the Artemis I Mission).

3.2 Complexity Comparison

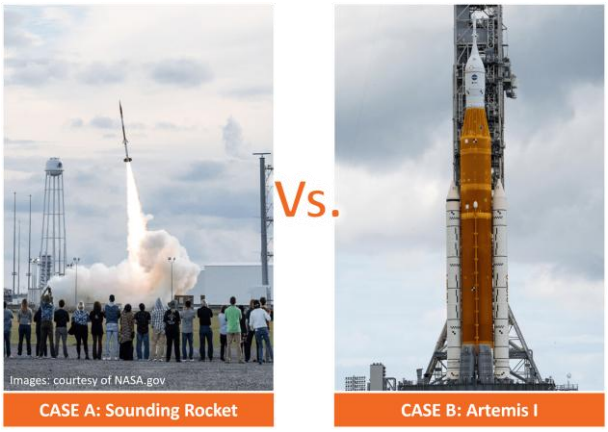

Fig. 3. Two case studies at different complexity and risks scales used to demonstrate what a good application will look like. Images courtesy of NASA.gov.

The comparison below highlights some of the key differences of the two cases as it relates to Australian regulation.

<u>CASE A: Sounding rocket mission</u>

- Single stage
- Suborbital
- No onboard guidance system
- Simple design – low number of potential failure modes
- Low TNT (explosive) potential
- Short trajectory distance (ground-track)
- Small potential debris footprint
- Low potential environmental impact
- No flight termination system (wind weighting / containment used to plan debris locations)

<u>CASE B: Artemis I mission</u>

- Multi-stage
- Orbital
- Complex, highly reliable guidance systems required
- Complex design – many potential failure modes
- High TNT (explosive) potential
- Long, complex trajectories, overflight of other nations
- Large potential debris footprint
- High potential environmental impact
- Complex, highly reliable flight termination (launch abort) systems required

With an understanding of the differences in complexity and risk, listed below are examples of how

the launch Rules related to safety may be addressed for the two rocket types. These comparisons are illustrative in nature and are not intended to be all encompassing.

3.2.1 Quality

CASE A: Sounding rocket mission

The applicant can submit a Quality Plan that demonstrates:

- Procurement controls are in place so only previously flight qualified hardware is used
- There is a defined approach to technical qualification of assembled systems
- The configuration will be managed (so that what is approved by the Minister is what will be used for the activity)
- People will only perform tasks they are competent and qualified to perform

CASE B: Artemis I mission

For a system as complex as a lunar mission rocket, demonstrating the safety case requires more information. To demonstrate appropriate quality management systems are in place, the applicant must submit a comprehensive set of information that demonstrates that the Quality controls are appropriate for the highly complex systems. This would likely include, but not be limited to:

- International Certification (AS9100, ISO9001, or similar)
- Dedicated / independent quality management staff
- Rigorous quality management plans including supplier assessments
- Detailed inspection processes
- Formalised non-conformance management and quality review teams

3.2.2 Technical Soundness

CASE A: Sounding rocket mission

For a simple rocket, the applicant can take a simple approach to demonstrating that the system is technically sound and will keep public risk low. Ideally design, assembly and test information should be provided, but for a simple system it may be sufficient to demonstrate that the applicant:

- Procure only flight-proven components (used in similar applications)
- Conducts comprehensive system validation testing (structural, electrical, etc.) to show parts and assembled systems perform as expected

CASE B: Artemis I

For a complex rocket like the Orion spacecraft for the Artemis I mission, an applicant must demonstrate rigorous control through design, manufacture and test in order to prove the vehicle will be technically sound, maintaining low risk to the public. This will likely include:

- Formal, gated design reviews (system requirements, preliminary design, detailed design, etc.)
- Detailed designs developed down to the component / configured item level, approved by competent and qualified engineers
- Design analysis for critical systems including structural, thermal, electrical, aerodynamic performance, RF (communications), etc.
- Formal specification release
- Manufacturing instructions, with records of work performed ('as built' information), and
- Formal verification and validation testing at all levels, including Test Review Boards for off-nominal results.

3.2.3 Operational Controls

CASE A: Sounding rocket mission

For a simple sounding rocket mission, the operational controls can be proportionately simple to the risk. The application may include an approach that incorporates:

- WHS procedures: Rocket motor handling, launch safety zone clearance, explosives permit (if required)
- Flight safety approach: wind weighting / containment procedure
- Air traffic management: local controller coordination, local broadcasts / monitoring
- Security: monitoring controlled areas, and
- Local emergency services notification.

CASE B: Artemis I mission

Similarly, for a complex mission like Artemis I, the operational controls must be comprehensive, ensuring public safety is maintained at each step of the launch. This may include an approach that incorporates:

- WHS procedures: hazardous materials handling, storage, disposal plans; emergency services notification planning for hazardous material; certifications and process for high-risk ground support tasks such as working at heights, crane operations, confined areas, etc.
- Flight safety: flight termination / flight abort systems with ordinances to break large structure into less harmful debris, flight safety corridors, defined flight termination criteria, operational plans for off-nominal situations, trajectory planning to avoid overflight of populated areas or pausing of the flight termination system at designated points of the trajectory, etc.
- Land, Air, Marine & Space traffic: extensive coordination required to ensure air, land, marine, and / or space traffic is cleared for launch; notifications and response plans; etc.

- Security: risk assessments, cyber and physical security plans to address risks; system hardening, airgaps, managed configurations; multi-layer physical security systems including patrols, monitoring, etc.
- Extensive emergency services coordination including dry runs, communication and response plans, etc. Notification to national emergency services.

3.2.4 Quantitative Safety Analysis

CASE A: Sounding rocket mission

While the Flight Safety Code requires the same methodology be used regardless of the complexity of the flight, the amount of analysis required can be reduced greatly when the launch type is simple. For example, for a sounding rocket, the analysis may include:

- Trajectory: simple parabola (unguided)
- Debris: simple debris catalogue (only likely to see few pre-determined pieces in a structural failure or aerodynamic break up event)
- Failure probabilities: can be determined from the flight history of similar systems
- Probability of impact dispersion: simple dispersion based on maximum wind conditions and the nominal trajectory
- Casualty areas: use a simplified worst-case based on maximum debris size with an inert impact & skipping.

CASE B: Artemis I mission

On the other hand, while the same Flight Safety Code methodology must be used for an Artemis-like launch, the number of variables that must be considered drastically increases the complexity of the safety analysis. For an Artemis type launch, the analysis may include:

- Trajectory: complex manoeuvres and guidance systems mean a variety of potential trajectories must be evaluated
- Debris: as there are multiple potential failure modes of the rocket (explosion – accidental or through termination, structural failure, etc.), debris catalogues must be created that vary depending on failure modes. Independent analysis is likely required to determine what the debris catalogues are most likely to look like.
- Failure probabilities: detailed reliability and failure information must be determined from component level to system level analysis
- Probability of impact: must account for failure modes, different debris catalogues, potential ablation / demise on atmospheric re-entry, potential trajectory variation, winds, etc.
- Casualty area: multiple debris sizes from various catalogues must be considered for inert impact & skip, as well as explosive potential, hazardous material exposure, including the potential impact of structures, whether there are assets of catastrophic potential, etc.

4 Intersecting regulation

While regulated space activities are relatively straightforward, depending on the activity, they do interface and intersect with many other regulations and regulatory bodies, as demonstrated in Figure 4.

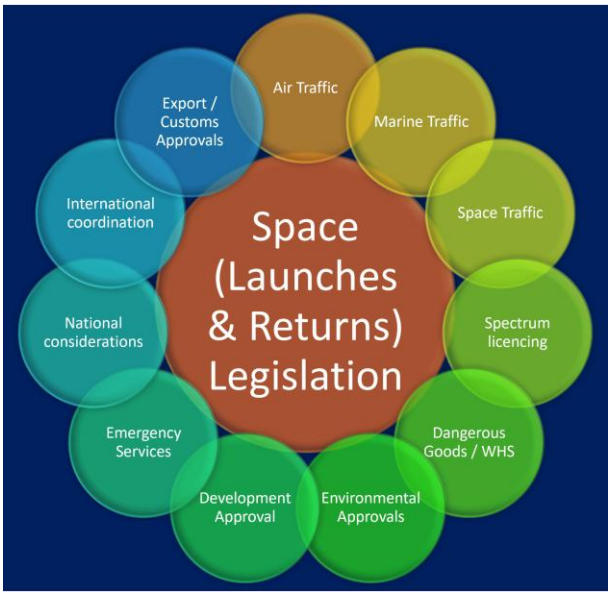

Fig. 4. Potential intersecting regulatory considerations to the space legislation

Below is an indicative list of other regulations / regulators who may be impacted by a space activity, which may not be directly part of the Space (Launches and Returns) approval.

Air traffic

- Civil Aviation Safety Authority (CASA)
- Airservices Australia
- International Civil Aviation Org (ICAO)

Marine traffic

- Australian Maritime Safety Authority
- State or local authorities (e.g., Maritime Safety Queensland)
- International Hydrographic Organization's (IHO) World-Wide Navigational Warning Service (WWNWS)

Space traffic

- US Space Force (USSF) 18 Space Defense Squadron (18SDS), or equivalent

Spectrum licencing (RF communications)

- Australian Communications and Media Authority (ACMA) (for the International Telecommunication Union (ITU))

Dangerous goods / Work Health and Safety (WHS)

- WorkSafe Australia (and / or state-based WorkSafe organisations)

Environmental approvals

- Department of Climate Change, Energy, the Environment and Water (DCCEEW)
- State-based regulators (e.g., South Australia – Department of Environment and Water (DEW); New South Wales (NSW) Department of Planning and Environment and the Environment Protection Authority (EPA))
- Marine Park regulators (e.g., Great Barrier Reef Marine Park Authority (GBRMPA))

Development approval

- State-based and / or local development authorities (e.g., Plan SA, Planning VIC)

Emergency services

- State Emergency Services (SES) including Police, Fire, and Ambulance
- National Emergency Management Agency (NEMA)

National considerations / international coordination

- Department of Foreign Affairs and Trade (DFAT)
- Department of Home Affairs

Export / Customs approvals

- Defence Export Controls (DEC)
- Australian Federal Police (AFP)

Weather monitoring / input

- Bureau of Meteorology (BOM)
- World Meteorological Organization (WMO) – Worldwide Met-Ocean Information and Warning Service (WWMIWS).

5 Evolution of Australian Space regulations

5.1 Open and responsive regulator

The Australian Space Agency has proven to be open and responsive to industry feedback, incorporating updates to the framework to reduce the administrative burden and improve process times.

5.2 Regulatory updates

Since 2019, the Space Agency has initiated several updates to improve the space activity regulatory environment. These include:

- Two (2) amendments to Rules to reduce application administrative requirements and reduce application time (e.g. removed requirement for independent party to perform quantitative safety analysis, reduced mandatory notification periods before a launch activity)
- The enactment of US / Australia Technology Safeguards Agreement (TSA) to enable US technology to be launched from Australia
- Planned updates to the Flight Safety Code – the first of which is out for consultation now; feedback due by 10 October 2024 (https://www.space.gov.au/news-and-media/have-your-say-flight-safety-code-september-2025)

5.3 Industry engagement

In order to remain focused on the industry needs, the Space Agency has established several formal and informal communication and information exchange forums. These include:

- Engaging with the sector through the Space Regulation Advisory Collective to understand future needs
- Establishing routine flight safety workshops to communicate changes to launch and return safety standards and seek feedback from the sector
- Participation in domestic and international space conferences

5.4 Where to from here?

The Space Agency has indicated (from a recent IAASS presentation) that they are looking to:

- Build capability and capacity in flight safety systems engineers and analysts and implement a range of process improvements
- Publish detailed guidelines to support key elements of the launch or re-entry safety case (flight safety plans, flight safety analyses, and flight safety systems), and
- Update the Flight Safety Code to better align with global best practice [updates are out for comment now: https://www.space.gov.au/news-and-media/have-your-say-flight-safety-code-september-2025]

6 Conclusions

While the space regulatory framework in Australia is straightforward, the intersection to other regulators and regulation, and the non-prescriptive nature of the regulation may make it difficult for new applicants to navigate. This paper provides some examples of what an application may look like when tailored to the complexity and the risk of the activity being undertaken. This paper also includes a list of potentially intersecting regulatory environments for consideration