GHOST
GROUND HANDLING OPERATIONS SAFETY TEAM

Inoperative APU Operations

Introduction

The Ground Handling Operations Safety Team (GHOST) had previously developed detailed guidance and procedures for the application of ground power to live aircraft, with a focus on the arrival phase.

Due to several serious incidents and rising concerns from its members, GHOST has produced this document that incorporates both the arrival and departure phases, for when an aircraft's Auxiliary Power Unit (APU) is inoperative. Due to the complications associated with the discharging of aircraft batteries, this operational necessity results in the undesirable situation of ground handling personnel having to approach aircraft whilst the engines are running and the anti-collision lights are still illuminated, in order to supply ground power.

Several common modern aircraft types require full system resets and significant time to clear all the associated warnings, if electrical power to aircraft systems is not sustained. This could cause unnecessary distraction to the flight crew during a turnaround, which in turn has safety implications as the crew prepares the aircraft and themselves for the subsequent departure.

This is a safety critical activity. Jet blast and ingestion are two very real possibilities for those working around the aircraft if it is not conducted safely - the consequences of which are unimaginable. Whilst the process is achievable, there are multiple factors that can affect preparations and outcomes, including the current of levels of industry experience.

This article and its appendix, aligned with regulatory obligations and industry best practices, have been produced to raise awareness of the hazards generated by this activity, provide an insight into industry's expert analysis of the process and suggest topics that should form the basis of any related risk-based conversation and assessment.

Note: Many of the same considerations in the previous guidance are repeated but with good reason.

Safety Reports

In recent years, many related safety reports have been submitted. Typical examples include:

- The ground crew were unaware that the aircraft required power on arrival and therefore, no briefing for the INOP APU was given. The team leader saw the captain's signal for the GPU to be connected and approached to place the chocks. Once the chocks were placed, he backed away to get the GPU cable. Whilst doing so, he observed the dispatcher of the flight, standing beside the airbridge signalling to someone and turned around to see a member of staff approaching from the wing tip, to place the cone in front of the number one engine. The team leader began signalling frantically for the member of staff to return to the waiting area.
- The aircraft pulled onto stand last night with an INOP APU. We had not been informed and as a result, waited for the engines to spool down before attaching the GPU. The captain signalled for the GPU to be attached and then proceeded to switch off the anti-collision lights, with the engines still running. The lights being switched off led one of our lesser experienced team members to believe that the aircraft was safe to approach. He had to be stopped from going towards the number two engine to position the safety cone.
- A briefing between the headset operator and the flight crew had taken place, the number one engine was to be started first. Shortly before departure due to a last minute change to the load, the flight crew were informed that the ASU had to be "re-positioned" in order to offload the cargo. This casual remark provided for information only, was the start of a communication breakdown, which included several non-standard phraseologies. Statements confirmed that after the original brief, all were in full agreement that engine number one would be started first. However, it was the number two engine that was started, with the ASU and two agents positioned in front of it. The flight crew could not see the position of the ASU form the flight deck.
- The Duty Manager spoke with the flight crew to ask which engine would be started first and the captain advised it would be the number one. The ASU was therefore positioned in front of the number two. Once connected and ready, signal was given for air. Within a few seconds, engine number two was heard starting up. The agent quickly moved away from the danger area to the head of stand and turned to see the airstart hose being drawn toward the engine. Luckily, it stopped short. The headset operative advised the captain who then shut down the engine.

In 2022, a ramp worker tragically lost her life after being ingested into the engine of an aircraft that had just arrived on stand with an inoperative APU. At the time of the accident, the aircraft was parked with one engine running, waiting for ground power to be supplied.

The preliminary investigation report stated that after positioning a safety cone at the rear of the aircraft, the agent then walked along the leading edge of the left wing and directly in front of the number one engine. She was subsequently pulled off her feet and into the operating engine. Throughout the course of the accident, the aircraft's upper anti-collision beacon appeared to be illuminated.

GHOST Review

During several meetings, including a workshop at the FAA's InfoShare Ground Operations forum, industry experts reviewed this practice and identified several widespread concerns, namely:

- **Poor communications.**
- **Lack of industry standardisation.**
- **Familiarity with procedures.**
- **Inadequate supervision/oversight.**

Poor Communications

When handling an aircraft with an inoperative APU, the receiving ramp team need to be able to properly plan and prepare. To do so, they need to know in advance. There are various methods of communication, but it was recognised that due to the many different layers and systems involved, none were particularly robust.

Airlines' operations departments will send either a SITA (movement) message or an e-mail to the ground handling agent, allowing the ramp team to be notified at local level. However, most of the arrival incidents industry has experienced, involved situations when this vital communication chain was broken - messaging systems were not being monitored, meaning that this information was not received and passed on to frontline personnel.

If frontline personnel are not aware, they could be vulnerable to a physiological reaction called the startle response. This can be triggered by a sudden intense and unexpected stimulus, commonly known as the "fight or flight" reflex. Humans will respond to what may be perceived as a harmful event, or more simply fear itself, which can lead to actions inappropriate for the situation.

To try to reduce this risk, the group suggested several items:

- Ensure all operational contacts and VHF frequencies are kept up to date.
- Updates regarding aircraft/stand changes must be provided throughout the operation.
- Use standardised electronic messaging formats to send INOP APU information.
- Communication methods should incorporate a way to acknowledge notifications/messages.

- Automate information to the team leaders to ensure a task includes aircraft defects information.

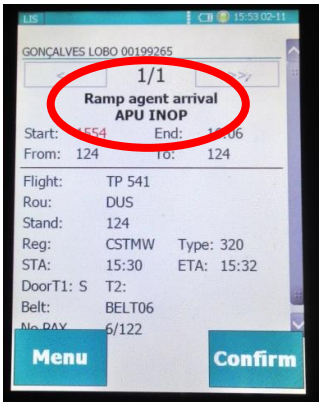
Ideally, we would like prior notification of every INOP APU but they will sometimes fail when the flight crew has tried to start it in preparation for the arrival. However, that phase of flight must be conducted in a "sterile" environment, especially when in busy airspace, so the handling agent may not get notified of the required change to the arrival procedure. The presence of jet blast and engine noise may not be immediately obvious to a driver in a vehicle or a person wearing ear defenders.

Without knowing the aircraft's APU status, risks may be further increased for the ground crew. If for any reason an aircraft stops short of its final parking position, the ground crew may inadvertently interpret that they are now clear to approach to commence their duties. If at the same time, flight crews are focused with the final positioning of the aircraft and are unaware of the approaching ground crew, the situation becomes dangerously hazardous. If an increased "break-away" thrust setting is applied to counter ramp slope or a single engine taxy, engine danger areas will significantly increase.

One airline has equipped their flight crew with iPads and in the event of an inoperative APU, a 'GPU REQUIRED' message will be flashed on the tablet, in the window of the aircraft.

Some other best practices include:

- Hand-held electronic devices to inform the ramp team of the INOP APU.
- Flashing wands used to indicate to all around the aircraft that the APU is INOP and the engines will not be shut down immediately after arrival.
- Consider planning additional turnaround time when an APU is INOP.
- Consideration should be given to providing a method of direct communication between team leaders and ramp teams, such as an earpiece.



Lack of Industry Standardisation

As with many activities in the aviation industry's ground handling community, different organisations have determined different ways of conducting the same process. The lack of standardisation can add ambiguity and result in confusion for what is a safety critical task.

Stakeholders are recommended to refer to and align with the detailed procedures provided in Appendix A, which are consistent with industry best practice, as described in the IATA Ground Operations Manual (12th Edition at time of publication). This includes the hand signals that flight and ground crews use to communicate with each other during INOP APU arrivals and departures, the importance of which can never be overstated.

GHOST could not identify an industry standard for how aircraft engines are identified. Some are called left and right, others number one, number two etc.

Familiarity with Procedures

Familiarity with any procedure, or the lack of, can result in very different outcomes:

- Familiarity with a routine procedure often dilutes the safety critical nature of the task and breeds complacency.
- The lack of familiarity with a procedure will result in a reduced level of safety for all involved in the process.
- Whereas, total awareness of an 'unusual' situation may provide all involved with a heightened level of awareness.

Whilst initial and recurrent training in accordance with standard operating procedures is the recognised way of trying to achieve familiarity, there are limitations. Every member of staff should also receive basic SMS awareness training which should, as a minimum, address the following:

a) The importance of the GHSP's SMS framework, safety policy and safety culture.
b) The individual involvement of the personnel in the SMS, including the use of an occurrence reporting system, application of safe working and operating practices, and response to emergency situations; and
c) Human factors and human error.

Refer to the ICAO Doc 10121 (Manual on Ground Handling) for more information.

Some other best practices include:

- Training should incorporate non-standard scenarios, so personnel know how to properly respond when things go wrong (training for failure, not just for success). To ensure personnel respond accordingly to a non-standard scenario, training should include consequences of actions, including the worst case outcome.
- A laminated 'Unserviceable APU Handling Team Briefing' card, used as the basis for the arrival/departure checklist, to aid recency and familiarity of process. After all, the flight crew use one when operating the aircraft!

Inadequate Supervision/Oversight

Practical drift, as defined in ICAO doc 9859, occurs when the baseline performance of any system "drifts" away from its original design when the organisation's processes and procedures cannot anticipate all situations that may arise in daily operations.

Effective management and supervision of any safety critical activity is imperative, so the agreed process must be included within all stakeholder's compliance monitoring programmes. Whilst a desktop review of the risk assessment, procedures and training must be periodically conducted, it is essential to observe the actual process in all weathers and visibilities, day or night.

Historic observations have witnessed:

- Ground crew becoming overly confident and trying to open access panels and apply ground power before the aircraft has come to a standstill. In addition to the risk of ingestion, this practice could lead to an operative being struck by the aircraft.
- Ground crew not required for the initial procedure of chocking the nose gear and attaching ground power to the aircraft were noted to be 'strategically' waiting in operational areas, not staying clear of the stand until the initial arrival process was completed.
- Flight crew turning off the anti-collision lights with engine(s) still running.
- Ground crew being provided with notification of the INOP APU but not reviewing the electronic device receiving it.

Operational Considerations

Whilst it is impossible to list and effectively cover every operational consideration, several were raised/discussed during group research and these must be considered for any development of procedures and/or risk assessment. They included:

- On arrival, engineers are sometimes required to use headsets to verify whether aircraft brakes are at temperatures that are safe for under-wing turnaround activities. This action must be coordinated with ground crews and only completed after the aircraft has been chocked.
- Whilst the need for flight and ground crews to maintain in visual contact has been mentioned in this article, it is recognized that this is not always possible, depending on the layout of the parking stand and surrounding infrastructure, particularly with wide-body aircraft. In addition, aerodrome and apron complexities and layouts are a significant factor. Stands are, in some cases, becoming more restrictive which will affect operations.
- Aircraft can operate with inoperative anti-collision warning lights for a limited number of sectors, in accordance with the Minimum Equipment List (MEL). It is also understood that one aircraft manufacturer is looking into concerns that a single engine taxi or electrical power transfer could even extinguish the anti-collisions. Therefore, aircraft operators should review MELs to ensure that an anti-collision light and APU can't be INOP at the same time, which they currently can.
- Most aircraft have a light on the nose landing gear that illuminates when the parking brake is set. However, in the same way as the anti-collision lights, aircraft can operate with it inoperative. Therefore, this light should not be relied upon as the only indication that brakes have been set. Some aircraft types also have a towing light in the same location, so beware.
- Over time, the length of the hose(s) on Air Start Units can get shorter as running repairs are made. The result of which is a closer proximity of GSE and ground staff to the aircraft. This should be taken into consideration during routine maintenance and never be less than the manufacturers recommended length.
- If you are using the thumbs up as a response to a hand signal from the flight crew, be cautious, as other ground staff may misinterpret this as a signal that all is clear, when it is not.

Summary

In a factory environment, physical barriers can be placed in the form of safety nets or shields to deal with close proximities and/or abnormal situations, but these do not exist when working in close proximity to live aircraft engines. Due to the severity of the potential consequence, the robustness of mitigations and strict adherence to agreed procedures is vital.

Therefore, as part of the Safety Management System and duty of care obligations, aerodrome operators, airline operators and ground handling service providers should ensure that rules and procedures for safe engine running on the aerodrome are promulgated and understood by flight crews, handling staff and others working or intending to work on or around the aircraft.

There are many other activities around the aircraft during turnround that could be influenced by this activity, so it is important that any development and adoption of this procedure does not dilute the long established need for vigilance and situational awareness around aircraft whilst engines are running and anti-collision lights remain illuminated. Especially, as it is very easy for repetitive procedures to lose their significance over time.

Many of the team alluded to a need for a significant change in ramp safety culture and leadership. Whilst many of the factors mentioned above create complexity, we need to further empower our frontline colleagues.

Single point stand management control is seen as a key component to this procedure but the limitations of a single ramp coordinator must be recognised, as they can't be responsible for all activities and parties around the aircraft. In the interest of safety, we need to encourage the implementation of dedicated supervision for both inoperative APU arrivals and departures, which could be provided by airfield operations personnel. Their presence would enhance the flight and ground crew's awareness during both phases.

From initial training to routine compliance monitoring, employees need to understand how important it is to always remain clear of hazard zones and be aware of the consequences.

Hopefully this article will provoke a few thoughts, provide a few explanatory considerations and most importantly remind all that safety is the number one priority. Therefore, in the interest of best practice, GHOST recommends that stakeholders consider the following basic actions:

- Safety leaders to review this document and use the information contained to align related policies, procedures and training materials.

- All stakeholders are involved in the evaluation of the specific activity and work together to ensure that all associated risks are identified and managed to an acceptable level.
- Verify that Flight and Ground Operations Manuals contain all details of this procedure and align.
- Related supervision and monitoring activities are in place that ensure that this topic is appropriately checked for performance and compliance.
- Personnel, working within a just culture, understand the importance of reporting related incidents and concerns, including near misses, and;
- Work together during the subsequent investigations, to understand why they occurred and build the lessons learned into procedural reviews and future training.

For any related comments, feedback or information please contact GHOST@caa.co.uk

Appendix A

Aircraft operators are to incorporate these safety critical elements into all related policies and procedures, before sharing them with their Ground Handling Service Providers and aerodrome operators.

1. Pre-Arrival

1.1 INOP APU information must be communicated by the aircraft operator to the ground handling service provider, as soon as available. Updates must be provided (to avoid any last minute stand changes that could disrupt planning and result in crews rushing), communicated to frontline personnel and acknowledged.

1.2 All personnel involved in the arrival process must meet at the head of stand for a threat and error management based briefing. A designated responsible person will conduct this briefing, to ensure that the team is reminded of their associated duties and hazards associated with this type of arrival. This briefing should incorporate the following elements:

a) A review of the operators INOP APU arrival procedure.
b) The designated responsible person will confirm the assignment and sequence of tasks for the ground crew, including communications with the flight crew, chocking and ground power. This confirmation will need to include any other personnel directly involved in the arrival i.e., ground engineers.
c) Other members of the team will be reminded not to engage the aircraft (approach or drive equipment toward the aircraft) until they have been given clearance to do so.

1.3 As far as possible, the designated responsible person will also notify any other providers present, that the arriving aircraft has an INOP APU and will not immediately shut down engines.

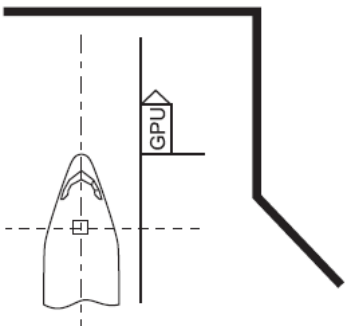
Note: The designated responsible person must:

a) Be located at ramp level.
b) Maintain focus and not be distracted by any other tasks, e.g., chocks/ground power/etc.
c) If possible, remain in direct visual contact with the flight deck.
d) Continually monitor the ramp team's actions.

2. Pre-Positioning of GPU/FPUs

2.1 GPUs must not be pre-positioned unless there is an assigned position provided and approved by the aerodrome operator. FEGPs can be pre-positioned but must remain outside of the ERA:

a) It is permitted to pre-position a Ground Power Unit (GPU) inside the ERA provided there is a marked GPU parking position.
b) Position the GPU on the appropriate side of the aircraft as shown.
c) Set parking brake/chock for the GPU.



d) Ensure the GPU, while in operation, is positioned a minimum of 3 m (10 ft) from any fueling vehicles and aircraft fuel vent exits.
e) Fixed Power Units (FPU) and leads shall be fully stowed/retracted during aircraft arrival as per the system design.

3. Arrival on Stand

3.1 The designated responsible person will ensure the ground crew assigned to chock and power the aircraft, are positioned at the head of stand and whenever possible, stay in visual contact with the flight crew.

3.2 Other ground crew members, providers and Ground Support Equipment (GSE) must remain in the designated safe area at the head of stand, clear of the aircraft path, outside the Equipment Restraint Area (ERA). This area should be considered sterile for the entire arrival phase.

3.3 When turning onto stand, flight crews should use the minimum power required to carry out a normal arrival. Where possible the aircraft should be kept moving to avoid the need to apply 'break away' power to continue the approach to the stand.

3.4 As much as possible, the designated responsible person will ensure that no other staff, vehicles or equipment approaches the aircraft.

4. Post Arrival

4.1 To reduce the risk of ingestion, the flight crew shall shut down the engine on the ground power receptacle side of the aircraft. The other engine will remain running to maintain electrical power and the anti-collision beacons must stay switched on.

4.2 When the flight crew has brought the aircraft to a complete stop and the parking brake has been set, they must signal "Brakes Engaged" to the ground crew. This is to inform the designated responsible person that they have finished maneuvering.

4.3 With confirmation from the flight deck that aircraft parking brakes have been set, the designated responsible person will firstly respond to the flight crew that the message has been received and understood by replicating the hand signal, then indicate to the previously assigned person that it is safe to approach the aircraft and position the nose wheel chocks to be positioned.

4.4 Once the nose wheel chocks have been positioned, the designated responsible person will notify the flight crew, using the "Chocks Inserted" signal.

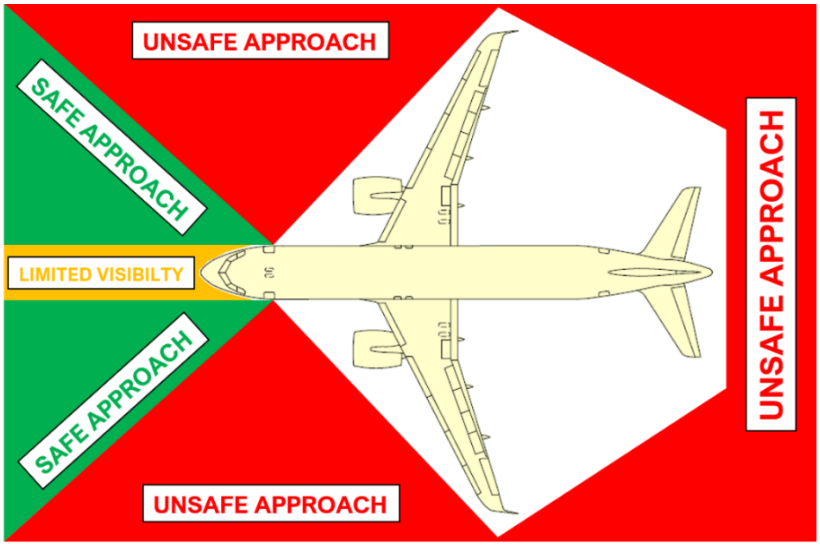
4.5 Only after the aircraft nose gear is chocked, can the ground power be connected.

Note: If ground power is attached to the passenger boarding bridge, a ground-based power source should be utilised.

4.6 If the reactions and behaviours of the ground crew indicate that to the flight crew, that they were not aware of the need to supply ground power on arrival, the flight crew must signal "Connect Ground Power".

If there is any ambiguity, all engines must be shut down in the interest of safety.

4.7 Ground crews positioning nose gear chocks and providing ground are only to approach the aircraft from the nose, never immediately in front of the nose wheels, or from its extremities (wing areas), staying clear of engines and propellers.



4.8 When the ground power has been connected and energized, the designated responsible person must inform the flight crew by replicating the “Ground Power Connected” signal.

4.9 Once the flight deck systems indicate that the aircraft is accepting the ground power, the flight crew will shut down the engine(s) and switch off the anti-collision lights. If there any problems with the delivery of the power source, this must be clearly communicated to the ground crew using the “Negative/Hold” signal:

a) Whilst an alternative power source is found, the designated responsible person will, as much as possible, ensure that no other staff, vehicles or equipment approaches the aircraft.

4.10 Only when the engine(s) have spooled down and the anti-collision lights have been switched off, is it safe for ground service providers to approach the aircraft and commence servicing tasks.

4.11 When not providing the hand signals described above to either the flight of ground crew, the designated responsible person will display the “Negative/Hold” hand signal until the aircraft has fully shut down, when they can then display the “OK” signal.

4.12 If at any time during the arrival and/or post arrival phases, someone walks into the aircraft footprint, the designated responsible person must provide the “Emergency Engine Shut Down/Cut Engines” hand signal to the flight crew.

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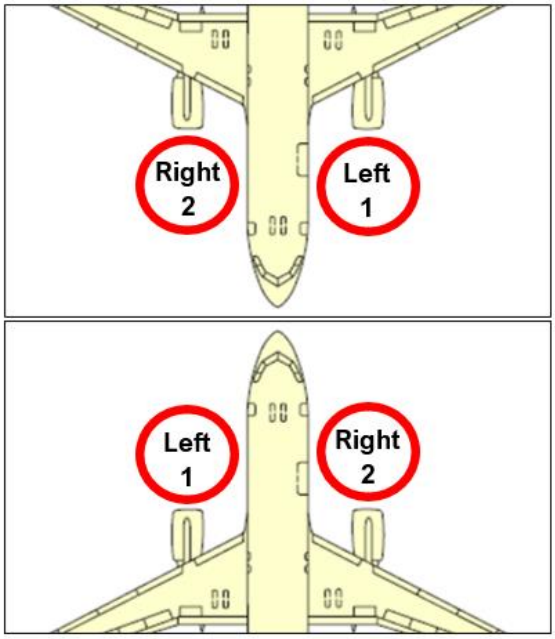
5. Pre-Departure Communications

5.1 INOP APU information must be communicated by the aircraft operator to the ground handling service provider as soon as available. Updates regarding aircraft/stand changes must be provided throughout the operation, provided to frontline personnel and acknowledged.

5.2 A face-to-face pre-departure briefing with the flight crew and a designated responsible person must be conducted, prior to closing the aircraft doors. This briefing should incorporate elements of threat and error management and consist of the following:

a) Review engine starting procedures and the start sequence.
b) Confirm the total number of ASUs required and their position around the aircraft.
Note: To overcome any potential misinterpretations/language barriers, the flight crew should physically point out which engine will be started on stand and the position of the ASU.
c) Review standard hand signals to be used, including emergency signals.

Note: From the flight crew seat facing forward, the engine on the left is referenced as engine number one.



5.3 Following the pre-departure briefing with the flight crew, all personnel involved in the departure process must meet at the head of stand for a threat and error management based briefing. The designated responsible person will conduct this briefing, to ensure that the team is reminded of their associated duties and hazards associated with this type of arrival. This briefing should incorporate the following elements:

a) Review engine starting procedures and the start sequence.
b) Confirm the total number of ASUs required and their position around the aircraft.
c) The designated responsible person will confirm the assignments of tasks to communicate with the flight crew, operate/disconnect the ASU, disconnect ground power and remove chocks. This confirmation will need to include any engineering staff involved in the departure.
d) Review standard hand signals to be used, including emergency signals.
e) Other members of the team will be reminded to remain clear of the aircraft.
f) As far as possible, any other providers that are present will also be notified.

Note: The designated responsible person must be:

a) Located at ramp level.
b) Not distracted by any other tasks, e.g., air start/ground power/chocks etc.
c) Remain in direct visual contact with the flight deck.
d) Continually monitor the ramp team's actions.

6. Departure Communications

6.1 The headset is the preferred method of communication method with the flight crew, unless adverse weather is present or the equipment becomes unserviceable. In which case, hand signals must be verified with the flight crew, prior to departure, in accordance with standard procedures.

6.2 The headset person must be the sole departure coordinator, to minimize the persons involved in the communication chain and the opportunity for an error.

7. Departure Preparations

7.1 The ASU should be positioned on the opposite side of the aircraft to the engine being started.

7.2 If ground power is attached to the passenger boarding bridge, a ground based power source should be utilised.

7.3 Confirm with the flight crew that the aircraft parking brake is set, then remove main gear chocks. If a pushback tractor/towbarless tug is not connected and/or not required, a chock must be positioned in front of the nose wheel to protect against unexpected forward movement.

7.4 The headset operator should establish and be in continuous communication with flight crew. They should inform the flight crew when the ground crew are ready for engine start.

7.5 Other ground crew members, providers and Ground Support Equipment (GSE) must remain in the designated safe area at the head of stand, clear of the aircraft path, outside the Equipment Restraint Area (ERA). This area should be considered sterile for the entire departure phase.

8. Engine Start

8.1 When air traffic control clearance has been obtained by the flight crew, they must ask the headset operative for permission to switch on the anti-collision lights.

8.2 Once clearance to switch on the anti-collision lights has been given, the flight crew will do so, then request the air to start the first engine. On receipt of this request, the headset operative will signal "Air Up" to the staff member operating the ASU.

8.3 The headset operative will continually scan and monitor area around the aircraft for any engine start related issues and/or emerging hazards.

8.4 After the first engine has been started and stabilised, the flight crew will request that the ASU and GPU/FPU are disconnected:

8.5 When engine start is complete, the headset operator will signal to the ASU and ground power operator(s) to power down/disconnect the ASU and remove ground power, using the “Ground Power Disconnected” signal:

a) When disconnecting the ASU hose(s), ensure the unit is powered down and the hose has fully depressurized.
b) After closing and latching the external air start and electrical panels, walk directly underneath the fuselage, or close alongside it, keeping clear of engine danger areas.

8.6 Engine start using cross-bleed can only be performed once the pushback has been completed, the aircraft brakes have been engaged, and the area around the aircraft is clear.

8.7 If at any time during the departure phase, someone walks into the aircraft footprint, the designated responsible person must provide the “Emergency Engine Shut Down/Cut Engines” hand signal to the flight crew.