ANAC NATIONAL CIVIL AVIATION AGENCY - BRAZIL

Manual of

OPERATIONAL RECOVERY MANAGEMENT FOR RUNWAY CLOSURE EVENTS BY A DISABLED AIRCRAFT

MANUAL OF OPERATIONAL RECOVERY MANAGEMENT FOR RUNWAY CLOSURE EVENTS BY A DISABLED AIRCRAFT

AIRPORT INFRASTRUCTURE SUPERINTENDENCE

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We would like to extend our sincere thanks to all the institutions and professionals who supported the Operational Recovery Project, highlighting that this Manual is the result of a broad collaborative effort involving various industry stakeholders throughout its development.

Many valuable contributions were made throughout the different stages of technical discussions, text drafting, tabletop and field simulation exercises, and experience sharing. These contributions reflect the result of a joint effort, as well as the commitment and cooperation of everyone involved.

We would like to express our heartfelt thanks to everyone who contributed to this publication and the release of this first edition.

We hope this Manual will be used whenever necessary to support informed decision-making and effective, safe operational recovery actions.

Thank you!

VERSION CONTROL

VERSION	DATE	APPROVED BY	SUMMARY OF CHANGES
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SUMMARY

PRESENTATION

On March 17, 2023, the National Civil Aviation Agency, in collaboration with the civil aviation sector, launched the Operational Recovery Project with the aim of identifying opportunities to improve resources and procedures to better prepare the system to respond more quickly to runway closures caused by aircraft accidents or incidents.

Over this period, nine virtual meetings were held, featuring presentations by expert representatives from various areas that play a key role in removing disabled aircraft.

Additionally, tabletop and practical simulations were conducted at fourteen aerodromes to assess performance and identify improvements to the Disabled Aircraft Removal Plans (DARP), as well as in the procedures and protocols required for a partial or full resumption of aerodrome operations. The combination of expert knowledge sharing, and the simulation execution from a collaborative industry perspective provided a unique opportunity for the sector's growth and maturity, enabling it to respond more efficiently to such events, thereby strengthening the resilience of the Brazilian civil aviation system.

In parallel, another important aspect of this project focused on investigating the current legislation regarding the distribution of responsibilities between aircraft and aerodrome operators, which was supported and guided by the insurance sector.

Due to the complexity of such events, a timely, proportional and safe response depends on prior planning of actions, timelines and responsibilities, as well as on the training and maintenance of a qualified team, the adoption of the best techniques and appropriate equipment, and the allocation of necessary resources, all with the common goal of safely resuming operations and minimizing the impact on the continuity of aerodrome operations.

It is also emphasized the importance of a collaborative approach between the aerodrome operator, the air traffic control authority, and aircraft operators in order to successfully resume operations in a safe and timely manner. Although the aircraft operator is the primary party responsible for the aircraft removal actions in accordance with current legislation, aerodrome operators must act in a coordinated, planned, and proactive manner to properly remove the aircraft and resume operations, in part or in full, in a safe manner.

This Manual is the result of collaborative work and represents the initial step towards establishing and consolidating a culture of readiness for the removal of disabled aircraft and resuming operations quickly and safely. If the best practices outlined herein are implemented, operators will be better able to act safely and efficiently and minimize impacts on the continuity of aerodrome operations.

Congratulations and many thanks to everyone who contributed their knowledge to this project, which represents a major milestone for civil aviation!

Giovano Palma
Superintendent of Airport Infrastructure

ACRONYMS AND ABBREVIATIONS

ACI: Airports Council International

AEP: Aerodrome Emergency Plan

AM: Aerodrome Manual

ANAC: National Civil Aviation Agency (Brazil)

ARM: Aircraft Recovery Manuals

CBA: Brazilian Aeronautical Code

CENIPA: Accident Investigation and Prevention Authority (Brazil)

DARP: Disabled Aircraft Removal Plan

DECEA: Department of Airspace Control (Brazil)

EOC: Emergency Operations Center

IATP: International Airlines Technical Pool

ICAO: International Civil Aviation Organization

METAR: Meteorological Aerodrome Report

NOTAM: Notice to airmen

RBAC: Brazilian Civil Aviation Regulation

SMS: Safety Management System

DEFINITIONS

The following are definitions specific to the topic covered by this Manual. They must be read in conjunction with the definitions stated in regulations issued by the National Civil Aviation Agency (ANAC) and the Brazilian Air Force Command.

Aerodrome emergency response: Actions taken to respond effectively to aerodrome emergencies, aimed at saving lives and reducing material damage, as well as returning the aerodrome to operations.

Aircraft debogging: The removal of an aircraft from a runway or taxiway following a runway excursion in which the aircraft has become "bogged down" (immobilized at its stopping position) and suffered minor or no damage.

Aircraft recovery: The removal of any aircraft that has suffered substantial damage to the point that it cannot be moved by its own means or via normal towing methods indicated in the aircraft's manual, which deals with the use of an appropriate tow tractor and tow bar.

Aircraft salvage: The removal of any aircraft following an accident or incident in which the aircraft is substantially damaged and considered a hull loss by the insurer. For insurance purposes, aircraft salvage is the process of recovering valuable materials from an aircraft deemed financially unviable for full restoration. In general, the salvage process entails disassembling the aircraft down to its shell and retrieving materials such as aluminum, steel, titanium, copper wire, engine nacelles, avionics, and engines.

Business continuity management: A continuous process involving a range of strategies and procedures that an organization implements to increase its resilience and ensure that its critical operations can continue in the event of unexpected interruptions, such as natural disasters, cyber-attacks, technological failures, pandemics, etc. The main objective of these management actions is to minimize the impact of interruptions, protecting both the organization and its customers, partners, and other stakeholders, and ensuring a rapid operational recovery.

Crisis management: A continuous organizational process of preparation, response, and recovery to rapidly and efficiently adopt and coordinate actions to respond to unexpected events or crises that may damage the company's reputation or operations. A crisis can cause significant consequences for the continuity of an organization's activities. Thus, the main goal of crisis management is to minimize multiple damages and restore normal operations in a safe, fast, and efficient manner.

Disabled aircraft removal: The set of procedures, processes, actions, and resources for removing an aircraft in one of the following situations: aircraft debogging, aircraft recovery, and aircraft salvage.

Risk management: A continuous process that includes hazard identification, analysis of the consequences of the hazards, risk evaluation from the identified hazards, proposing actions to eliminate hazards and/or mitigate their risks, and evaluating the effectiveness of proposed actions

to deal with threats to operational safety related to operations. This risk management refers to one of the elements in the structure of a Safety Management System (SMS).

Secondary damage: Any damage that occurs to an aircraft during removal operations.

Brazilian Civil Aviation Regulations:

RBAC No. 107 - Civil Aviation Security Against Acts of Unlawful Interference – Aerodrome Operator

RBAC No. 121- Public Air Transport Operations with Aeroplanes Certified for More Than 19 Passenger Seats or a Maximum Payload Capacity Above 3,400 kg (7,500 lb)

RBAC No. 135 - Public Air Transport Operations with Aeroplanes Certified for Up to 19 Passenger Seats and a Maximum Payload Capacity of up to 3,400 kg (7,500 lb), or with Helicopters

RBAC No. 153 - Aerodromes- Operation, Maintenance, and Emergency Response

RBAC No. 154 - Aerodrome Design

RBAC No. 175 - Transport of Dangerous Goods on Civil Aircraft

INTRODUCTION

Disabled aircraft removal events are possible and expected scenarios in aerodrome operations. Although it is impossible to predict the exact moment, location, or specific circumstances of their occurrence, they require planning, preparation, and adequate resources for a safe, efficient, and rapid response, guaranteeing the removal of the aircraft and resumption of operations. Such events can have significant impacts on passengers, airlines, air navigation service providers, aircraft operators, and the aerodrome operator itself.

A runway closure can prevent or substantially reduce the number of landings and take-offs, depending on the number of available runways. This can result in revenue loss for the aerodrome and airlines, as well as causing harm to users and jeopardizing the continuity of public service provision. Standards in Annex 14 – Aerodromes, Volume I – Aerodrome Design and Operations, of the Chicago Convention, recommend that States establish a plan for the removal of a disabled aircraft in the movement area of an aerodrome, or in an area adjacent to it. The plan should consider the characteristics of the largest and most frequent aircraft normally expected to operate at the aerodrome.

It should be noted that this international provision is codified in the Brazilian Civil Aviation Regulation – RBAC No. 153 - Aerodromes- Operation, Maintenance, and Emergency Response.

As new generations of New Large Aircraft begin operating at aerodromes, the problem of removing a disabled aircraft becomes increasingly serious. Most aerodrome and aircraft operators find it economically unviable to acquire the specialized equipment needed to remove a disabled aircraft, because in addition to the purchase cost, there are expenses for storage, maintenance, training, staff availability, and logistics.

The approach traditionally used in the industry is to draft operational agreements or create associations (pools) between airlines and/or aerodrome operators, in order to dilute these costs.

Given the difficulty of owning their own equipment and, once again, diluting the costs, several airlines have taken measures to make specialized equipment available, in the short term, to all parts of the world, through the provision of strategically located Recovery Kits as part of agreements or associations.

In addition, it is up to aircraft operators to develop their disabled aircraft removal plans in accordance with the operational characteristics of their aircraft, manufacturer recommendations, route configuration, and the availability of appropriate human and material resources. Furthermore, these plans must be coherent and harmonized with the disabled aircraft removal plans of the operators of the aerodromes where they operate.

Similarly, aerodrome operators have the same obligation, but their plan must be tailored to the critical aircraft operating at the location, considering the main aircraft types and the resources available at the aerodrome (internally and externally) to support the aircraft operator's removal action if necessary.

The aerodrome operator must also be adequately prepared to take the necessary steps to remove the aircraft itself, directly or indirectly (by hiring external companies or consultants), should the aircraft operator fail or be unable to do so. For this reason, coordination and synergy between the removal plans of airlines and aerodrome operators are extremely important.

At aerodromes with only one runway, closure events are even more critical, as they mean the suspension of fixed-wing aircraft operations. In such a scenario, planning, preparation, and resource availability become essential. For this reason, operators of highly busy aerodromes that are critical to the country's air network must allocate more resources to be prepared to assist the aircraft operator in the removal process. Ultimately, they must be prepared to perform the removal themselves if the airline is unable to do so.

In certain specific cases, and only for certified aerodrome operators under RBAC No. 139, aerodrome operators must be prepared for additional measures to strengthen decision-making and keep the runway's minimum operating conditions during contingencies. This is needed to minimize the impacts of runway closure or to evaluate alternatives for transporting the specialized removal equipment.

With these challenges in mind, this manual was developed to help the industry plan for and manage the process of removing disabled aircraft, ensuring a quick, safe, and efficient return to operation, mitigating the operational impacts caused by runway closures.

It is not the purpose of this manual to provide technical guidance on executing the physical removal of an aircraft. For this reason, the guidelines in this manual must be used in conjunction with the technical documentation provided by the aircraft and specialized equipment manufacturers. In the event of any conflict, specialized documentation takes precedence.

Although the manual mentions runways as the most critical element of infrastructure, aerodrome operators should also consider, in their plans, the possibility of similar events occurring on taxiways that are critical to the flow of aircraft.

Throughout this manual, the terms "aircraft operator" and "aircraft explorer" are used interchangeably. Both terms refer to any natural or legal person involved in aircraft operations, whether providing air services or not, and regardless of whether they operate as owner, lessee, or charterer.

CHAPTER 1: REMOVAL PLANNING

The purpose of this chapter is to emphasize that the success of resuming the aerodrome's operations, as well as the emergency response actions and the management of subsequent events following a runway closure, depends on thorough planning encompassing people, equipment, information, and coordination among all involved.

1.1 PHASES OF EMERGENCY RESPONSE MANAGEMENT

Emergency response management should be viewed as a framework guiding all immediate agents (responders) and organizations involved, oriented by previously established processes, resources, protocols, and tools to respond, mitigate, and restore normal operations following aeronautical accidents/incidents or other disruptive events at the aerodrome.

Various international references suggest how to organize the emergency management process. The Federal Aviation Administration (FAA) uses the concept of CEM (Comprehensive Emergency Management) from Advisory Circular AC 150/5200- 31C. This management method features four phases, described below (adapted from Table 2-1 of AC 150/5200- 31C):

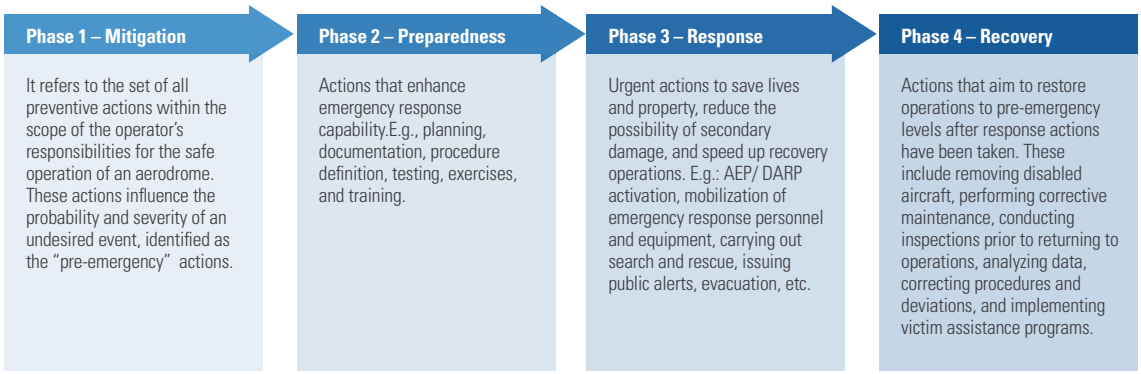

Figure 1 – Phases of emergency management process

Depending on the runway closure scenario and the estimated removal time of the aircraft, the first phase of the aerodrome's operational resumption may take place with reduced aerodrome capacity. It is important that these situations be previously explored and studied by the aerodrome operator to minimize the impacts of the interruption.

Another reference for organizing the operational actions necessary for successful disabled aircraft removal is DOC 9137 Part 5 - Removal of Disabled Aircraft, published by the International Civil Aviation Organization (ICAO). The stages defined in this document are:

Figure 2 – Stages of an Aircraft Removal Process

Appendix I of this Manual presents a mapping of the planning for aircraft removal operational actions to serve as a general guide to assist the aircraft removal process.

Having the principles presented above as the foundation for the planning, development, and revision of the Disabled Aircraft Removal Plan (DARP) and as provided in paragraph 153.325(a)(8) of RBAC 153, both aerodrome and aircraft operators must prepare their plans with a structure that combines the FAA's emergency response planning references and ICAO's aircraft removal process execution and actions.

It is worth noting that the DARP should be seen as part of the operator's overall planning to deal with various unexpected events that could trigger a crisis and therefore significantly compromise the continuity of operations. In the case of aerodrome operators, the DARP is part of the Aerodrome Emergency Plan (AEP), which in turn must:

- List the resources made available for different emergency scenarios;
- Describe the responsibilities of each element (agencies, entities, or professionals who may be called upon);
- Include the means of activation and their flow, as well as the expected response times for dealing with emergencies at the aerodrome or in its vicinity.

It should be emphasized that the primary goals of an emergency response plan are to ensure:

1. The maintenance of operational safety during the unfolding of the unexpected event and its immediate consequences; and
2. A return to normal operations as quickly as possible.

Although ANAC legislation addresses emergency response planning, it is relevant to highlight the Airports Council International's (ACI) recommendation that aerodromes implement a business continuity management approach, encompassing preventive, contingency, and business recovery measures adapted to the individual characteristics of each aerodrome :

> *"…Effective business continuity strategies can safeguard passengers and the airport community, enable the delivery of services to customers, sustain commercial revenue streams, and protect infrastructure. Plans and the approach to business continuity should be tailored to the circumstances of events and the individual airport (ACI Policy Handbook, 10th Edition, 2020).*

It is essential that aerodrome operators, particularly those at Class III and IV aerodromes according to RBAC 153, identify the potential disruptive events threatening the continuity of operations (whether landside or airside) and establish robust plans to deal with them effectively. More information can be found in the Airport Business Continuity Management Handbook from Airports Council International (ACI).

1.2 MINIMUM STRUCTURE OF THE DARP

To assist in this planning process, and adequately prepare for an aircraft removal event, aerodrome and aircraft operators (where applicable) must observe the items bellow for the minimum structuring of the DARP and the operational resumption plan, framed within the planning phases involving preparation, response, and resumption, as explained in the preceding section of this chapter.

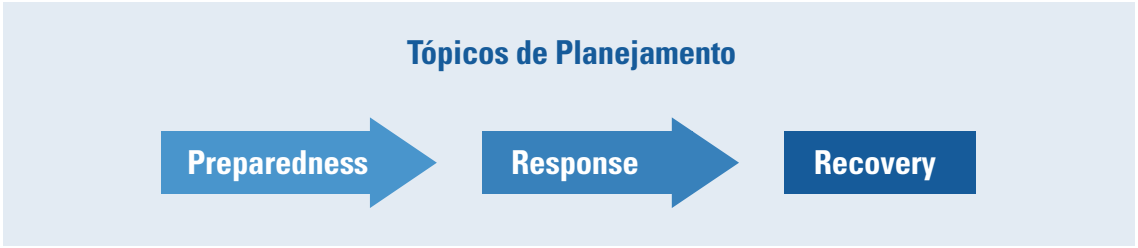

Figure 3 – Stages for structuring a plan for removing a disabled aircraft and resuming operations

PREPAREDNESS

- Identification of the scenarios most likely to occur on-site, according to the SMS risk analysis (see Chapter 5);
- Coordination structures (technological equipment, crisis room, whiteboards, markers, paper, aerodrome maps, support infrastructure, communications tools, etc.);
- Support and public communication structures;

It is important that the aerodrome operator designate a focal point for communicating and updating ANAC on actions.

The following minimum information must be submitted to ANAC:

a. event data (time, location, presence or absence of victims, aircraft's final position, aircraft damage, photos);
b. flight information (aircraft, number of passengers, and crew);
c. meteorological aerodrome report (METAR) at the time of the event;
d. time of RFFS activation;
e. activation of the aircraft operator's and aerodrome operator's DARP (is the aircraft operator taking the necessary actions to remove the aircraft?);

f. estimated time of aircraft removal;
g. flights and passengers impacted, estimate for resumption of operations.

- Procedures for total or partial runway interdiction;
- Responsibilities, including a pre-arranged model agreement with aircraft operators regarding responsibilities and expected performance during aircraft removal events;
- Identification of trained operational staff;

The removal strategy does not have to be limited to an internal team. External experts may be called upon to help choose the best removal strategy. The aerodrome operator may include in its DARP a list of such experts, whether they are companies or individuals, with their emergency contact numbers, in case these services are activated.

- Deadlines for removal and declaration of timeliness of removal by the aircraft operator;
- Coordination procedures with the plans of the main parties involved, including ground-handling companies that may provide equipment to help remove the aircraft;
- Procedures for monitoring and disseminating weather forecasts to support the aircraft removal team's choice of strategies;
- Procedures for aircraft removal if the operator decides/has the technical capacity to carry it out;
- Procedures to assess the aircraft operator's removal capacity;
- Procedures for collaborative efforts and obtaining authorization for removing the aircraft (aircraft removal authorization template);
- Integration with the plans of the main aircraft operators at that aerodrome, including the provision of the Aircraft Recovery Manual (ARM) information for their aircraft;
- Internal and external resources for aircraft removal. The list of resources must indicate the location, availability, and average arrival time at the aerodrome (for external resources) for each item indicated for aircraft removal;
- Equipment and procedures to mitigate environmental damage;
- Lists and flowcharts for internal and external activations, capacities, and response times;
- Identification of aerodromes that can be used as alternatives for receiving the Recovery Kit;
- Time estimates and arrival alternatives for receiving other equipment to assist in the aircraft removal process;
- Identification of the removal team (Recovery Team), if applicable;
- Training;
- Simulated exercises.

It is recommended that the aerodrome operator prepare checklists to verify procedures for all planned activities, using this Manual's technical guidance as a reference.

To assist in this preparation stage, Figure 4 illustrates a standard activation flowchart showing the areas involved in triggering the DARP, and their relationship to the aerodrome's operational resumption planning.

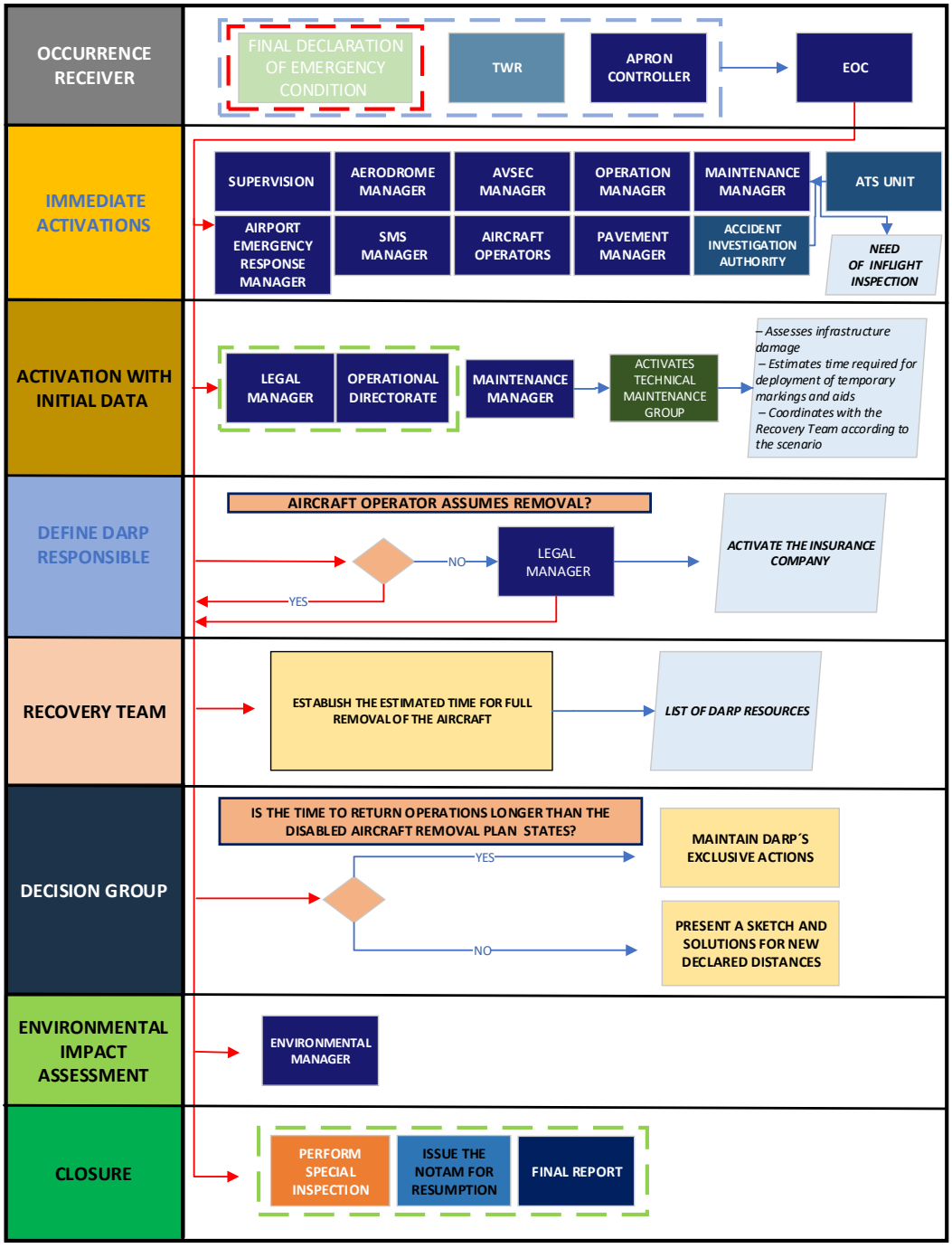

Figure 4 – Standard flowchart of DARP activation and the operational resumption plan

An important element of the preparation must be the identification of the logistical actions required for the transportation of the equipment and the aircraft removal teams, and even for the displacement of the investigators. Questions such as:

- "Does the disabled aircraft's location allow the possibility of using the runway itself to transport the Recovery Kit equipment?
- "Which alternate aerodromes could be used by the aircraft carrying the Recovery Kit equipment, in the event of the closure of the aerodrome where the disabled aircraft is located?"
- "Which company(ies) will transport the cargo from the alternate aerodrome to the affected aerodrome? What are their operating hours and the estimated delivery time? What will the logistics be for transferring the kits from the aircraft to the transport company's trucks?"
- "What are the expected arrival times of the investigators from the accident investigation authorities (Cenipa, in Brazil) and of the other equipment that will assist in the aircraft removal?"

RESPONSE

- Analysis of the event site (Initial Survey);
- Aircraft Weight and center of gravity management;
- Preparation for removal;
- Aircraft weight reduction;
- Aircraft leveling and lifting;
- Aircraft movement.

In the event of an aircraft weight reduction procedure, operators must follow the procedures described in RBAC 107 and RBAC 175, and their respective supplementary instructions regarding the handling and transportation of dangerous materials and valuables carried by the aircraft.

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- Identification of scenarios and procedures for partial or full runway reopening;
- Corrective actions on infrastructure and navigation aids damaged by the event;
- Preparation of reports and documents to record the event;
- Critical analysis of the event and continuous improvement (lessons learned and changes to the DARP).

It should be emphasized that the aircraft operator holds primary responsibility for removing disabled aircraft. Therefore, it is essential that the aircraft operator maintains a well-structured Disabled Aircraft Removal Plan (DARP) tailored to its fleet and the bases where it operates. **In an ideal scenario, the aerodrome operator's DARP would serve as a subsidiary plan, providing**

valuable information on alternative air and ground transportation for Recovery Kit equipment, identification of local suppliers of materials and resources to assist with the aircraft removal action, internal resources available at the aerodrome, provision of a crisis room, etc.

The aerodrome operator's DARP plays a fundamental role in events involving general aviation aircraft, as these operators generally do not have a structured DARP or the resources to deal with these events. Therefore, in its own DARP, the aerodrome operator must clearly identify the necessary resources and contacts, both inside and outside the aerodrome, to assist general aviation operators during the aircraft removal process. The presence of local general aviation maintenance hangars is a major facilitating factor.

> *"The success of an accident response depends on planning, organization, and exercises to ensure clarity of responsibilities and proficiency of the personnel involved in response actions, as well as proper coordination between the organizations concerned."* (ICAO, Humanitarian Assistance and Disaster Response in Aviation – HADRA)

1.3 SPECIFIC ITEMS OF THE AIRCRAFT OPERATOR'S DARP

Aircraft operators must develop a DARP that is compatible with their fleet and the locations in which they operate. This document should contain detailed instructions and checklists covering the preparation, organization, and execution phases of aircraft removal. Each stage must be detailed, from reporting the event to inspecting the aircraft after maintenance.

Complementing the points listed for the aerodrome operator's DARP discussed in the previous section, aircraft operators must structure their planning for aircraft removal events, also taking into account the technical recommendations in Appendix 5 of ICAO DOC 9137 Part 5, namely:

a. Up-to-date list of the person in charge and the team responsible for removal (Recovery Team), the leaders of the teams, and the other team members, with names, addresses, and immediate/emergency contacts. The operator must ensure that the list is permanently updated;

b. List of aircraft for which the team is responsible, which may include aircraft that are owned or leased by the operator, aircraft from subsidiary airlines, or other contracted aircraft;

c. Clear procedures to be followed upon being notified of an incident, including requirements to record all relevant data;

d. Comprehensive list of the operator's support team and contact information numbers for assistance in different removal scenarios, including representatives from specialized sectors such as maintenance, operational standards, operational safety, engineering, etc.;

e. Updated list of government agencies involved, including contact names and phone numbers;

f. Creation of a planning and removal execution map (see Appendix I of this Manual);

g. Logistical organization and preparation of a "Go Kit," including passport/visa requirements, vaccines, as well as airside access for the team of investigators from the competent authority and those responsible for the aircraft removal operation;

h. List of local and general materials and equipment to support the aircraft removal process, available locally at or near the aerodromes where the company operates, indicating the location, capacities, and extended and compressed heights of lifting bags, slings, and jacks;

i. List of the specific removal equipment, owned or contracted, required to carry out the removal process, including the location, container size, and weight;

j. Up-to-date copy of the list of equipment pools of the International Airlines Technical Pool (IATP), or other associations organized for this purpose, if it is a member, showing the contents and location of its removal kits, available at www.iatp.com (only for airline members or sponsors);

k. Availability of the fleet's Aircraft Recovery Manuals (ARM);

l. Identification of cargo door dimensions for each aircraft in the operator's fleet. This information will be useful when it is necessary to transport equipment from one aerodrome to another.

Also, the aircraft operator must provide in theDARP procedures and agreements for removing and storing the aircraft's fuel, if necessary, along with its fuel supplier or another supply company (see ACI Emergency Preparedness and Contingency Planning Handbook, 2014).

The IATP is a global non-profit organization comprising airlines from around the world that share technical resources with the aim of generating economies of scale, as well as providing support for on-time dispatch reliability and operational safety. Such collaboration includes sharing spare parts, maintenance equipment, Recovery Kits, technical training, conferences to share best practices, and other essential resources for the safe and efficient operation of airlines.

In the context of aircraft removal, the IATP facilitates access to Recovery Kits strategically positioned in various locations around the world. These kits enable member airlines to carry out aircraft removal operations.

If the aerodrome operator organizes itself, alone or in association with other operators, to provide the technical capacity for removing aircraft, the guidelines in this section can help in this structuring process, where applicable.

CHAPTER 2: PLAN COORDINATION

Responding to a runway excursion requires the involvement of multiple institutions, represented by their experts, who will analyze the situation and define the best strategy for aircraft removal and resumption of aerodrome operations.

It is, therefore, an inherently multidisciplinary activity that demands effective prior planning, as well as coordination among all involved, to successfully mitigate damage and safely and efficiently return to normal aerodrome operations.

As part of the planning phase for an aircraft removal process, it is important that the aerodrome operator establishes coordination between the different existing emergency contingency plans at the site. The need for emergency response coordination between multiple organizations that must activate response plans is an ICAO requirement, defined in paragraph 9.1.3 of Annex 14, Volume I.

Ensuring this coordination is Element 1.4 of the requirements in Annex 19 for the operating structure of a Safety Management System (SMS) as set out in its Appendix 2.

The recommended practice is to promote the synergy of actions, ensuring mutual cooperation between the competent authorities at all levels of government, such as Civil Defense, Fire Departments, and the public health system, as well as private entities, such as airlines, ground-handling service providers, air navigation service providers, and removal support companies. Other bodies or entities, such as the aerodrome security forces and the Air Traffic Management (ATM), may also be mobilized for immediate action. It is essential that all those involved in aerodrome operations, as listed in the AEP/ DARP, are integrated into this coordination effort.

The aerodrome operator must make efforts to promote coordination between the different emergency response plans of the users and those directly involved with the impacts of the interruption of normal runway operations.

An important tool for assessing the degree of coordination between the plans, especially at the interfaces, is to conduct simulated exercises (see Chapter 8 of this Manual). Periodic coordination meetings with all the major parties involved can also be held to open a communication channel and establish prior action agreements, which will prove invaluable during an actual removal operation.

Additionally, as those primarily responsible for removal according to the Brazilian Aeronautical Code – CBA (Art. 88-Q), it is essential for aircraft operators to establish their Emergency Response Plans, which must include actions for the possible removal of a disabled aircraft.

Specifically for aircraft operators, ANAC regulations (RBAC 91K, 135, 121) establish this obligation within the scope of their SMS.

It is recommended that aircraft operators define the critical locations in their plans from the point of view of their network operations and carrying out actions to remove disabled aircraft, providing for specific actions to deal with these cases, such as alternatives for ground and air transportation of Aircraft Recovery equipment in general, and contractual arrangements for the provision of resources to support the actions of the Aircraft Recovery team. This plan must take into account the aircraft models operated at each location.

For private aircraft operators, it is recommended to become familiar with the removal practices adopted at the aerodrome to ensure agility in the event of such an occurrence.

Despite the primary legal responsibility of the aircraft operator, the aerodrome operator can be considered the focal point for coordinating removal actions, given their knowledge of the location and easier access to facilities and resources, in addition to the need to plan local-level measures.

Therefore, the aerodrome operator'sDARP can support the aircraft operator's DARP by systematically relating the available resources, establishing the most likely and critical scenarios for activating external resources, in addition to containing the response time estimates for each scenario.

An important way to formalize coordination and integration between the aerodrome operator and the aircraft operator is through the establishment of an operational agreement to ensure a rapid and coordinated response. The agreement should define responsibilities, mutually agreed-upon aircraft removal deadlines, resource allocation, training, and simulation exercises to minimize delays and unnecessary damage during aircraft removal. Such an agreement can help prevent conflicts and eliminate indecisions about who should carry out each action, especially during critical times when a lack of coordination can result in delays, risks to people's safety and the aircraft's integrity.

CHAPTER 3: RESPONSIBILITIES

3.1 PRIMARY RESPONSIBILITY

According to Article 88-Q of the Brazilian Aeronautical Code (CBA – "Law n°. 7,565, December 19, 1986"), the responsibility for removing a disabled aircraft rests with the aircraft operator:

> *Art. 88-Q: The obligation to remove an aircraft involved in an accident, wreckage, and transported goods, in any part, shall be the responsibility of the aircraft operator, who shall bear the resulting expenses.*
>
> *§1° At public aerodromes, if the operator does not arrange for the removal of the aircraft or its wreckage in a timely manner, it will be up to the aerodrome administration to do so, and the latter will be responsible for compensating the expenses.*

This article is based on the principle of the supremacy of the public interest and the need to guarantee the continuity of public services, since a disabled aircraft, by interdicting a runway, can prevent the aerodrome from operating and cause damage to passengers and the aerodrome operator, as well as affecting the entire air network in general.

In this sense, the private interest of an aircraft operator, such as removing the aircraft only when it is convenient for them, cannot override the public interest of having that infrastructure available for use as soon as possible.

REMINDER:

The "Aircraft Operator" is not necessarily the aircraft's owner. Article 123 of the CBA defines it this way:

Art. 123: The following are considered to be aircraft operators:

I – a natural or legal person who provides air services (as amended by Law No. 14,368 of 2022);

II – a natural or legal person who uses the aircraft, owned by themselves or by others, directly or via agents, to carry out operations that do not constitute the provision of air services to third parties (as amended by Law No. 14,368 of 2022);

III – the charterer who has reserved the aircraft's technical control, the management, and the authority over the crew;

IV – the lessee who has acquired technical control of the leased aircraft and authority over the crew.

The aircraft operator is the party that holds legal possession of the aircraft at the time the undesired event occurs and may or may not be its owner.

3.2 SUBSIDIARY RESPONSIBILITY

At public aerodromes, if the removal of the disabled aircraft does not occur with the required "timeliness[1]"(1), the aerodrome operator shall be responsible for carrying it out, and the aircraft operator shall reimburse the removal expenses, according to §1 of Art. 88-Q of the CBA.

Furthermore, the "removal of aircraft involved in an accident" (extract from Art. 88-Q of the CBA), according to Brazilian civil law, may be considered an obligation of the aircraft operator.

On breaching an obligation, Article 249 of the Civil Code (Law 10,406, of January 10, 2002) states:

> *Art. 249. If the fact can be executed by a third party, the creditor shall be free to have it executed at the debtor's expense, in the event of refusal or delay by the debtor, without prejudice to the compensation that may be due.*
>
> *Sole paragraph. In urgent cases, the creditor may, regardless of judicial authorization, execute or have executed the fact, and shall then be compensated.*

Hence, reading together Art. 88-Q of the CBA with 153.325(a)(8) of RBAC 153 and Art. 249 of the Civil Code, it is possible to conclude:

> *a) The primary duty to remove a disabled aircraft lies with the aircraft operator, who must comply with the terms defined in the Aircraft Recovery Manual (ARM) and as defined by the aerodrome operator's DARP. It is important to note that the removal may also be carried out by third parties contracted by the aircraft operator, including the possibility of hiring the aerodrome operator to provide this service;*
>
> *b) If the aircraft operator does not remove the aircraft within the guidelines set out in the aerodrome operator's DARP, it will be up to the aerodrome operator to do so, either by its own means or by contracting a third party. In such cases, as this is not a service provided by the aerodrome operator, but rather an obligation on its part, if the aircraft operator fails to comply with this obligation, it will be up to the aerodrome operator to carry out the removal;*
>
> *c) It is the aircraft operator obligation to bear all expenses arising from the removal of the disabled aircraft, whether the removal is carried out by its own means (directly or indirectly) or at the initiative of the aerodrome operator, when the period defined in the aerodrome operator's DARP for aircraft removal by the operator has elapsed. The aircraft operator shall reimburse the aerodrome operator for all costs arising from the removal.*

As outlined above, this is a mandatory obligation to act. In the event of noncompliance by the aircraft operator, the aerodrome operator becomes responsible for taking action and shall be reimbursed for the expenses incurred.

1 The term "timeliness" will be explained and detailed in Chapter 4 of this Manual.

However, it is worth remembering that, according to Art. 88-Q of the CBA, the amount owed to the airdrome operator is limited to the amount related to carrying out the activity of removing the disabled aircraft, whether the activity is carried out by the aerodrome operator itself or by a third party contracted for that purpose.

TIP:

To receive compensation from the aircraft operator for the costs incurred in removing the aircraft, the aerodrome operator will have to account for the amount spent.

To this end, it is recommended that an itemized account be submitted to the aircraft operator, accompanied by records proving the expenses incurred.

Additionally, if possible, obtain authorizations before making expenditures, always keeping records of such approvals. Appendix II provides an example of a removal authorization form.

To avoid aerodrome operator potential liability for preventable secondary damage, when acting in a subsidiary capacity and on legal bases of §1° of Art. 88-Q of the CBA, it is recommended that:

- The removal complies with the provisions of the aerodrome operator's DARP and any operational agreements that may be implemented;
- The removal is carried out using suitable equipment in accordance with the guidelines contained in the Aircraft Recovery Manual (ARM).

It is further recommended that the aerodrome operator remove the aircraft with due diligence and care, maintaining records of the aircraft operator's failure to remove it in a "timely manner". In the case of insured aircraft, the aerodrome operator should notify the insurance company that holds the insurance policy for the damaged aircraft so that the procedure carried out by the operator is guided by the insurance adjuster indicated by that company. If, at the time of the unwanted event, the aircraft operator is unable to notify the insurer, the aerodrome operator may do so, as it is an interested third party directly affected by the situation.

It is also recommended that the aerodrome operator records the aircraft operator's awareness of his conduct and every detail of the aircraft removal procedure, recording it in videos and photographs when possible.

In addition, it is important to keep as many records as possible to prove diligence was exercised and to prove all expenses incurred in the removal for future reimbursement by the aircraft operator. This recommendation also applies when the aerodrome operator acts under the aircraft operator's approval and on its behalf.

CHAPTER 4: TIMELINESS AND DEADLINES FOR AIRCRAFT REMOVAL

In the case of removing a disabled aircraft from the runway, although the aircraft operator and the aerodrome operator share the objective of removing the aircraft as promptly as possible, differences arise in each party's priorities.

While the aircraft operator, often supported by the aircraft manufacturer, acts with all the necessary caution to avoid secondary damage during the removal process, since at all stages it is the primary party responsible for the integrity and safety of the aircraft, the aerodrome operator aims to reduce runway closure time and minimize the impact on aerodrome operations and terminal activities resulting from the interruption.

For this reason, both parties must act collaboratively and have their plans previously coordinated.

It is important that the representative of the aircraft's insurance adjuster is involved and participates in the decision-making process regarding the aircraft removal, and is made aware of the terms of the aerodrome operator's DARP, as well as the operational agreement, if any.

However, as mentioned in Chapter 3 and based on Article 88-Q of the Brazilian Aeronautical Code (CBA), the aerodrome operator has the power and duty to remove the disabled aircraft should the aircraft operator fail to do so in a "timely manner".

Aerodromes have different operational realities and effects on the national air network. Moreover, as they are managed by different organizations and influenced by diverse factors, such as cost and revenue structures, they operate with different appetites, aversions, and resilience toward the risks of operational disruptions. Therefore, it is not possible to establish a single temporal or operational parameter to prescribe the expected timeliness for the aircraft operator's removal action.

Thus, the timeliness of the removal actions by the aircraft operator, excluding the emergency response phases and the initial actions by the investigative authority, must be evaluated and predefined considering the operational impacts on the aerodrome, while respecting and preserving the principles of regularity and continuity in the provision of public services.

Obviously, the aerodrome operator's assumption of aircraft removal responsibilities fundamentally depends on the level of planning, preparation, and capacity of its human and material resources to carry out such activities. It is worth remembering the inherent complexity of the strategies and execution involved in the removal of a crashed aircraft. There are high risks to the physical safety of all personnel involved and to the preservation of the aircraft's airworthiness, which must never be diminished in any way or dealt with without adequate preparation by those responsible for the operations.

That said, according to paragraph 153.325(a)(8) of RBAC 153, the aerodrome operator must establish in the DARP the estimated deadlines for the removal of a disabled aircraft, considering the impact on the safety of air operations at the aerodrome and the economic aspects associated with the discontinuity of such operations.

Based on these deadlines, the aerodrome operator may define an acceptable waiting time for the aircraft operator to begin removal operations in order to remove the aircraft in a 'timely manner" and reopen the runway, as set forth by the CBA.

To this end, the aircraft operator must maintain constant dialogue with the aerodrome operator regarding actions taken to remove the disabled aircraft by its operator, enabling the aerodrome operator to participate in the process, including the eventual establishment of the need for action to take over the disabled aircraft removal.

It is worth remembering that the deadlines for runway reopening may vary due to several factors, such as: the complexity of the actual scenario (weather conditions, terrain, aircraft's ability to move using the landing gear, its center of gravity, types of cargo, etc.), in addition to investigation procedures, internal processes for obtaining authorizations, logistical challenges, and the availability of human and material resources. Thus, the aircraft removal process can vary from hours to days, depending on the severity of the occurrence and the availability of properly prepared equipment and personnel.

Indeed, paragraph 153.325(a)(8)(ii)(A) of RBAC 153 states that, when defining the DARP, the aerodrome operator must establish a deadline for aircraft removal, considering the impact on the safety of air operations at the aerodrome and the economic aspects associated with the discontinuity of such operations.

However, for planning and reference purposes to characterize the term "in a timely manner" in its DARP, the aerodrome operator may consider the following parameters:

- Definition of the crashed aircraft scenarios (e.g., debogging, recovery, or tire burst) in which the aerodrome operator will be able to assume the removal actions;
- Number of flights or passengers impacted during the estimated runway closure period;
- Selection of peak hours or days of the week in which "in a timely manner" will be applied, with the possibility of defining multiple time limits throughout the day, on holidays, or outside business hours;
- Estimates of travel times for the Recovery Kit identified in the aircraft operator's removal plan and its availability to the removal team at the aircraft site. In other words, the aerodrome's accessibility (e.g., how far the alternate aerodrome is for transporting equipment and the removal team);
- Options for the aerodrome's reduced operational resumption based on alternative infrastructure availability and according to the location of the crashed aircraft.

It is important to emphasize that the aerodrome operator will only be able to define "timeliness" after a robust planning process that includes:

a. time estimates for each required preliminary step;
b. identification and availability of adequate human and material resources prepared to carry out the removal of the disabled aircraft;
c. a cost-benefit assessment of the action; and
d. a business continuity plan for the aerodrome.

It should be noted that the pre-defined timeliness established by the aerodrome operator in its DARP cannot be interpreted rigidly. Those involved in the decision-making process (aircraft operator and aerodrome operator) must consider the severity of the event that disabled the aircraft, and the complexity of removing it, as well as the viable options for resuming aerodrome operations with reduced capacity to mitigate the operational impacts of a partial or total closure of the runway where the event occurred.

It is essential, in assessing this process, that the aircraft operator demonstrates the capability to remove it from the accident site. Therefore, the term "timeliness" should not be assessed solely from a temporal standpoint, since, depending on the complexity of the removal operations, the time taken to reopen the runway will exceed the deadline established in the DARP. Thus, the aerodrome operator's authority and duty to remove the aircraft should not necessarily be triggered merely because the time limit has been exceeded.

In this way, once the acceptable waiting time for characterizing the term "timeliness" has been pre-defined in the DARP and reflected in prior agreements for operation at the aerodrome, the aerodrome operator may assume the crashed aircraft removal actions, acting under its authority and duty to ensure the continuity of public air service provision.

It is also recommended that the aerodrome operator widely publicize the characterization of "timeliness" and the DARP procedures to the aviation community. In this way, the main aircraft operators will be previously aware of the procedures for removing disabled aircraft adopted at the aerodrome.

The dissemination of the deadlines and procedures of the aerodrome's DARP may be carried out through:

- the aerodrome's official website;
- formal and direct communication to the aircraft operators operating at the aerodrome;
- published aeronautical information related to the aerodrome; and
- operational agreements previously concluded with aircraft operators who operate or intend to operate flights at the aerodrome, whether scheduled or non-scheduled.

CHAPTER 5: RISK ANALYSIS

According to ANAC regulations, certified aerodrome operators must maintain an SMS within their organizational structure to manage risks related to aerodrome operations. A good definition of the purpose of this core SMS component is:

> *Risk management aims to guide the balanced allocation of resources for the rational control of risks affecting an organization's operations. (ANAC, Aviation Risk Management Guide, emphasis added)*

Thus, a mature SMS can provide a conceptual and procedural foundation to guide the aerodrome operator's decision-making planning phase, execution of actions, and identification of the most appropriate, efficient, and safe resources for emergency response in general, and especially those relating to aircraft removal and resumption of aerodrome operations. The goal is to minimize the various damages caused by an interruption of this nature in operations.

For a better understanding of the risk management component of the SMS, consult the "Aviation Risk Management Guide" from the "SMS in Practice" series, published by ANAC and available on its website.

This risk analysis will support emergency response planning for any situations that threaten to disrupt normal operations and will assist the business continuity plan, ensuring a successful recovery in the shortest possible time.

The aerodrome's risk depends directly on its operational characteristics, infrastructure (in this case, the number of runways available to absorb most air traffic), its connectivity to the national air network, accessibility, types of air services provided, aircraft mix, etc. Therefore, different types of events represent different levels of damage, mainly in the form of human and asset losses, as well as direct and indirect financial costs for the aerodrome, and especially for the airlines. It is up to the aerodrome operator, in conjunction with the main aircraft operators at the aerodrome, to formally assess and determine the level of tolerance for the main mapped risks.

It is important to remember that an organization's resilience, i.e., its capacity to respond in an emergency, will determine its appetite for the mapped risks of interruption. However, when it comes to aerodromes and airlines, the effects on the air transport network must be considered. In other words, to what extent is the national air network, or that of a specific airline, affected in the event of an aerodrome closure?

It is important to assess the effects that go beyond the locality, since the vulnerability of the national air transport network varies according to the aerodrome analyzed.

At the end of a risk analysis focused on unexpected events, such as the removal of a disabled aircraft, the following questions must be answered from the aerodrome operator's perspective (but with the appropriate adaptations, these questions may also apply to the aircraft operator):

1. What dangers exist in this context?
2. What is the risk associated with each of these consequences?

    a. Which consequence(s) is/are the most severe?

    b. Which one(s) are the most likely?

    c. What is the greatest risk?

    d. To which type(s) of aircraft operator(s) is the aerodrome most vulnerable? (This analysis should consider the volume of operations by aircraft operators at the aerodrome and the degree of preparedness each one has for the timely removal of disabled aircraft.)

    e. For which of them is the aerodrome's service level best prepared?

Besides the more obvious hazards associated with the removal of crashed aircraft, it is essential to consider less obvious but equally important hazards, which can be underestimated or overlooked during planning. A complete risk analysis should take into account the following aspects, which are not always immediately recalled:

- Fuel leakage (even after defueling) during aircraft removal;
- Structural damage to the aircraft during the removal process;
- Adverse weather conditions during the removal operation;
- Presence of dangerous goods onboard the aircraft;
- Risk of fire or explosion during the removal process (hydraulic fluids, fuel residues, etc.);
- Environmental impact risk on the site or surrounding areas as a result of the accident (e.g., removal of large amounts of contaminated soil);
- Difficulty accessing the accident site, considering the topography and existing infrastructure;
- Occurrence of a new accident during the removal operations (aeronautical or otherwise);
- Interference from bystanders or media at the accident site, hindering removal operations.

Check how this new hazard interacts with existing hazards listed in the aerodrome's "Hazard Library."

3. What are the operational costs?
    a. How much does one hour of aerodrome closure cost?
    b. How much does an unperformed aircraft operation cost?
    c. What is the cost of not being prepared to reopen the runway?
    d. What is the costs of not responding to known occurrences?
    e. What is the reference timeframe used to characterize the aircraft operator's "timeliness"?
    f. What are the estimated costs of aircraft removal operations at the aerodrome?
4. How prepared is the organization to face each of these risks?
    a. Is there a plan for each of these situations?
    b. What human and material resources are available?
    c. What investments will be needed?
    d. Who are the existing and potential partners?
5. Has the aerodrome operator's planning been coordinated with the main parties involved with runway operations?
6. Do the airlines directly involved in managing this crisis agree with my plans?
7. What is the plan of the largest and most frequent airlines to take over aircraft removal at the aerodrome? Is this plan aligned with the aerodrome's?
8. What resources do the airlines provide? Do they all have easy access to the Recovery Kits and Recovery Teams available in Brazil?
9. Does the aerodrome operator have the necessary resources at the aerodrome, or elsewhere, to conduct the aircraft removal process (Recovery Kit)?
10. Does the aerodrome have an operational agreement model with aircraft operators clearly establishing responsibility limits and action deadlines for aircraft removal?
11. What alternatives are available for maintenance with reduced operational capacity? Is there another runway capable of absorbing most of the air traffic? In which scenarios is it possible to maintain landing and take-off operations with reduced declared distances? (see Chapter 9)

Only after satisfactorily answering these questions based on a thorough and comprehensive risk analysis conducted jointly with aircraft operators, may the aerodrome operator begin to prepare to provide the necessary resources for each mapped scenario.

The more integrated the risk analyses of the aerodrome and aircraft operators are, the more efficient the response to these events will be.

CHAPTER 6: AIRCRAFT REMOVAL MANAGEMENT

As explained in Chapter 5 of this Manual, the aerodrome operator must plan for some aircraft removal scenarios at the aerodrome, taking into account the most probable and significant risks.

The objective of this chapter is to address some essential resources for a quick and effective emergency response to these scenarios. Among them, the following stand out:

- Coordination structures;
- External and internal resources and equipment to assist in removing the aircraft;
- Qualified technical personnel available for immediate deployment.

The aerodrome emergency response system encompasses additional elements not covered in this Manual. Furthermore, aerodrome and aircraft operators should also include aspects of logistics, administration, and finance, as well as social communication, in their planning.

For reading material in Portuguese with more details on the technical issues of aircraft removal, see the article published in *Revista Conexão Sipaer*, titled "Aircraft recovery: Difficulties present during the widebody aircraft retrieval process,' Vol. 10, No. 3, pp. 73-94.." Vol. 10, No. 3, pp. 73-94.

6.1 COORDINATION AND INTEGRATION STRUCTURES

These are physical structures specifically developed to coordinate emergency and contingency actions at the aerodrome, such as the Emergency Operations Center (EOC), the Mobile Command Post, etc. The focus here is on the best way to act and the responsibilities of the EOC members, the Recovery Team, and the operational resumption decision-making group in runway interdiction events.

The EOC is responsible for coordinating the aerodrome's emergency response actions. Therefore, its work must be integrated with other aerodrome elements, such as aerodrome and airline operations centers, surveillance systems, and other public agencies, since the EOC has all the infrastructure, communication, and coordination facilities needed to ensure a quick and effective removal.

For this reason, it is recommended that the EOC structure be physically integrated with the coordination facilities, communications, and management systems of normal operations. A study carried out at aerodromes in the United States, **ACRP Report 189 Design Considerations for aerodrome EOCs**, identified the following benefits of integrating the EOC with the operations center:

- Increased situational awareness of those involved with communication improvements;
- Discovery of opportunities for collaborative actions for operational efficiency of both centers;
- Reduced duplication of facilities and, consequently, lower construction, maintenance, and IT infrastructure costs;

- Enhanced security measures against acts of unlawful interference; and
- Cross-functional training.

By obtaining the economic benefits of this integration, aerodrome operators can provide a more robust EOC infrastructure.

The following basic elements must be considered for the EOC structure:

- **Area:** the space allocated to the EOC must be large enough to accommodate all representatives of the decision-making group, furniture, equipment, and support materials for each representative's work, facilitate the flow of information and coordination activities (briefings);
- **Proper furniture:** comfortable chairs and tables in sufficient size and number for all members of the Decision-Making Group, sufficient electrical outlets for every seat at the table. Modern audio and video resources to facilitate information sharing;
- **Lighting and noise:** Adequate lighting and acoustic treatment to minimize interference;
- **Proper personal care amenities:** Nearby restrooms, and availability of drinking water and food for participants;
- **Other resources:** Internet, resources for virtual meetings, air-conditioning with local control, whiteboard, an aerodrome grid map, markers, paper, printed checklists, the Aerodrome Manual (AM) available in print or easily accessible, post-it notes, etc.;

Another recommended action, which has shown great efficiency in sharing information, is forecasting the activation of online crisis rooms. Thus, the operator must include in the EOC structure the provision of equipment such as televisions, internet, and communication systems that allow remote connections of those responsible for technical response actions by aircraft operators;

The integration of aircraft and airdrome operators' teams is essential for optimizing response capacity, especially when mobilizing the resources needed for removing the aircraft.

It is even possible to conduct live calls with operational personnel in the field, greatly enhancing everyone's situational awareness regarding the scenario being faced.

Nevertheless, it is recommended that individuals in charge designated by the aerodrome operator must be physically present whenever possible, with full access to all the facilities available, for faster and more effective decision-making.

Finally, while still in the planning phase of aircraft removal actions, it is crucial to identify all the equipment required for the removal, even the simplest and most basic (adapters, compressors, generators, straps, wood, etc.), before the deployment of these resources begins, to avoid unnecessary delays due to lack of equipment.

Segregating coordination structures into physically separate rooms, whether separated by walls, glass, or doors only makes it more difficult to carry out tasks at that moment. A single coordination structure, i.e., a structure that functions as a unified command center is paramount for crisis management.

6.2 EXTERNAL AND INTERNAL RESOURCES

This section deals with the possibility of actions and responsibilities of any entities external and internal to the aerodrome, as well as the materials and human resources that might assist in the aircraft removal process. The goal is to ensure that all the necessary resources are available and operational if needed.

AVAILABLE RESOURCES, LOCATION, AND DETAILED INVENTORY

According to item 153.325(a)(8)(iii) of RBAC 153, the aerodrome operator must list the available aircraft removal equipment at or near the aerodrome and maintain a detailed inventory of these resources. This listing and inventory must specify:

- **Location:** where the equipment is stored, whether at the aerodrome or in nearby areas, including the geographic positioning of equipment inside or outside the aerodrome;
- **Owing company:** the company responsible for the equipment;
- **Capacity:** the lifting and/or movement capacity of each piece of equipment (e.g., cranes with X-tons of capacity, hydraulic jacks for aircraft up to Y-tons);
- **Contacts:** telephone numbers and other means of contact for those responsible at any time, constantly checked and updated;
- **Removal capacity:** details on each piece of equipment's ability to lift, move, or tow aircraft;
- **Availability time:** the estimated time for resources to be ready for use from the moment they are activated;
- **Preferred routes:** for external resources, defining the fastest and most efficient routes for accessing the aerodrome operational area.

GROUND-HANDLING AND SERVICE COMPANIES

Item 153.325(a)(8)(iv) of RBAC 153 states that the aerodrome operator must keep an updated list of the following:

- **Airlines:** companies operating at the aerodrome, with contact information for calling the persons responsible at any time;
- **Ground-handling service providers:** contact information for calling the persons responsible at any time.

The most common errors found in ANAC audits are out-of-date inventories and contact information for mobilizations, the absence of data on the response times of external resources, consistent with the actual travel times in the region where the aerodromes are located, and the lack of coordination of preferential routes and procedures with local traffic agencies.

EQUIPMENT WAITING AREA

During the removal actions, **the removal team leader** must establish a **waiting area** to place the equipment. This area must be **strategically located** and easily accessible to the removal team. **It must not interfere** with runway operations if flight operations continue while the removal is in progress.

TEAM SUPPORT RESOURCES

The aerodrome operator must plan internal and external resources for feeding, hygiene, and supporting the teams involved in the aircraft removal. This includes:

- **Shelters:** protection from rain and sun;
- **Energy:** power generators;
- **Lighting:** portable lighting system for nighttime operations;
- **Restrooms:** chemical toilets;
- **Food:** meals, even outside business hours;
- **Drinking water:** adequate supply.

It is essential to provide a portable lighting system to ensure safety and continuity of removal activities at night.

In the DARP, it is recommended that the operator create a checklist of the items to be made available to assist the person responsible for logistics during the event.

It is recommended that the aerodrome operator establish procedures for regular reviews of resources, so that all the items on the list are updated monthly.

It is essential that the aerodrome operator maps these resources and conducts real, practical exercises for the most critical resources, in order to maintain a feasible forecast of the aerodrome's aircraft removal capacity. Once resources and routes are mapped out, these exercises will serve to anticipate displacement problems and improve response times.

A common example of a critical resource is the large-capacity cranes included in aerodrome plans, which are slow to move and time-consuming to hire. These exercises can help speed up deployment and traffic coordination so that these resources arrive at the aerodrome and access the operational area quickly.

6.3 LIST OF REMOVAL RESOURCES AND EQUIPMENT

As explained in Chapter 5 of this Manual, the aerodrome operator must be prepared for occurrences involving the most critical and most likely aircraft.

The most critical occurrences are those of high severity when it comes to the removal of the crashed aircraft and, therefore, with a high potential to keep the runway fully or partially closed for long periods.

Meanwhile, those most likely but of lower severity cause several interruptions to operations, and may result in days of aerodrome closure if analyzed over a 5-to-10-year period.

Considering the requirements and nature of operations, runway excursion events, tire blowouts, and mechanical or hydraulic failures are more frequent in general aviation.

A reasonable conclusion to this dilemma is that, given the higher frequency of interruptions caused by events of smaller magnitude, runway closures caused by such events may represent higher long-term impacts than those caused by events classified as critical.

For this reason, it is recommended that the aerodrome operator provides the necessary resources and equipment (hydraulic or pneumatic jacks, pumping equipment, generators, compressors, rigging gear, pneumatic lifting devices, R2S columns, lifting slings and spreader bars, belts, steel plates, soil stabilizing mats, pieces of wood, etc.) to assist with the removal and to properly handle the events to which the aerodrome is most vulnerable, properly identified and analyzed as explained in Chapter 5 of this Manual.

Thus, with relatively low cost and good organization level, the aerodrome operator will be able to keep resources available for a large portion of the most likely aircraft removal occurrences.

A general equipment list can be modeled according to local reality, based on Appendix 7 of DOC 9137 Part 5 and the technical manuals published by aircraft manufacturers.

In Appendix III of this Manual, you will find a reference list of general and specific resources and equipment to aid in the aircraft removal process.

Additionally, aerodrome operators must obtain from aircraft operators updated Aircraft Recovery Manuals (available under different nomenclatures), which contain extensive lists of generic and

specific equipment for use in each different aircraft model (see Figure 5). The Embraer 190/195 manual, for example, includes a specific chapter titled "Tooling and Equipment," listing both general and specific equipment for each type of event involving that aircraft model.

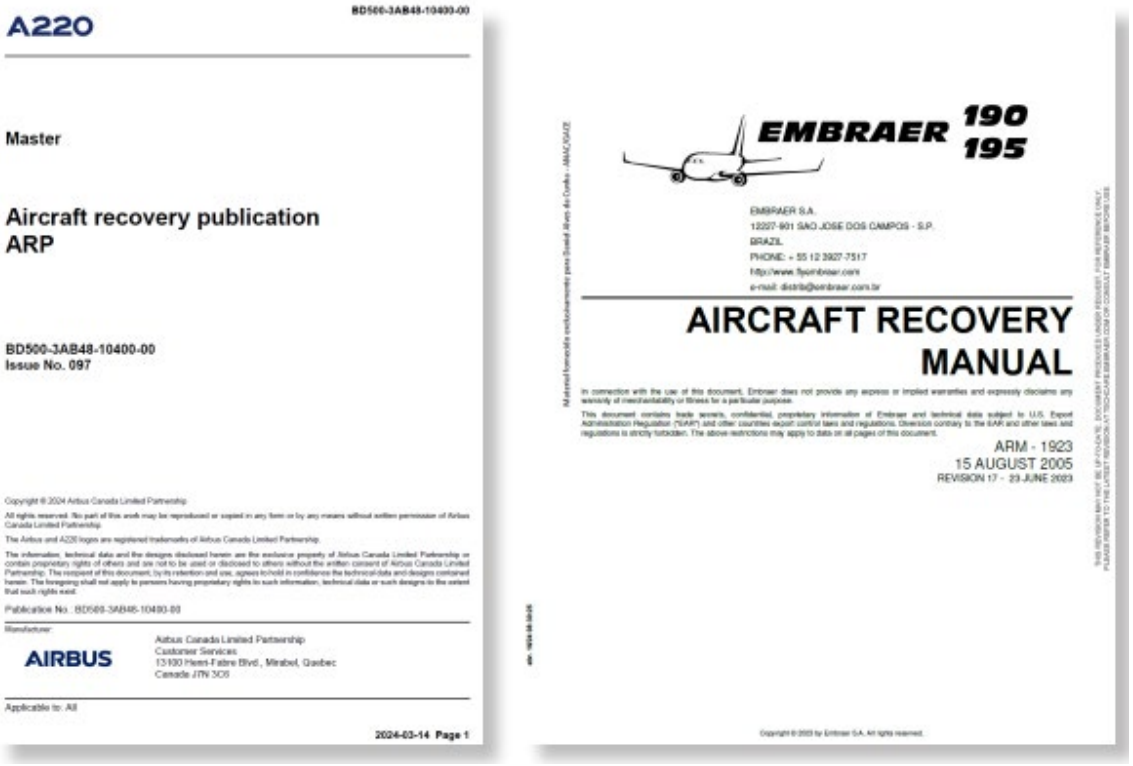

Figure 5 – Examples of manuals prepared by manufacturers

A good practice adopted by Boeing was the publication of a document aimed at aerodromes, entitled "Boeing Material Recommendations for Aerodrome – Planning for an Aircraft Recovery," which includes a basic list of equipment. The document can be accessed through the following link: https://www.boeing.com/content/dam/boeing/boeingdotcom/commercial/airports/faqs/aircraft_recovery_planning.pdf.

The use of these reference documents is fundamental for preparing the list of equipment and resources that the aerodrome operator can acquire to reduce the aerodrome 's vulnerability to events if this nature. Deciding which items to purchase depends on the risk assessment carried out by the operator, as outlined in Chapter 5 of this Manual.

It is suggested that the aerodrome operator carry out a Price Registration Agreement (a system that defines a price but only pays upon usage) for the provision of higher-cost equipment and materials. The aim is to have a predetermined value for the service or the provision of equipment by suppliers, since it is observed that suppliers raise the prices of services and equipment during crises.

6.4 RECOVERY KIT

A highly valuable resource used by the industry is assembling Recovery Kits and making them available at strategic global locations, as in the case of airlines associated with the International Airlines Technical Pool (IATP). This is a varied set of equipment that allows operators to remove an aircraft (aircraft recovery) that has been damaged to such an extent that it cannot be moved by its own means.[2]

Although it is useful for organizing and planning aircraft removal actions, there is no standard kit for all situations because the most suitable equipment depends on the aircraft model, the extent of the damage, and the ground conditions where it came to a stop.

Therefore, the acquisition or contracting of third parties must be subject to thorough prior analysis in order to identify the required equipment for each case, adjusting the forecast according to the level of removal capability that the operator intends to provide. The level of removal capability must be assessed and defined in accordance with the risk analysis conducted (see Chapter 5 of this Manual).

Even though the use of a Recovery Kit has proven to be of great value for the efficient reopening of runways, concerns over its proper use are important, as using this resource incorrectly may cause undesirable secondary damage to aircraft.

A common error observed is indicating the use of these kits in aerodrome operators' AEP/ DARP without properly evaluating the logistical and contractual challenges, such as: costs of contracting the kit and the team, verifying response times, the means of transport, the existence of prior activation contracts, appropriate sizing for different planning scenarios, etc.

Hence, it is not enough to simply indicate the company owning the large-aircraft removal kit and the respective contact information so that those responsible can be called at any time, as stated in RBAC 153. It is important that this valuable resource is available when needed.

In addition to the importance of properly sizing the Recovery Kit, it is also important to ensure that teams are trained and proficient in the most appropriate handling and removal techniques, in accordance with the kit manufacturers' recommendations and the aircraft operating at the aerodrome.

Manufacturers of aircraft removal equipment offer online, in-person, and practical training. Operators who define an actual removal capacity in their DARPs must maintain trained teams.

Integration of the aerodrome and airline teams is also another important measure for ensuring a more agile and successful operation.

2 IATP is mentioned here as a successful example of a pool created for mutual assistance among its members; however, other associations may be established among aerodrome operators, aiming to provide technical capability among themselves for aircraft removal, for example.

6.5 RECOVERY TEAM

COMPOSITION

At the aerodrome, it is crucial to have aircraft maintenance professionals who are trained in, or familiar with, the techniques and tools used for removal, to ensure quick aircraft removal in low-severity occurrences.

It is important that the aerodrome operator identifies the most suitable professionals within the aerodrome community and establishes cooperation with companies, whether they provide auxiliary services or operate hangars, in order to provide specialized training. In this way, these professionals will be able to provide technical support to the aircraft operator's removal operations.

It is also advisable for the aerodrome operator to establish a team that works in cooperation and harmony with the aircraft operators' removal team, in order to assist in operational actions during aircraft removal.

The general recommendations for the team are:

a. be composed of aircraft maintenance technicians from airlines and operational technicians, firefighters, or maintenance technicians based at aerodromes;

b. each individual with operational duties and decision-making responsibilities must have a solid technical background, as well as an interest in and aptitude for the activities of the aircraft removal process. This background must include basic fundamentals of aircraft removal, practical training in the use and operation of removal equipment, training related to the aircraft operated, the Aircraft Recovery Manual (ARM), and specific training in the management and execution of disabled aircraft removal;

c. Members must remain part of the Recovery Team, even if they are promoted or transferred to other internal departments, so that the experience gained is not lost; and

d. It is important that members be available for call-up at any time, on any day.

RECOVERY TEAM MANAGER

Each removal team must have a designated member as manager, responsible for overseeing the team's operational activities in the field and supervising any removal events. They must clearly understand their responsibilities and have the authority to make operational decisions in the field. It is suggested that the manager meets the following requirements and functions:

a. experience in operations and/or aircraft and aerodrome maintenance;

b. experience and knowledge related to aircraft removal;

c. organize regular meetings and training sessions for the aircraft removal team; and

d. act as an interface between the airline's senior management, the aerodrome operator, and the competent authorities involved in the aircraft removal process.

TEAM LEADERS

Depending on the size of the airline and the aerodrome, more than one team leader may be necessary. It is suggested that team leaders meet the following requirements:

a. have experience and solid technical and operational leadership skills within the airline or at the aerodrome;

b. have experience and knowledge of aircraft removal;

c. have knowledge of operational and aircraft maintenance equipment, such as tools, jacks, pneumatic lifting bags, cranes and their general operation, as well as other company or aerodrome equipment expected to be used for aircraft removal;

d. report directly to the team manager about events and problems related to aircraft removal;

e. control aircraft removal equipment owned by the airline and ensure its operability;

f. make recommendations and suggestions regarding the purchase of aircraft removal equipment; and

g. supervise any removal process on-site.

TECHNICAL TEAM

The technical team is responsible for operating the equipment made available for aircraft removal, under the supervision of the team leader. Technical team members must:

a. have a solid technical operational background in the aircraft to be removed, and training in aircraft recovery operations;

b. hold a valid aircraft maintenance license for the specific aircraft types;

c. report to and assist the removal team leader; and

d. perform specific operational and maintenance tasks assigned by the team leader at the time of removal.

Technical team members do not need an aircraft maintenance license, provided they work in coordination with properly certified aircraft engineers.

ENGINEERS

Engineers may or may not be part of the recovery team established by the operator. If they are not, their contact information must be available to the team. They can act remotely, providing technical guidance to better assess the situation and define the aircraft removal strategy. Aeronautical engineers or members of the manufacturer's continuing airworthiness team are a reliable and continuous source of information, particularly regarding the structural characteristics of the aircraft.

Structural and systems engineers can help in the following ways:

a. assess aircraft damage;

b. prepare any drawings required for possible temporary repairs; and

c. assist decision-makers in determining the best strategies and actions for the fastest and most effective removal, without causing secondary damage to the aircraft.

PLANNING AUXILIARS

The team must have personnel who act as planning agents, responsible for the logistical details required prior to aircraft removal activities. They must also perform auxiliary functions during the procedure execution. These functions include:

a. hiring heavy-equipment operators as needed;

b. arranging for the transportation and on-site availability of the required aircraft removal equipment, including logistical arrangements for transportation;

c. organizing the lease of other necessary equipment, hotels, shelters, meals, aerodrome accreditation, transport, etc.; and

d. providing all logistical support needed for the proper execution of the operation by the team.

CHAPTER 7: INVESTIGATION AUTHORITY

In Brazil, the investigation of aeronautical accidents and serious incidents is carried out under the legal responsibility of Cenipa. After an event of this nature occurs, the investigation authority must be notified as soon as possible via official communication channels to ensure that the investigation begins at the occurrence site and that the aircraft is released in a timely manner.

It is important to remember that the investigation authority has legal priority to perform the initial action at the occurrence site and to release the aircraft for removal work. The only actions that may legally be taken on the aircraft prior to this are immediate emergency responses, such as firefighting, rescue and saving victims, containment of fuel leaks, and area preservation, aiming to keep people's safety and minimize material and environmental damage.

It should be emphasized that, except for saving lives, no crashed aircraft, its remains, or items transported by it may be searched or removed unless in the presence of or with the express authorization of the Investigator in Charge of the aeronautical occurrence, in accordance with the Brazilian Aeronautical Code. Under no circumstances may the aircraft removal process begin until the investigation authority has formally authorized its release.

Once the emergency response personnel have cleared the occurrence site, measures must be coordinated to ensure the isolation and security of the area. This includes establishing a security perimeter, controlling access to the site, providing adequate signage, and, if necessary, assigning personnel for surveillance, in order to preserve clues and evidence at the aeronautical occurrence location. From that point on, the investigation authority assumes responsibility for the initial investigation actions, and only after it has been formally released can the practical removal work begin.

The investigation authority may request that the aircraft operator carry out a series of initial tasks, such as removing the flight data and the cockpit voice recorders. These tasks can only be performed under strict coordination with the investigation authority and may be completed even before the aircraft is released.

An action the aerodrome operator can take to help reduce the time spent on the initial actions of the investigating authority is to ensure that key members of the operational team have training in the prevention or investigation of aviation accidents. This way, they can act as support points for the authority's technicians, providing photographic and video recordings to be sent to them to help with their initial actions, before these technicians arrive at the aerodrome or the site of the occurrence.

The investigation authority may request extensive photographic coverage of the occurrence, including ground impact marks, wreckage placement, etc.

However, this does not prevent initial planning and preparation for aircraft removal from being carried out concurrently with the initial actions conducted by the investigation authority. On the

contrary, it is advisable that the removal teams and procedures set forth in the DARP be put into action immediately following the occurrence of the event.

It is the aerodrome operator's responsibility to find ways to facilitate the investigation authority's access to the occurrence site.

It is worth remembering that the investigator accredited by the Brazilian Air Force Command, while exercising their duties, is granted access to controlled and restricted aerodrome areas, as established in RBAC 107.

CHAPTER 8: TRAINING AND SIMULATED EXERCISES

Being prepared for aircraft removal occurrences and runway closures means incorporating best practices in crisis management. Crisis management is an ongoing process of management, training, and continuous improvement of protocols and checklists, aimed at preparing and keeping all principal and multiple parties ready to respond to events that disrupt operations at the aerodrome.

Within the concept of crisis management, the more that those responsible for procedures and decision-making are proficient in what they must do, as previously planned and trained, the more capable they will be of handling the pressures that naturally arise in emergency scenarios.

Therefore, emergency response procedures are "living instruments" that can be analyzed under the lens of the **PDCA (Plan, Do, Check, Act)** cycle, a tool for continuous improvement. In this cycle, training and simulations are fundamental elements to ensure the system's readiness. In this context, the PDCA cycle should be understood as follows:

- **Plan:** This phase involves normative mapping and risk analysis to identify potential crisis scenarios, as well as the development of the entire action plan. This includes defining roles and responsibilities, drawing up aircraft removal protocols, creating checklists, defining needed resources (human, material, and financial), establishing communication flows, and scheduling trainings (both practical and theoretical) to train the team.
- **Do:** This phase consists of carrying out what was planned. In a normal scenario, this includes delivering the scheduled training and maintaining resources. In a real crisis scenario (aircraft recovery), this phase involves activating the emergency plan, mobilizing resources, communicating with stakeholders, and executing the response actions defined in the protocols.
- **Check:** This phase is dedicated to evaluating the effectiveness of the plan and its execution, whether after simulated exercises or a real event. It involves analyzing the results obtained versus the objectives set out in the planning phase. This involves assessing response time, suitability of resources used, clarity of communication, coordination among teams, detection of procedural failures, and analysis of deviations from what was planned. The aim is to identify strengths and weaknesses, lessons learned, and opportunities for improvement.
- **Act:** Based on the assessment made in the "Check" phase, this phase involves the implementation of corrective and preventive actions. If the results were satisfactory, successful practices should be standardized and incorporated into operational procedures. If failures have been identified, protocols must be updated, checklists revised, training adjusted, resources realigned, and necessary improvements implemented for the next PDCA cycle. **The goal is to learn from the experience (whether simulated or real) and to constantly improve the crisis management plan for aircraft recovery**.

It has been shown that a successful response to accidents depends on planning, organization, and exercises (ICAO, Humanitarian Assistance and Disaster Response in Aviation – HADRA).

Thus, the training and ongoing verification of knowledge and skills related to the procedures set out in the DARP and operational resumption must be carried out not only by the aerodrome operator's personnel, but also by those responsible for the organizations with significant operational and planning duties related to disabled aircraft removal and operational resumption actions.

Training in the planning and operational skills related to disabled aircraft recovery occurrences must be part of the training programs of the organizations involved, particularly of the aerodrome and aircraft operators that have established a Recovery Team.

These trainings must also be closely connected to the modular simulated exercises of the aerodrome emergency exercise as required by section 153.331 of RBAC 153. Among these modules, a specific module on the DARP is mandatory, which must be executed every 36 months, at least.

Given the importance of keeping procedures up to date and adapted to the complexity of this type of aerodrome operation interruption, it is recommended that operators of Class III and IV[3] aerodromes carry out at least one full-scale practical aircraft removal exercise every 12 months, always preceded by a tabletop exercise. In this way, the simulated exercises will be carried out every six months. Other aerodromes (particularly those considered critical from an accessibility standpoint), should consider carrying out these exercises every 24 months.

8.1 TRAININGS

The operational team involved in emergency response must receive adequate and appropriate training so they can carry out their responsibilities in the aircraft recovery scenario as competently as possible.

It is important for the aerodrome operator to ensure that the manager responsible for aerodrome emergency response receives training in the planning and management of disabled aircraft recovery activities, and that the operational and technical personnel (Recovery Team members) receive both theoretical and practical training in this activity.

If a manager is designated for the Recovery Team, that professional must undergo practical and theoretical training and, whenever possible, should have prior experience in aircraft recovery operations.

Some providers offer this type of training around the world. It is recommended that professionals designated for key roles in the DARP (if the operator decides to establish a Recovery Team) receive specific training from providers with recognized technical expertise in conducting aircraft recovery operations in recent years. Additionally, training offered by aircraft or specialized equipment manufacturers is also recommended.

3 Class III: aerodrome where the number of passengers processed is equal to or greater than 1,000,000 (one million) and less than 5,000,000 (five million); and Class IV: aerodrome where the number of passengers processed is equal to or greater than 5,000,000 (five million).

It is important that no person takes part in practical exercise activities or emergency preparation activities in the aerodrome movement area unless they have received proper training.

Moreover, training programs must include recurrent practical training to ensure that the knowledge and skills previously acquired by these professionals are maintained.

As part of the training program, it is recommended that the knowledge and skills needed to perform these activities be verified, as appropriate, and that the results be recorded.

In addition to specialized technical training, it is recommended that local training sessions be carried out with the teams, considering scenarios that most commonly occur or are likely to occur at the aerodrome.

It is also recommended that these training sessions be used to improve procedures, correct previous failures, and improve the interaction between those involved. Remember, the stronger the synergy between participants and the more aligned the procedures, the faster the resumption of normality will be.

8.2 SIMULATED EXERCISES

Time is a critical factor in runway interdiction events, which requires those involved to be adequately prepared so that they can react professionally and quickly, avoiding unnecessary delays and ensuring the safety of the aircraft recovery process. In this context, simulated exercises are essential for maintaining the proficiency and efficiency of protocols, as the recovery procedures require the handling of various types of equipment, critical situation analysis, and setting a plan of action, as well as specific skills.

Simulated exercises provide an opportunity for teams to experience real situations in a controlled manner and practice the procedures planned for different emergency scenarios, allowing them to become more familiar with specific protocols, equipment, and techniques.

Another important benefit of simulated exercises is the early identification of deficiencies and improvements in procedures, preventing resource shortages or the execution of inadequate procedures in real situations.

Additionally, simulations allow all parties involved to practice coordinating their roles and responsibilities, thereby improving communication and collaborative work. Therefore, experts representing all organizations directly responsible for aircraft recovery activities and for operational resumption must be invited. These include: those responsible for the SMS, aerodrome maintenance, emergency response,

AVSEC, operations, Air Navigation Service Provider, aircraft operators, ground-handling companies, public agencies, suppliers, Accident Investigation Authorities, aircraft recovery experts, etc.

Simulated exercises may be planned and carried out in two ways:

- **Tabletop Exercise:** a test of the integration and emergency response capabilities of the aerodrome emergency response system, conducted through discussions and decision-making regarding a given scenario, without mobilizing resources (cranes, tractors, vehicles, etc.). It is a theoretical moment for alignment among the various links involved. It is recommended to carry out activities such as the technical evaluation of the most likely and most critical scenarios in the aerodrome's operation, performing calculations, activations, and checks.
- **Practical Exercise:** this is a practical test of emergency response procedures, which simulates a real event. This exercise tests equipment and tools essential to the management, coordination, and integration of those involved, measures the response times of resources to reach the accident site, and completes checklists, among others.

It is recommended that these two types of simulated DARP exercises and operational resumption training be planned and performed together. The tabletop exercise must precede the practical exercise in order to reinforce the procedures, policies, and support tools (such as supplier contact numbers, radio channels, virtual crisis rooms integration, documents, as well as key personnel of the aerodrome emergency response system stakeholders). In a one-year period, it is undesirable to conduct only tabletop or only practical exercises in isolation.

Hence, preparing for simulated exercises must be preceded by meetings that ensure:

a. Simulated exercise planning

Prior organization with periodic meetings and coordination to ensure the participation of organizations and their experts who have crucial roles and responsibilities in the aircraft recovery procedures and operational resumption, identification of the NOTAMs needed for practical exercises, action plans with deadlines and those responsible for each task, prior training on the dynamics to be applied etc.

b. Establishing objectives

General: to verify the execution of all procedures in the DARP or operational resumption plan.
Specific: according to the needs identified by the aerodrome operator (e.g., measuring the time taken to mobilize resources and reopen the runway, as well as testing support tools such as telephones, radios, videoconferencing, etc.).

c. Defining the scenario

Based on the specific objectives, a scenario with different levels of complexity is defined, from the choice of the type of equipment (small, medium, or large aircraft), or the aircraft operator, and the aircraft's final stopping location relative to the runway (assessment of a possible resumption and the use or not of alternate aerodromes), recovery capacity by internal

means or the need for external resources, the existence of fatalities (which will define the levels of the investigation process), the condition of the crashed aircraft (e.g., damage to the main landing gear, the need for weight reduction, lifting actions, debogging, etc.), terrain, and other items provided in the Initial Survey stage. In this definition of scenarios, it is also necessary to plan for surprise elements introduced as the events unfold.

During simulated exercises, it is advisable to appoint individuals to serve as critical observers, responsible for evaluating and recording at least the following aspects:

- compliance with regulations and procedures.
- integration among the various organizations and departments.
- the attributions and responsibilities defined in the planning.
- the motivation and preparation of those responsible and the operational teams.
- response times.
- equipment availability and condition.
- decision-making.

For organizational purposes, a minimum period of 60 days is recommended for the development of each simulated exercise (whether tabletop or practical), considering the following organizational guidelines:

Table 1 – Planning, Execution, and Documentation of Simulated Exercises

D - 60 days:	Initial meeting with the participation of key personnel from the aerodrome administration and main aircraft operators to define the most suitable date for the simulation exercise, formulate the scenario, action plan, and select the organizing committee.
D - 30 days:	Organization committee meeting to evaluate action plan progress.
D - 0 days:	Simulated exercise.
D +1 to +7 days:	Critical analysis meeting.
D +30 days:	Preparation of the final simulated exercise report, including an action plan and revision of procedures based on the critical analysis of the exercise.

After the simulated exercise, the aerodrome operator must coordinate a critical analysis meeting to identify and plan the implementation of lessons learned. The results must be recorded in a final report containing evidence of the simulated exercise organization and execution, along with an action plan for improving procedures and resources.

The following is a structure of (non-exhaustive) technical guidelines that can be used both for planning a simulated exercise and for the sections that will appear in the final exercise report. In addition, the topics from Appendix IV of this Manual may also be included:

a. Executive Summary

Exercise objective: describe the main objective (e.g., testing DARP or operational resumption procedures).

Scope and context: provide a brief overview of the simulated scenario and conditions in which the exercise took place.

Date and location: indicate the date, time, and location.

Participating organizations: list all organizations involved, as well as the functions/specialties represented by each.

b. Simulated Exercise Planning

Specific objectives: list the specific objectives of the simulated exercise, such as measuring response times, coordination among those involved, handling aircraft recovery equipment, execution of removal techniques, operational resumption under contingency conditions, among others.

Scenario: describe in detail the condition of the aircraft and the complexity of the recovery (e.g., the aircraft has stopped at the edge of the runway strip or in the RESA, the aircraft has stopped on the runway due to a tire blowout, the level of severity of the recovery event). It may be valid to consider scenarios that emulate the recovery of aircraft from an air operator without a structured DARP, or that evaluate partial operational resumption alternatives in a contingency situation.

Teams and duties: identify the duties and responsibilities of each team or participant.

Resources and equipment used: list the resources and equipment deployed for the simulation (e.g., generators, pumps, slings, cranes, dollies, and recovery kits).

c. Description of Exercise Stages

Preparation stages: describe pre-exercise activities such as the initial briefing, team allocation, and equipment checks.

Execution: report the steps of the exercise, including:

- the beginning of the exercise and the mobilization of the teams;
- the arrival time of the investigators and the aircraft's release by the investigation authority;
- preparation, transportation, and arrival of the recovery kit;
- the process of stabilizing and lifting the aircraft;
- the removal of the disabled aircraft;
- demobilizing equipment and support structures used in the aircraft recovery;
- corrective maintenance actions for any infrastructure damage;
- maintenance and operations inspections for runway reopening.

Event timeline and response actions: record the actions, decisions, and coordination taken during the course of the simulation.

Response times and duration of main phases: record the response times and duration of each phase of the simulation, as well as the total runway interdiction time.

d. Performance Evaluation

Team performance: assess the effectiveness and readiness of the response teams, aircraft recovery and operational resumption teams.

Communication and coordination: analyze the effectiveness of communication channels and coordination among participants, the use of a virtual crisis room, etc.

Use of resources and equipment: assess the suitability and performance of the equipment used, considering the availability and efficiency of resources.

e. Main Lessons Learned

Identifying challenges: report on the main challenges faced, such as communication issues, equipment-handling difficulties, or access restrictions to the site.

Observed best practices: document the best practices identified, which can be incorporated into the DARP.

Opportunities for improvement: list suggestions for improving the aircraft recovery process, such as additional training, equipment upgrades, or DARP adjustments.

f. Recommendations and Action Plan

Immediate actions: highlight any corrective actions to be implemented urgently to solve identified problems.

Future training: recommend additional training for participants, including specific training on equipment usage and communication procedures.

DARP improvements: suggest changes to the DARP to incorporate lessons learned and improve efficiency in real situations.

g. Conclusion

Summary of results: provide an overall summary of the outcomes, highlighting areas of success and areas requiring improvement

Next steps: briefly indicate the subsequent measures for implementing the identified improvements and for planning future simulated exercises.

CHAPTER 9: OPERATIONAL RESUMPTION

The guidelines set out in this chapter may only be applied by certified aerodrome operators.

9.1 SCENARIO ASSESSMENT AND RESUMPTION STAGES

In a runway excursion occurrence or aircraft being stopped on the runway due to mechanical or hydraulic failures, for example, after the aerodrome emergency response actions, the initial actions and subsequent release of the aircraft by the investigating authority follow. In occurrences of this nature, the aerodrome operator or air navigation services provider must request the immediate issuance of aeronautical information publication for the interdiction of the runway.

At that point, information gathering for evaluating aircraft recovery actions begins. Depending on the complexity, within up to 2 hours, the first removal time estimates are made by the aircraft operator's team[4]. Based on the protocols set out in the AEP, coordinated by the EOC, the aerodrome operator calls up everyone involved who has responsibilities in the AEP and mobilizes its entire operational team. The first evaluations of alternatives for partial or total reopening of the runway occur at this stage.

Figure 6 shows the macro activities in this set of actions that happen either simultaneously or in sequence.

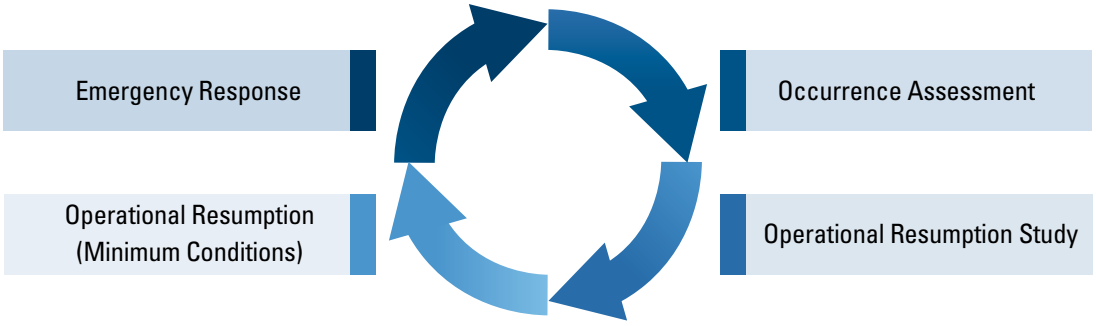

Figure 6 – Macro activities for response and resumption after an occurrence

In the field of occurrence assessment activities, the focus of this chapter, the necessary information is gathered to evaluate impacts, determine the objectives, and define the strategies for recovering the aircraft and resuming operations.

It is important for the aerodrome operator to plan resumption actions for some likely scenarios, taking into account the aerodrome's operational and physical characteristics, accessibility, and local vulnerabilities.

4 This estimate does not apply to simpler cases in which, due to low gravity, the aircraft is removed in a matter of minutes.

Figure 7 shows an example of a scenario matrix for events involving disabled aircraft on or near the runway.

Damage to the Aircraft: / Stopping Location:	Tire Burst	Bogged Aircraft	Aircraft Recovery	Aircraft Salvage
Last runway third				
Middle runway third				
Runway strip graded portion				
Outside runway strip graded portion				
RESA				
Outside runway strip graded portion and RESA				

	Partial resumption is not feasible, either because of the short interdiction time or because operational conditions are unacceptable.
	Partial resumption may be evaluated depending on the progress of the aircraft recovery process and the impacts of the runway closure.
	Partial or total resumption, depending on the existence of obstacles in the protection surfaces and the aircraft.

Figure 7 – Scenario matrix for occurrences of a disabled aircraft

9.2 DECISION GROUP

In scenarios where a partial operational resumption is possible, the resumption of operations planning must include the establishment of a decision-making group composed of specialists and representatives from all institutions directly affected by the runway interdiction, in order to evaluate and decide whether to partially reopen the runway.

It is not enough to have an aircraft operator representative who does not exercise functions or possess the technical background needed to provide support for a technical decision on whether or not to partially resume operations.

The main organizations that should form the decision group, whether in person and/or remotely, are:

Table 2 – Participants in the decision group

Organization	Area/Functions
Aerodrome Operator	- Aerodrome manager. - SMS manager. - Maintenance manager. - Operations manager. - Emergency response manager. - AVSEC manager. - AEP Coordinator. - Specialist in calculating declared distances and assessing obstacles on takeoff, approach, and transition surfaces.
Air Navigation Service Provider	- Representative from the Safety area. - Representative from the AGA area (if possible). - Representative from the ATS unit (TWR or AFIS).
Aircraft Operator	- DARP coordinator. - Representative of the Safety area. - Representative of the engineering or operational standards area. - Representative of the commercial area (company's route network).
Recovery TEAM	- Team representative to provide updates on actions.
ANAC and DECEA	- Representative of the Airport Infrastructure Superintendence at ANAC (Civil Aviation Authority) - Representative of DECEA's Operations Sub-department (Airspace Control Authority).

Table 2 below shows some of the main technical functions within the decision group, which are important for better evaluation of the scenarios of whether or not to resume operations on the runway while the activities to recover the disabled aircraft are underway. Administrative, financial, and public communication aspects are also relevant but are not addressed here because they can be found in the crisis management literature.

Table 3 – Technical roles in the Decision Group

Planning and logistics based on up-to-date information	a. Interface with the Recovery Team and aircraft operator (updating aircraft recovery time estimates). b. Gathering information on affected flights and passengers (updating in accordance with the estimated aircraft recovery time information). c. Needs and availability of resources for aircraft recovery actions and resumption of operations.
Mapping obstacles on the runway	a. Exact position of the crashed aircraft. b. Equipment used in the aircraft recovery. c. Characterization of whether the crashed aircraft and the recovery equipment constitute an obstacle on the flight protection surfaces.

Defining runway operational conditions	a. Type of operation. b. Weather conditions. c. Declared distances. d. Aircraft taxi routes.
Analyzing the performance of the main aircraft to operate under the resumption scenario	Are the proposed operational conditions feasible for the operations of the main affected aircraft operators?
Developing charts and maps to communicate the runway's operational condition to aircraft operators	Visual information is key for communicating the operational scenario to pilots. The map must include graphic information showing the new declared distance, operational restrictions, the location of the crashed aircraft, and the presence of recovery equipment.
Infrastructure corrective maintenance actions	a. Pavement, air navigation aids, etc. b. Markings and lighting for the new declared distances configuration. c. Potential environmental damage control actions.
Operations activities	a. Runway inspections. b. FOD removal. c. Establishment of access routes for personnel and vehicles involved in aircraft recovery. d. Interdicted area signage.
Air traffic analysis	Identifying safety measures for air traffic control.
Safety management	a. Coordinating the elaboration of Operational Safety Impact Assessment / Specific Operational Safety Procedures. b. Monitoring operations with reduced capacity.

The decision to partially resume operations on the runway requires consensus. If the choice is made to allow partial reopening of the runway, a risk assessment for such operations must be prepared and signed in accordance with the AM, without detriment to any risk assessments that each organization directly involved in the operation must conduct.

The risk analysis must take into account the type of operation intended by each aircraft operator, such as ferry flights, equipment transport operations for recovery, passenger operations, and operations with restricted maximum take-off weight (MTOW), among others.

ANAC and DECEA must take part in the decision-making process for partial runway resumption.

To help the decision-making process, during the first few hours after the occurrence, it is important to maintain a situation board with up-to-date information in the EOC or assigned crisis room (both physical and virtual), containing at least the data indicated in Table 3.

Table 4 – Minimum information on the Situation Board

Occurrence Data	1. Date and time. 2. Event type. 3. Aircraft's stopping location. 4. Runway interdiction NOTAM. 5. Agencies activated.
Impacts	1. Estimated runway closure duration. 2. Number of flights and passengers affected so far and over the expected runway closure period. 3. Aircraft damage and severity level of the recovery. 4. Damage or risk of environmental damage.
Mobilized Resources	General equipment (cranes, belts, tractors, generators, etc.)
Event Map	1. Disabled aircraft location (coordinates and position on the runway). 2. Characterization of the aircraft and equipment as obstacles (height and position). 3. Wait/hold area for removal resources. 4. Access routes for trucks, tractors, and support teams.
Recovery Strategy	1. Updates on aircraft recovery status. 2. Unloading any hazardous cargo. 3. Aircraft defueling for weight reduction. 4. Strategy adopted for recovery. 5. Missing resources. 6. Next steps.
Partial Operational Resumption Alternatives	1. Alternatives for operational runway reopening (operational condition, restrictions, declared distances, etc.). 2. Identifying which aircraft models might operate under those scenarios.

9.3 PARTIALLY RUNWAY REOPEN

Once the aerodrome emergency response actions have been concluded and the investigating authority has cleared the site, the decision-making group may consider and evaluate a partial runway reopening, depending on the accident/incident scenario and the difficulties in quickly removing the aircraft without the risk of causing secondary damage.

It should be noted that this is a partial operational resumption in a contingency situation, particularly for:

- Flights departing from the aerodrome;
- Transfer flights; or
- Cargo flight for the transport of Recovery Kit equipment.

Arrival flights normally scheduled for passenger transportation should not be considered if the disabled aircraft's position, any support equipment, or personnel involved in the removal activities are within the designated runway safety areas:

- Runway strip;
- RESA; or
- Violating the takeoff or approach surfaces

In any case, operational resumption must be planned in accordance with the change management requirements for the operation of the SMS, as documented in the Aerodrome Manual (AM). For detailed guidance on change management, please refer to the "Garantia da Segurança Operacional" (Operational Safety Assurance) section of the "SMS NA PRÁTICA series". This document is available on the Agency's website.

For a possible partial runway reopening, the aerodrome operator's risk assessment must satisfactorily meet the following checklist items:

Table 5 – Checklist for the partial resumption risk assessment

No.	Verification Items	Note
1	Geographical positions of the disabled aircraft and the tallest equipment used in its removal.	
2	Are the minimum required RESA dimensions in compliance with paragraph 154.209(b)?	
3	Do jet-blast effects on the personnel involved in aircraft removal need to be considered?	
4	Is the disabled aircraft or the removal equipment an obstacle in the takeoff, approach, and transition surfaces of the aerodrome protection zone plan?	
5	Are the disabled aircraft or the removal equipment obstacles in the runway strip?	
6	Calculation of the new declared distances. Are the new declared distances feasible for operations of the main aircraft operators affected?	The calculation must be performed by a team of operational safety specialists from the aerodrome operator and evaluated by the airline operators' safety, engineering, and operational standards teams.
7	Damage to the runway pavement	
8	Is FOD generated by aircraft removal activities?	
9	Are the navigation aids (PAPI, DME, ILS, ALS) intact and available for operation?	Is there a need for in-flight inspection flights to determine whether any of the aforementioned aids contributed to the event? Are the disabled aircraft or the removal equipment within the ILS critical and sensitive areas?

No.	Verification Items	Note
10	Will IFR approach and takeoff procedures be available?	
11	Runway signage and lights, as well as any runway closure signage and lights. (Warning! Due to the complexities of pavement marking and the short period of interdiction, displacing the runway threshold for landing operations should be avoided.)	Threshold displacements must consider the estimated time to return to normal operations and the time needed for in-flight inspection to recheck the navigation aids. The visibility of all runway markings must meet RBAC 153 parameters. Please refer to the "Manual de Obras e Serviços de Manutenção" (Manual of Construction Works and Maintenance Services), available on Anac's website, for guidance on interdiction markings and lights (as applicable).
12	Under which weather conditions will operations take place?	It is not recommended operations with moderate or heavy rain. Operations in Instrument Meteorological Conditions (IMC) should be supported by risk assessments from aircraft operators.
13	Entry and exit of equipment, vehicles, and personnel in the maneuvering area.	If the routes pass through the maneuvering area, it introduces dangers to air operations, increasing the risk of runway incursions and FOD generation.

For additional risk assessment items, we recommend utilizing ANAC's "Manual de Obras e Serviços de Manutenção", as it covers situations analogous to partial operational resumption process, particularly the preliminary list of dangers contained in one of its appendices.

The calculation of declared distances is essential information for the decision-making group considering the possible partial aerodrome reopening. For this reason, the aerodrome operator must provide technical personnel prepared to perform the first calculations soon after the event. Field measurements should be taken to determine the crashed aircraft exact location. Plans that include terrain and runway measured data should be used to determine the highest point of the aircraft or equipment, to support the calculation of the declared and aircraft performance distances.

Below are some guidelines on calculating declared distances:

- Consider providing the minimum runway strip and RESA lengths as required by RBAC 154.

Depending on the operational scenario, it may be desirable to provide a longer length mitigating RESA. The decision group must assess this possibility.

- Disregard the stopway and clearway at the runway end where removal actions are being carried out;
- Ensure that the approach and take-off surfaces are not violated by equipment or the crashed aircraft.
- Consider jet-blast effects of the aircraft, whose envelope does not exceed 56 km/h, on the people and equipment involved in the aircraft removal. According to the guidelines outlined in ANAC's "Manual de Obras e Serviços de Manutenção", the distances stipulated in aircraft manufacturers' manuals may be reduced by using a jet-blast deflector (blast fence).

The Agency's website provides a spreadsheet to help calculate declared distances. However, the scenarios covered by the spreadsheet do not address this Manual's situation. Therefore, the results should be critically evaluated by users. It is essential that the aerodrome operator ensures the training, development, and preparation of personnel in their teams to master the knowledge of calculating declared distances. Further guidance is available in the "Manual de Cálculo de Distâncias Declaradas" on the ANAC website.

Once the items in Table 5 are satisfactorily answered, the risk assessment must clearly address the following:

1. Detailed and comprehensive assessment of the main risks in this scenario:

    a. In-flight collision;

    b. Runway excursion;

    c. Runway incursion; and

    d. FOD.

2. Acceptable operational scenario for air operations:

    a. Type of operation (VFR/IFR; daytime or nighttime);

    b. Weather conditions (e.g., IMC/VMC; restrictions on operations in rain (moderate or heavy); tailwind or crosswind, etc.);

    c. New declared distances and reconfiguration of visual aids;

    d. Operational restrictions (prohibition of landing or take-off that could risk collision with the crashed aircraft, taxiway closures, etc.);

    e. Type of operation: transfer flights only, take-off only, or Recovery Kit transport flight only, for example.

3. Steps and means of communication:

    a. Assessment of the impacts on aeronautical publications and the needs for updates and suspension of NOTAMs or charts, including IAC or SID procedures, or the availability of navigation aids;

    b. New aeronautical publications:

        i. Two SDIAs must be issued to publish the new declared distances, indicating:

            1. New distances: Distances relating to landing or takeoff operations with prohibited directions must be indicated with a zero or NIL value in the SDIA.

            2. Reason: The explanation that the first few meters of the runway are closed for landing and takeoff due to the crashed aircraft or aircraft removal actions.

        ii. Report the location and the height of the highest object, either the crashed aircraft or the equipment utilized in the aircraft removal activity.

    c. Production of graphical material to disseminate the operational scenario to pilots.

4. Procedures for monitoring the effectiveness of mitigation measures for each operation.

It is worth emphasizing that, more important than quickly returning to operation, even if only partially, it is crucial to first guarantee the safety of people and of any aircraft still operating or scheduled to operate at the aerodrome. It is absolutely essential that there are no subsequent secondary events that could further increase operational risk at the aerodrome.

The operational scenarios presented in Table 5 require careful and additional analysis as to whether take-off or landing operations for passenger-carrying flights should be permitted, given that, depending on the local situation, they may introduce additional risks to the operation that need to be assessed to determine their acceptability.

Table 6 – Operational scenarios requiring careful and additional analysis before deciding to partially resume operations

No.	Critical Operational Scenarios
1	Flight over a crashed aircraft or the site of removal activities.
2	Landing or taking off in the direction of the crashed aircraft or the scene of the removal activities.
3	Very short declared distances values in theory should not be considered for jet aircraft landing operations governed by RBAC 121.
4	Landing or taking off on a wet runway.
5	Low visibility meteorological conditions, as defined in RBAC 153.
6	Unavailability of meteorological information at the aerodrome.
7	Lack of a visual approach slope indicator system for landing operations.
8	Landing operations using non-standard or unusual approach aids or trajectories, such as trajectories that prevent the aircraft from complying with the usual stabilized approach criteria, such as: approach path with angles above 4.5º (steep angle approaches) or an ILS localizer offset (LLZ offset).
9	Nighttime operations.
10	Instrument Meteorological Conditions (IMC) operations.
11	Adoption of procedures to increase the factor used to calculate the effective runway length, as per IS 91-014.
12	International commercial air transport operations.

It is up to each aircraft operator to decide whether or not to operate at the aerodrome in such a scenario, according to its own risk assessment, considering its operational safety policy, performance, and airworthiness requirements of the aircraft, crew and operational standards.

9.4 RETURN TO NORMAL OPERATIONS

After the disabled aircraft has been removed, the runway must be prepared to return to normal operations. It is recommended that the aerodrome operator create a checklist for the actions required to resume operations, which can be included in the AM as part of the operational resumption planning. The actions should include at least the following:

1. Removal of the equipment and materials used in the aircraft removal;
2. Withdraw and sign out all personnel who accessed the operational area to remove the aircraft;
3. Inspection of the runway for FOD, as well as the integrity and functionality of the lighting system, and the condition of the horizontal and vertical signs;
4. Check for pavement damage and carry out corrective maintenance actions on the runway;

5. Conduct tests on the electrical systems and verify the integrity of cables and ducts that may have been damaged during aircraft removal;
6. Cleaning any contaminants from the runway, especially in the case of oil or fuel spills during the event or aircraft removal actions;
7. Check for damage and carry out tests on navigation aids.
8. Schedule and carry out an in-flight inspection to check the aids, if needed.
9. Verify the cleanliness, level, and obstacle-free condition of the runway strip graded portion and RESA.
10. Check if the grassed areas have been restored and are able to withstand jet blast.

Depending on the results and the damage to the infrastructure caused by the aircraft removal process, the stability of the ground, the capacity of the RESA, or the runway strip may have been compromised. In such cases, once the runway is has been cleared and these areas have been made fully available to recover the original declared distances, load-capacity tests (fire truck passes) should be conducted to confirm the performance of these areas.

11. Check whether to remove any markings or lights indicating taxiway closure or runway partial closure;
12. Carry out a final inspection of the monitoring activity before reopening the runway, as provided for in the Aerodrome Manual (AM);
13. Coordination with the Control Tower and aircraft operators;
14. Check if any operational restrictions need to remain in effect due to infrastructure damage that requires more planning and resources to resolve;
15. Cancel all NOTAMs related to the runway closure due to the event.

It is important that the aerodrome operator's maintenance team carries out inspections, tests, and monitoring of the infrastructure before returning to normal operations.

9.5 LESSONS LEARNED

Each runway interdiction event has unique consequences and requires specific technical and organizational capacities from those involved. For this reason, the final report, which records the event and documents the critical analysis performed for the learning of all those involved, is essential for closing the PDCA cycle applied to the aerodrome emergency response system.

Appendix IV provides a model structure for the final report.

When conducting debriefing meetings on lessons learned from disabled aircraft runway closure events, it is important to follow certain guidelines to ensure productive discussions and identify opportunities for improving the handling of future events. The following questions can guide the meeting:

- What were the main challenges encountered during the runway closure?
- What mitigation measures proved effective?
- What were the gaps in the resumption plan?
- What were the main learnings gained during this process?
- What could have been done differently to improve the closure management and operational resumption?
- What adjustments should be made to the plans?
- What adjustments to legislation could be suggested?
- What agreements or partnerships should be made?
- Did the training carried out before the event adequately prepare the teams to deal with the situation?
- Did the response times meet expectations? If not, what factors contributed to the delays?
- What measures could be implemented to minimize the impact of future closures on operational continuity?
- Was communication with stakeholders (passengers, airlines, regulators, the press, etc.) effective? How can it be improved?
- Did this event generate the need for new equipment, contacts, or technologies to assist in future incidents?

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APPENDIX I – PLANNING AND EXECUTION MAP FOR DISABLED AIRCRAFT REMOVAL

The following table is based on Appendix 3 of DOC 9137, Part 5. It aims to serve as a visual reference of the main stages in planning the removal action of a disabled aircraft, thus assisting in the removal process. It should be noted that it is not intended to serve as a step-by-step instructions for dealing with an aircraft removal event.

Basic Recovery Steps				
1. Survey	**2. Plan**	**3. Prepare**	**4. Recover**	**5. Report**
Aircraft condition: - Recover or salvage - Attitude - Landing gear - Structure - Damaged components - Missing components ausentes - Unserviceable components - Cargo and fuel **Site:** - Terrain - Soil - Access routes **Weather:** - Current - Forecast **Equipment availability:** - Preparation - Leveling - Lifting - Moving - Stabilizing **Manpower availability:** - Number - Skills **Environmental issues:** - Fluid spills - Hazardous materials	**Rapid recovery:** - important - not important **Weight and balance:** - Calculate weight of fuel and cargo - Calculate center of gravity **Weight reduction:** - Unload cargo - Defuel - Remove major components **Recovery:** - Reduce weight - Prepare site - Level - Lift - Stabilize - Move **Schedule equipment and manpower required:** - Confirm delivery plan **Secondary damage:** - Prevent or - Accept to reduce recovery time	**Monitor and record:** - Loads - Actions performed **Assemble equipment and manpower:** - confirm arrival dates/times **Weight reduction:** - Unload cargo - Defuel - Remove major components **Prepare site:** - Clear - Escavate - Fill - Stabilize **Roadway:** - Clear - Excavate - Fill - Stabilize - Manufactured temporary roadway for aircraft passage	**Monitor and record:** - Loads - Actions performed **Stabilize:** - Tether - Ground anchors - Jacks - Shoring **Level/lift:** - Jacks - Airbags - Cranes - New technology equipment **Debogging:** - Confirm a lifting method **Move:** - Tow on gear - Move on suitable trailer	**Report:** Include in the aircraft's technical history: - recovery details - repair details - record of loads

APPENDIX II – REMOVAL AUTHORIZATION TEMPLATE

AUTHORIZATION TO REMOVE A DISABLED AIRCRAFT

AIRCRAFT OPERATOR INFORMATION

Aircraft operator:	
Personal ID/ Company ID:	CANAC:
Pilot in command at the time of the interdiction event:	Attorney/Legal Representative:
Personal ID:	

AIRCRAFT INFORMATION

Registration:	
Fabricante:	Type:
Model:	Serial No.:

The operator of the aircraft described above, through its representative, AUTHORIZES the aerodrome operator, [**NAME OF THE AERODROME OPERATOR**], registered under Company ID No. ../****-, under Law No. 7.565/86[1] – the Brazilian Aeronautical Code (CBA), to remove the AIRCRAFT, its equipment, related goods, and/or its wreckage, aware that it must bear the direct and indirect costs incurred by the aerodrome operator, which must be fully reimbursed.

Furthermore, the aircraft operator, through its representative, declares that it is aware that the aircraft may sustain damage during removal procedures and that no compensation shall be required from the aerodrome operator for acting diligently and, whenever possible, with the prior authorization of this operator.

City/State , _____ of _____, 20__

Aircraft Operator / Representative

[1] Art. 38-A. The airport operator may remove aircraft, equipment, and other goods left in airport areas whenever they restrict the operation, increase in capacity, or the regular functioning of the aerodrome, or pose health or environmental risks.

§1. The provisions of the caput also apply to aircraft, equipment, and other assets belonging to bankruptcy estates, upon notification to the competent court.

§2. The expenses incurred with the measures referred to in this article shall be reimbursed by the owners of the assets and, in the event of bankruptcy, shall constitute non-judicial debts to be paid by the bankrupt estate.

Art. 88-Q. The duty to remove any aircraft involved in an accident, wreckage, or transported goods, in whole or in part, shall lie with the aircraft operator, who shall bear the resulting expenses.

§1. At public aerodromes, if the operator fails to remove the aircraft or its wreckage in a timely manner, it shall be the responsibility of the aerodrome administration to do so, and the latter will be responsible for compensating the costs.

APPENDIX III – LIST OF GENERAL AND SPECIFIC RESOURCES AND EQUIPMENT FOR AIRCRAFT REMOVAL

This list was prepared based on Appendix 7 of DOC 9137, Part 5 – Airport Services Manual – Removal of Disabled Aircraft, as well as on the document "Boeing Material Recommendations For Airports – Planning For an Aircraft Recovery" and on the aircraft removal equipment normally available and used by aircraft and airport operators in Brazil and worldwide (e.g., LATAM, Viracopos Airport, Changi Airport in Singapore, among others).

The objective is to serve as a guide to help aerodrome operators in the DARP planning phase and to encourage standardization of the names of this equipment throughout the country.

The values shown in the "Quantity" column are only a generic suggestion, and the aerodrome operator must determine the quantities according to its own financial, operational, and local reality. These values should not be used as parameters for punitive purposes.

This list does not include equipment or materials for the maintenance of any damage to the runway infrastructure or navigation aids.

Each operator must strategically decide, based on its risk assessment as recommended in Chapter 5 of this Manual, which and how many of these resources to make available at the aerodrome or in the region through third parties.

In the table below, orange-shaded rows identify the specific technical equipment needed to carry out a proper aircraft removal by the standards of DOC 9137, Part 5. If the operator decides to acquire this specific technical equipment itself and maintain a recovery team, it must observe the following guidelines regarding the equipment:

a. The equipment must comply with the technical guidance in DOC 9137, Part 5;
b. The equipment must be designed to meet the guidelines of the Aircraft Recovery Manuals (ARM) of Airbus, Boeing, Embraer, and other manufacturers;
c. The equipment must be able to perform controlled, continuous lifting in a single operation, at a variable angle, without affecting aircraft stability or causing secondary damage;
d. The equipment must include the latest technologies to remove new-generation large aircraft, such as the E190, E2 190, ATR, A220, A320NEO, B737MAX, B787, A350, etc.);
e. For safety reasons, lifting equipment and devices are not designed to be used to support aircraft indefinitely and without monitoring. Their use must be for a planned period of time and under continuous supervision;

f. The equipment must work effectively on all aircraft types for which it has been designed, in accordance with the projected aircraft removal scenarios;

g. The equipment must be able to operate effectively on runways, on low load capacity soils, and under adverse weather conditions.

All equipment must have preventive maintenance or test records ensuring safe operation and compliance.

If the equipment is available for use at more than one aerodrome, it is recommended that the items included in the equipment be packed in modified LD3 containers and air transportable pallets to facilitate storage and ground/air transportation, matching the aerodrome's existing infrastructure.

Below is the reference list of general and specific resources and equipment for removing disabled aircraft:

Material	Description	Quantity	Purpose	Observations
Ballast bags	Usually made of strong woven fiber (to be filled with sand or earth) to provide a manageable receptacle for the contents.	200 bags of 25kg (5.000kg total)	Used to provide mass in situations where counterbalance is needed; Can be used in many other ways, such as building a platform for leveling equipment; If laid in brick-fashion, a stable but non-rigid structure can be built.	The maximum weight per bag should not exceed 25 kg.
Plywood sheets	Plywood sheets measuring 6mm x 1.600mm x 2.500 mm.	10	Versatile material with many uses, such as for protecting pneumatic lifting bags from damaged aircraft skin, minor protuberances, and other areas with sharp and jagged edges; For use between aircraft skin and lifting or tethering cables to protect the aircraft; Heavy woven matting or light gauge sheet metal should be considered as a substitute.	It is recommended to use marine-grade plywood, which is more durable.
	Plywood sheets measuring 20 or 25 mm x 1.600 mm x 2.200 mm.	50	Thicker plywood used primarily for placement over soft earth to facilitate the movement of aircraft or equipment.	

Material	Description	Quantity	Purpose	Observations
Timber beams	Hardwood beams measuring 200 mm x 150 mm x 4.000 mm.	50	–	More robust support pieces, measuring between 1.2 m and 1.6 m each.
Steel or synthetic plates for ground reinforcement	Steel plates measuring 13 mm x 1.250 mm x 2.500 mm.	12	For ground reinforcement; Intended for placement under jacks to increase bearing area; Plate sizes of approximately 5 mm x 1.000 mm x 1.000 mm are suitable for use on very firm earth or thin pavement.	Subsurface preparation may be required when jacking on soft earth; Synthetic soil stabilization plates can be used, as long as they have the same coverage area as steel plates.
	Steel plates measuring 5 mm x 1.000 mm x 1.000 mm	6		
Steel tie rods	Measuring 15 mm in diameter and 60 mm long	200	For bracing when shoring.	–
Resources for soil preparation/ stabilization (if steel plates are not used)	Plates for soil reinforcement (made of metal, plastic and fiberglass).	–	Intended to provide a rolling surface on the ground to allow aircraft to be towed; To create five tracks, each at least 3 m wide and 50 to 100 m long.	Reinforcement of very soft ground may require more extensive preparations; Plywood sheets and steel plates can serve the same purpose, however, they will require additional quantities; Fiberglass and carbon fiber mats are also available for this purpose.
	Crushed rock	15 m^3	Used for filling and leveling areas for equipment access, jack or pneumatic bag replacement, etc.	–
	Concrete (quick set)	10m^3	For use in wet or damp environments; Intended for subsurface preparation for jacking or other concentrated earth load situations.	Availability for on-demand contracting with local suppliers.
Drainage pumps	-	2	For removal of water when excavation is required to prepare rolling or jacking surface; E.g., If an excavation needs to be carried out during rainy weather, this pump will remove the accumulated water and allow the work to continue.	May be unnecessary in arid climates. Boeing recommends: - 2" diameter pump, with capacity of 189 to 379 L/min (2 units); - 30 m suction hose, 2.5" diameter, so the pump can be placed away from areas with fuel vapors.

Material	Description	Quantity	Purpose	Observations
Earth anchors	9 to 13.5 ton capacity (or heavily loaded trucks full of sand).	5	Provide stability and allow tethering of aircraft during the lifting process.	Adequate anchors can be made on site by using a bulldozer to bury a bundle of timbers attached with a tethering cable.
Cranes	It may be self-propelled on crawler tracks or wheels.	in sufficient quantities and capacities to lift all or part of the affected aircraft.	For lifting the aircraft and/or its parts.	The operator must pay attention to the capacity of the crane and the mass distribution of the aircraft to be lifted, as well as the lifting point. For lifting aircraft components, including engines, Boeing recommends a crane with a capacity of at least 11 tons, a height of 8.53 m and a reach of 3 m.
Heavy mobile platforms ("Dolly" or "Dolly Recovery Trailer")	Multi-wheel dolly or special aircraft recovery trailers for moving aircraft without landing gear.	The number of units needed will depend on the weight of the aircraft.	Move aircraft without landing gear or with burst tires.	Usually procured from industrial movers of heavy equipment, such as transformers, turbines, bridges, and buildings
Low height flatbed trailer	With a capacity of 136 tons and a maximum height of 1.2 m.	2	-	-
Steel cables sets	Com o diâmetro mínimo de 25 mm, 30 a 50 m de comprimento, completos, com olhais e elos (tipo "mosquetão") em cada extremidade.	4	for towing or winching aircraft by attaching the cable to the main landing gear; frequently used to tow undamaged aircraft from soft earth to pavement.	Shackles must be supplied by the aircraft owner. Heavier cables may be available for larger aircraft, but may require reinforcement in the handling teams.
Lifting cable, landing gear structure assembly	45-ton capacity, 6 m long, with eyelets and metal reinforcement on each end.	3	–	–
Tethering cable	Tethering cable, or 3" (7.6 cm) diameter rope, with an 18 metric ton capacity, 80 ft (24 m) length, with splice eyes and thimbles.	8	For anchoring aircraft in order to stabilize them for Recovery operations that require lifting or shoring.	–

Material	Description	Quantity	Purpose	Observations
Rope	25 mm in diameter.	300 m	For many miscellaneous uses.	–
	50 mm in diameter.			
Block and tackle	Multiple-strand block and tacle, 50-tonne pulling capacity. It is recommended to use hoists, which reduce the lifting force.	2	Used as an alternative to winching or towing to move aircraft or to handle major detached pieces of aircraft.	Boeing recommends: - Double-sheave pulley blocks for 19 mm rope (4 units);
Pulling/ winching units	Pulling/winching units, each 10-tonne minimum capacity (e.g., tractors category 2 or 3, winch-trucks, army tanks).	2	Better control is obtained by winching from a stationary point or vehicle than conventional towing in an aircraft removal operation, which is usually not effective.	–
Storage capacity for fuel defueling from the aircraft	Proper tank, if available, is ideal as a storage and disposal facility for offloaded fuel.	e.g.: General Aviation = 500 liters Narrow Body Comerial = 20.000 liters Wide Body Comercial = 75.000 liters	Store and dispose of fuel drained from the aircraft.	Safety and ecological considerations may be involved in other temporary methods, such as pumping into collapsible tanks. Boeing recommends up to 20.000 gallons (75,710 liters) of capacity, whether fixed, mobile, or "bladder" fuel tanks. The aerodrome operator must assess its unloaded fuel storage capacity, taking into account the aircraft operating at the aerodrome and in conjunction with the fuel storage area.
Lighting equipment	Self-powered floodlight generator (10 kVA).	1	For illumination of aircraft removal site during night operations,	–
	Floodlights to use with the power unit above, with stands, junction boxes, and extension cords	10		
	Standard flashlights	As needed		

Material	Description	Quantity	Purpose	Observations
Communication equipment	Telephone, two-way radio, mobile phone etc.	As needed	For communication between aerodrome facilities and local operational bases/city telephone network.	Aerodrome complexity tends to determine the extent to which this must be provided and organized.
	Megaphones with self-contained amplifiers or similar.	3	For communication during actual aircraft lifting and movement between the several interrelated workstations.	handheld radio transceivers or cell phone telephones may be a better alternative than megaphones.
Area and terrain map	Map showing underground installations, soft and unstable ground/ areas recently excavated.	1	For planning aircraft towing, showing underground installations such as buried pipes, soft unstable ground, recently excavated ground and electrical installations, which may be disturbed by excavation or towing the aircraft.	–
Workshop trailer or tent	–	1	Provide storage and shelter facilities; For use as a workshop or field office at the removal site.	Some aerodromes have outfitted a large van with electrical power, desk and communication center for immediate location at the site of a removal operation or similar emergency. Leased coaches can also be used for the same objective.
Grounding rod	Copper-coated steel grounding rod, plus a 30 m copper cable with clip.	3 m	Provides an earthing/ grounding point for the aircraft while defueling and/or when other flammable hazards exists.	–
Fencing materials and signs	Fences marked with the necessary warning signs, such as "Danger, Keep Your Distance" or "Smoking Prohibited".	As needed	To demarcate and restrict the work area to those who are involved in the aircraft removal operation.	–
Earth-moving equipment	Bulldozer, tractor (or other earth-moving equipment).	1 Small 1 Large	for uses such as moving earth and leveling terrain to make temporary roadways, and towing, tethering, etc.	-

Material	Description	Quantity	Purpose	Observations
Self-powered compressor	For operating tools of 6,9 kPa and 38 l/s.	1	Tool operation, if necessary.	With manifold and connection to fit appropriate tools for drilling, sawing and other operations necessary to the removal operation.
Rotary or demolition saw	With hydraulic, pneumatic, electric or motor-driven.	1	Metal cutting saw for cleaning or removing wreckage.	–
Bolt cutters, metal shearers	-	1 Kit	For miscellaneous uses.	–
Basic tools	Picks, shovels, crowbars, sledgehammers, hand saws, hoes, hammers, nails, small hydraulic jacks, shackles, etc.	As needed	For miscellaneous uses.	–
Lightweight ladders	6 m in lenght.	2	–	–
	9 m in lenght.	2		
Soil Penetrometer	–	1	For assessing ground resistance.	–
Used rubber tires	–	30	–	–
Mattresses	Regular household mattresses.	8	–	–
Absorbent materials for environmental protection	Blankets, cords, pillows and other absorbent elements.	50 units of each type.	To quickly contain and absorb spilled liquids, avoiding contamination of the environment.	In the event of significant operations of wide-body aircraft, the operator should evaluate the acquisition of more units.
Hydraulic jacks	To perform simple landing gear lifts.	2	For use in lifting the landing gear to change tires or to place a low platform under the landing gear to allow the aircraft to be towed.	
Heavy-duty rubber tape	For protecting contact parts	Evaluate	Used to protect places on the aircraft where cables can be laid for towing, lifting or other lashing activities at points on the aircraft.	

Material	Description	Quantity	Purpose	Observations
Aircraft lifting bag kit	A set of pneumatic aircraft lifting bags must include the necessary support equipment, e.g. aircraft lifting bags, control panels, air hoses, air distributor, digital load monitoring sensors ("skin pressure"), air compressor.	Depends on the critical aircraft to be serviced	Aircraft lifting bags should help with the main removal scenarios mentioned in DOC 9137, Part 5 and the relevant aircraft removal documents provided by aircraft manufacturers such as Airbus, Boeing and Embraer.	Pneumatic lifting bags are generally classified in terms of lifting capacity in tons. Lifting bags are generally manufactured in standard capacities of approximately 15, 25 and 40 tons. To use the bags, digital load sensors on the fuselage are mandatory to monitor the structural load during lifting. The lifting columns included in the aircraft lifting bag kit must have interchangeable interfaces (pneumatic aircraft lifting bags with different shapes and load capacities and jack point adapter) to ensure efficient use in any removal scenario. Wing lift columns must include a folding aluminum frame with straps to ensure maximum stabilization between all the aircraft's lifting bags when lifting at great heights.
Debogging kit	The debogging kit must include sufficient and certified shackles, towing slings, separation bar and load measurement sensors.	Depends on the critical aircraft to be serviced	Resources for debogging an aircraft (without causing significant damage) that has left the paved surface and is bogged down in sand or mud. Removing an aircraft in this condition is called debogging. The aircraft is unable to move on its own or through normal towing procedures using a standard tow bar and tractor; however, it can be moved on its own landing gear.	–

Material	Description	Quantity	Purpose	Observations
Aircraft removal towing kit	The kit includes a height-adjustable rotating platform to be compatible with all possible types of aircraft. The aircraft recovery towing system must include the necessary support equipment, e.g. tie-down straps (X2), shackles, pneumatic interface air bags, etc.	Depends on the critical aircraft to be serviced	Resources needed to move the aircraft after it has been stabilized, leveled or lifted. This trailer must be specifically designed to move aircraft that cannot move by their own means.	Some items in this kit appear in the "General Equipment" list above. There may be cases where it is essential to use sensors to digitally monitor the load on the landing gear in order to start towing (see paragraph 7.7.5 of DOC 9137, Part 5).
Tie-down kit	The tie-down kit must include sufficient and certified shackles, lashing slings, separation bar and digital load sensors.	Depends on the critical aircraft to be serviced	This aircraft tie-down kit should assist with the main removal scenarios mentioned in DOC 9137, Part 5 and the relevant aircraft removal documents provided by aircraft manufacturers such as Airbus, Boeing and Embraer.	Some items in this kit appear in the "General Equipment" list above.
Crane lifting kit	The crane's lifting kit must include sufficient and certified shackles, adjustable telescopic bar, lifting slings, extension bar and digital load sensors.	Depends on the critical aircraft to be serviced	This crane lifting kit should assist with the main removal scenarios mentioned in DOC 9137, Part 5 and the relevant aircraft removal documents provided by aircraft manufacturers such as Airbus, Boeing and Embraer.	A complete crane lifting kit must be available to lift an aircraft by its nose according to the critical aircraft.

Important: If the aerodrome operator chooses to structure, alone or in an association, the capability to remove aircraft, the guidelines in this section may help in assembling such a plan, as appropriate.

APPENDIX IV – MINIMUM CONTENT OF THE FINAL REPORT

Recording the final report after a real or simulated occurrence is fundamental for continuous improvement and to demonstrate the execution of Aerodrome Manual (AM) procedures in the Agency's inspection actions, as well as to record the facts, which can be used in other situations, such as litigation or accountability to insurers, for example. The main topics to be covered in the final report are listed bellow:

- Executive Summary
- Table of Contents
- Occurrence Data
    - Flight information
    - Time of event
    - Aircraft
    - Meteorological information (METAR)
    - Runway condition (wet, RwyCC, friction, macrotexture)
    - Number of passengers and crew
    - Number of victims
    - Aircraft damage
    - Aircraft stopping location
    - Damage to the aircraft and to the infrastructure
- Chronology of the event and Response Actions
- Summary Table of the main events
- Resource Mobilization Times
    - RFFS response
    - Recovery Kit arrival
    - Maintenance team
    - Aircraft defueling or offloading cargo
    - Accident Investigation Authorities investigators
- Total Runway Closure Time
- Disabled Aircraft Removal Arrangements

- Operational Impacts Caused by the Runway Closure Time
    - Delayed and canceled flights
    - Affected passengers
- Photographic Report
    - Damage before and after the removal (if any)
    - Aircraft stopping location
    - Infrastructure damage
    - General photographs of actions during the event
- Analysis
- Conclusions
- Lessons Learned
- Action Plan
- Annexes

APPENDIX V – PRE-COORDINATION CHECKLIST BETWEEN AERODROME OPERATOR AND AIRCRAFT OPERATOR

This pre-coordination guide is based on *ACRP Synthesis 38 Expediting Aircraft Recovery at Airports (2012)*, and aims to assist aerodrome operators in the planning phase in their coordination stage with aircraft operators (aircraft explorers) who operate or intend to operate at the aerodrome.

The premise adopted in this guide is that the aircraft operator has a structured plan for taking over the aircraft removal process.

It is important that, in this pre-coordination process, those involved exchange information and explain their respective plans for removing disabled aircraft. The questions in this guide may also be used by the aircraft operator regarding the aerodrome operator's DARP.

1. When an aircraft becomes disabled in the movement area, is there a structured plan to remove it and reopen the runway as quickly as possible?
2. What specific steps does your company take to initiate aircraft recovery? What are the steps to carry out a complete removal?
3. What is the estimated time for mobilizing your aircraft removal team and beginning operations after being notified that the aircraft is disabled? Are there protocols to reduce this time?
4. Who is the insurer or the insurer's representative for your aircraft?
5. Who is your coordinator for aircraft removal procedures in your company? What is that person's contact information, and what is his role in the process?
6. How often and what kind of training do members of your company's aircraft removal teams receive? Are periodic simulated aircraft removal exercises conducted for these team members?
7. Which stages or equipment in the removal plan are outsourced? If so, which companies are used and for which specific activities?
8. Does your company have contractual access to a Recovery Kit or any other readily available supplies? If so, which items are included?
9. Where is the Recovery Kit located, and how long does it take to transport it to the aerodrome?
10. What logistical resources or actions could the aerodrome operator take to facilitate the execution of your company's aircraft removal plan?
11. Which other forms of aerodrome operator preparedness could help expedite your aircraft removal operation?
12. What internal and external resources listed in the aerodrome operator's DARP might be made available or improved to assist your company's aircraft removal process? Note that the aerodrome operator may not keep certain materials on-site (wood, beams, absorbent materials,

straps, tow bars, etc.) but may list a network of local suppliers and timber workshops, vehicles and machinery available for fabrication activities. These could be included in agreements with airlines or other aircraft explorers.

13. Which issues at the aerodrome might complicate the aircraft removal process, and how might the aerodrome operator help?
14. Would it be possible to share your company's aircraft removal plan and documents? Could the aircraft manufacturer's Aircraft Recovery Manual (ARM) be made available?

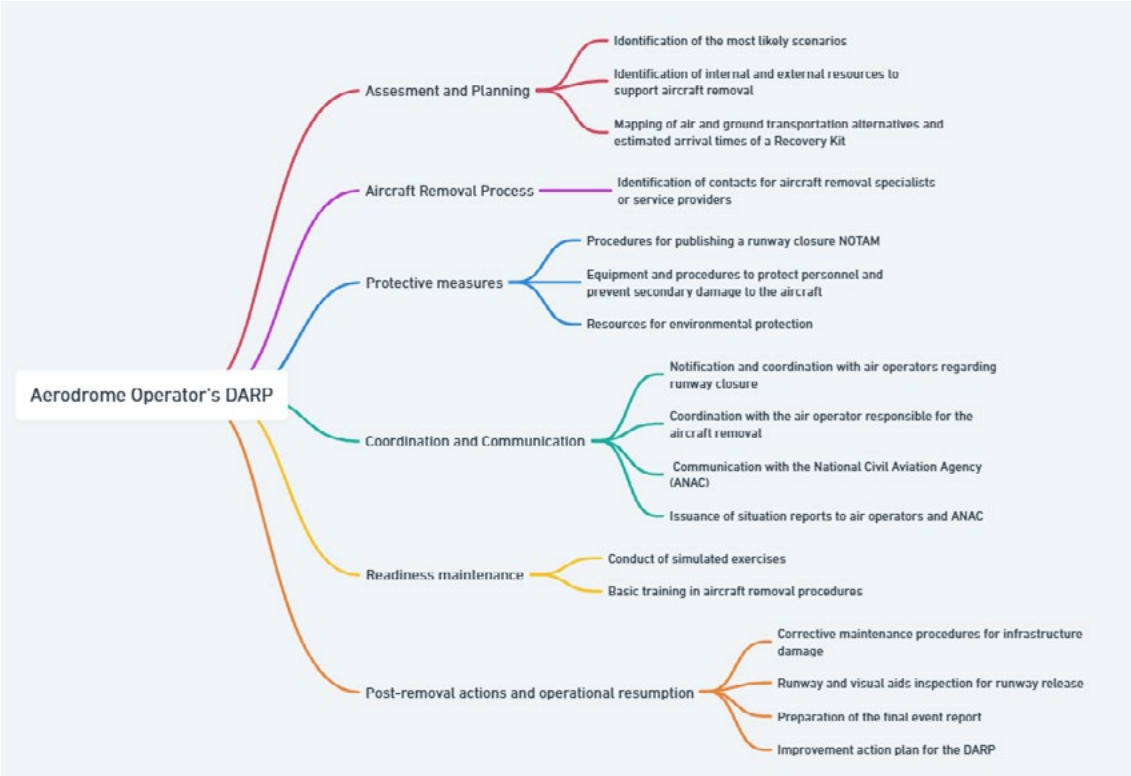
APPENDIX VI – GUIDANCE FOR SMALL OPERATORS

The content of this Manual was developed to guide aerodrome operators who have an SMS in place and process operations of greater complexity and volume.

Small aerodrome operators do not have the human or material resources, or the infrastructure, to structure a DARP with a technical capacity for removal. However, they must not adopt a passive attitude in the face of these events.

There is much that the aerodrome operator can do in terms of preparation and coordination to assist or facilitate the aircraft operator's removal efforts. For small aerodromes, the DARP must be adapted to the operational limitations, resource constraints, and the specific challenges faced by each location.

The mind map below shows the main areas that should be covered in the aerodrome operator's DARP.



On ANAC's website, there is a DARP template that can be used as a reference when structuring your plan. Below are some complementary and specific guidelines, in addition to those set out in the main body of the Manual.

The aerodrome operator must clearly define:

- Objectives of the DARP: The purpose of the Disabled Aircraft Removal Plan is to ensure a safe, efficient, and coordinated response to events involving a disabled aircraft. The plan

aims to minimize aerodrome closure time, mitigate risks to the physical integrity of people and aircraft, as well as to the environment.

- Chain of Command: Ensure that roles and responsibilities are well-established in advance.
    - Appoint the DARP Coordinator:
        - » Responsibilities of the DARP Coordinator, such as:
            1. Ensure that the DARP is up to date;
            2. Guarantee that local (and other) lessons learned are incorporated into the DARP;
            3. Plan and conduct simulated exercises;
            4. Maintain communication with the aircraft operator to monitor removal actions;
            5. Maintain contact with the representative of the insurance company or insurance regulator to define the best removal strategy;
            6. Maintain contact with the investigation authority to protect the aircraft and evidence until the removal is cleared;
            7. Coordinate the deployment of the internal and external resources listed in the plan.

- Inventory of Internal and External Resources: Identification of locally available resources, by creating a network of local suppliers for quick access at any time or day, such as tow bars, towing tractors, cranes, straps, timber, etc.).
- Access to the Site: Procedures to ensure easy access and temporary accreditation of people and vehicles.
- Communication Procedures: Appoint a person responsible for communicating with the affected airlines and with ANAC, defining communication channels and models for issuing periodic reports with updates on runway reopening progress.
- Protecting People and the Environment: Provide resources, locations, and procedures for containing fuel spills or handling and storing hazardous materials. It is useful to maintain contact with local companies specializing in environmental protection actions in order to map out the actions that the aerodrome operator can take in the most likely environmental risk scenarios involving disabled aircraft.
- Records of Removal Actions: Appoint someone to observe and document the aircraft removal process with photographic and video records, to highlight possible secondary damage to the aircraft and identify possible causes and parties involved.
- Training Actions, Simulation, and Continuous Improvement: Define training actions and simulated exercise activities that ensure maintenance of team readiness, DARP updates, and incorporation of lessons learned;

- Actions to Prepare for a Return to Normality: Identification of the damage caused to aerodrome infrastructure and provision of resources for corrective maintenance of pavements, RESA, runway strip, or navigation aids; cleaning of the affected operational area and procedures for inspecting the infrastructure and clearing it for reopening to air traffic.

Remember: Being prepared and trained, with the aerodrome operator and aircraft operator working in close alignment, is always the best solution!

Don't forget that removing the aircraft quickly and safely, thus restoring normal operations at the aerodrome, is a responsibility shared by all parties involved.

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