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30 September 2005

Ref.: AN 13/50-05/88

**Subject:** Runway Safety Toolkit CD-ROM

**Action required:** To note and take action as necessary

Sir/Madam,

I have the honour to refer to State letter AN 13/50-05/58, dated 27 June 2005, wherein you were provided with a copy of the Runway Safety Toolkit on CD-ROM. This toolkit was produced by the International Civil Aviation Organization (ICAO) and Embry-Riddle Aeronautical University, Florida, United States, as part of a continuing effort to assist States in the implementation of runway incursion prevention programmes.

In the above-mentioned letter, the narrative of the Runway Safety Toolkit segments was sent in English. It is my pleasure to forward the narrative in the official ICAO languages, attached herewith.

Accept, Sir/Madam, the assurances of my highest consideration.

Taïeb Chérif  
Secretary General

**Enclosure:**

Narrative of toolkit segments  
(for States, one copy only)

## **Opening Statement**

**by Dr. Assad Kotaite, President of the ICAO Council**

Ladies and Gentlemen,

For many years, aviation has enjoyed an excellent safety record, with a steady reduction in the rate of accidents and incidents. Lately, however, there has been an increase in the number of occurrences taking place on and in the vicinity of runways. In an effort to improve runway safety, ICAO has initiated a programme seeking to encourage States to implement international Standards, Recommended Practices and procedures already in place. Specifically, the areas of greatest concern are radiotelephony phraseology, aviation language proficiency, air traffic control procedures, standards and performance requirements for equipment, aerodrome visual aids and charts, flight operations and situation awareness. Efforts are under way to further enhance ICAO provisions and guidance to the aviation community in these areas, as well as to create an awareness of the important role played by human factors in the improvement of aviation safety.

Another example of the efforts undertaken by ICAO in its awareness campaign is the CD-ROM that you are watching right now. It features a comprehensive toolkit on runway safety, which includes references to relevant ICAO Standards, Recommended Practices and procedures along with guidance and documentation on runway safety programmes, educational videos and posters. Several States and international organizations have also launched comprehensive runway safety programmes, to which a number of links are provided.

I am certain that you will find this CD-ROM informative and enlightening, and that it will provide a number of ideas which can be further developed in your national or local environment. I wish you the greatest success in your efforts to improve safety for the benefit of international civil aviation.

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## INTRODUCTION

A typical day at any busy aerodrome anywhere in the world. Dozens, sometimes hundreds of vehicles and aircraft transit active runways every hour. For the most part, all of them get where they are going without incident. Occasionally, however, someone makes a mistake—perhaps it is a pilot who is arriving at an unfamiliar field for the first time. Maybe it is a poorly trained vehicle driver who takes a shortcut across a seemingly inactive runway.

Or possibly it is a busy Air Traffic Controller who momentarily forgets a particular aircraft. Any one of these mistakes could result in a Runway Incursion—a serious compromise to aerodrome safety that could easily result in a catastrophic collision and loss of life.

This Toolkit is a compilation of the contributing factors in Runway Incursions, illustrative examples, and constructive solutions. It is designed to be used with other runway safety programs and initiatives, which together will improve aerodrome safety at locations around the world.

Runway Incursion: “Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft.

It is worth noting that the world’s worst aviation accident took place on the ground, and that a runway incursion was to blame. In 1977 two fully loaded 747’s met disaster on a foggy runway as they were about to depart.

As is very often the case, two major factors were involved *miscommunication*, and loss of *situation awareness*, in this instance brought about by poor visibility. The resulting collision took the lives of 583 passengers and crew. The potential for another such disaster has not diminished. Though the lack of a worldwide definition of “runway incursion” has hampered the collection of data until recently, the number of reported incidents and near collisions has increased markedly by all accounts, mostly due to the dramatically increasing volume of air traffic around the world. In fact, according to a Transport Canada study, a 20% increase in traffic volume at an aerodrome causes a 140% increase in runway incursion potential.

With such vivid reminders of the consequences of runway incursions and the growing danger, it is easy to see why pilots, air traffic controllers and aviation authorities around the world are highly concerned about safety on and around runways. Some government agencies, for example, Transport Canada, the FAA in the United States and Eurocontrol, as well as others, have developed and implemented excellent programs to reduce runway incursions. Other bodies concerned with runway safety issues, such as the International Air Transport Association (IATA), the Airports Council International (ACI) and the Commercial Aviation Safety Team (CAST) have devoted much effort to achieving the same goal. As the world’s leading authority on international aviation, ICAO has also provided leadership in this area, including research, conferences, and runway safety seminars. This CD, the Runway Safety Toolkit, is a component of this comprehensive program. Wherever possible, the results of the aforementioned agencies and organizations’ research have been incorporated into the Toolkit, both in the functional areas and in the supplemental sections.

The Toolkit is designed to accomplish three major objectives:

- 1) Raise the awareness level of all participants in aerodrome movements regarding the dangers that accompany runway incursions;
- 2) Identify the most common hazards, and describe why they occur; and
- 3) Provide practical solutions and best operating practices that will improve runway safety.

In order to best accomplish these objectives, the Toolkit is organized by user interest. Some areas, such as the opening statement of Dr. Kotaite, and this introduction are intended for all users, as is much of the supplemental material. Most of the primary content is presented in functional area sections as follows:

- 1) Air Traffic Control
- 2) Flight Operations
- 3) Aerodromes and Ground Aids
- 4) Management Responsibilities

The Air Traffic Control section provides information specific to air and ground controllers responsible for the movement of aircraft. Flight Operations pertains to pilots of all types and sizes of aircraft. The Aerodromes and Ground Aids section is primarily for ground vehicle operators, but is applicable to all aerodrome users. The last category, Management Responsibilities, provides information for those who are in a decision-making capacity above the everyday operational level. Each of these functional areas includes a quiz section that allows users to test their knowledge at the completion of the instruction.

In addition to the aforementioned content, a great deal of supplemental information is included in the toolkit. A glossary defines terms related to runway safety, and the appendix contains ICAO provisions on runway safety. The References and Links section provides information on runway safety websites and references. The poster section contains sample runway incursion prevention posters that can be downloaded for printing and display. Videos created by various countries that pertain to runway safety are also included there. The Seminar section is a compendium of selected presentations from previous runway safety conferences sponsored by ICAO.

Finally, human factors considerations have been built into the discussions and solutions presented throughout the Toolkit. The emphasis, therefore, will be on human actions rather than technology remedies.

Runway incursions—Every airport is at risk, but accidents are *not* inevitable. Thorough, effective safety programs can be the difference between disaster and just another day of routine operations. Are you doing your part?

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# AIR TRAFFIC CONTROL

## Introduction

Runway incursions are one of the leading categories of incidents on and in the vicinity of airports across the world. A better understanding of why they occur will facilitate finding ways to reduce, and ideally, prevent their occurrence, thereby mitigating a substantial part of the risk associated with aerodrome and runway operations.

This module will discuss runway incursions from an air traffic management perspective and will highlight a number of measures that can be taken to reduce the number of incursions.

This module is divided into four separate sections: procedures, communications, equipment, and human factors. At the end of the module, a review quiz is available to re-state the key points and test your knowledge of the material.

## Procedures

At a first glance, this looks like a typical airport situation – a line of aircraft waiting to depart, aircraft rolling down the runway at high speeds, controllers working hard to ensure that each aircraft is given the careful attention it needs to provide for the highest level of safety. However, taking a look behind the scenes will give us a more realistic picture of what is required to keep this orchestra working in perfect harmony.

Runway incursions are an all-too-common occurrence at airports worldwide.

ICAO defines a runway incursion as, “Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft.”

The protected area also includes those portions of the taxiway located between the applicable runway-holding positions and the actual runway.

Fortunately, runway incursions can be prevented from an ATC perspective by the application of existing ICAO Standards, recommended practices and procedures, along with an understanding of relevant human factors principles involved.

Air traffic controllers working in control towers are required to maintain a continuous watch on all flight operations on and in the vicinity of the aerodrome as well as all vehicles and personnel on the manoeuvring area. This watch is maintained by visual observation, augmented during low visibility by radar or other advanced surface movement guidance and control equipment, when available.

Vehicles and aircraft shall not be permitted to hold closer to the runway than the applicable runway-holding position, which is designated by mandatory instruction signs and runway holding position markings, supplemented in some cases by runway guard lights and stop bars.

From time to time unexpected intruders - in the form of animals or flocks of birds - may show up on the manoeuvring area, obstructing the runway or taxiways.

Reviewing the local unit operating instructions for your airport on a regular basis will serve as a good reminder for “taxi” and “line up” techniques that can assist pilots and controllers alike. In addition, management must ensure that a proper safety management system is in place, and that a safety culture is fostered at all levels. The correct implementation of a safety policy will, among other things, result in all local unit operating instructions being followed, with proper standard phraseology used by all controllers.

In addition, training manuals will then be kept up-to-date, and memory joggers, such as marking of flight strips and their placement in the strip bay, will be used at all times.

Signs, markings and lights help clarify the delineation between taxiways and runways and define critical areas that must not be penetrated. Even if the visual aids are all working properly, the use of progressive taxiing, a form of giving taxiing instructions on a step-by-step basis, although time consuming, may in special cases, prove to be a useful method in the prevention of runway incursions.

Movements around the aerodrome can be confusing, even for the most experienced of pilots. Knowing which way to turn and when, can be even more intimidating when coupled with low visibility or night operations. Confusion can quickly compromise the safety of operations on the manoeuvring area.

Standardizing runway and taxiway movements is a way to help reduce runway incursions. Publications on aerodrome charts of the taxi routes used to get from one point on the aerodrome to another will help minimize confusion for unfamiliar pilots who frequent the aerodrome. If a pilot is given a published standard route to get from the gate to the runway, he or she will become more familiar with what can be expected. These routes should be identified by appropriate designers.

While preferred and published taxiway routes are the best option, they cannot always be used based on the other vehicle and aircraft movements on the aerodrome. When non-standard taxi routes are used, the pilot should be given the taxi instructions with reference to relevant points as they appear on aerodrome charts, followed by any other pertinent information that needs to be conveyed.

Instructing an aircraft to taxi from its gate to the active runway is the job of the ground controller. This controller is not only responsible for the control of aircraft, but of pedestrians and vehicles as well. Any movement on the manoeuvring area requires authorization by the control tower. At all times, vehicles and pedestrians on the manoeuvring area must give way to aircraft, with the exception being emergency equipment responding to an aircraft in distress. In this case the controller should, to the extent practicable, halt all movement of other surface traffic until it is determined that the progress of the emergency vehicles will not be impeded.

Once the departure and destination points of the aircraft have been determined, taxi clearances must be issued using concise instructions, including the taxi route the aircraft is to take to avoid a collision with obstacles or other aircraft, and ensuring that the aircraft will not incorrectly enter a runway.

When a taxi clearance contains a taxi limit *beyond* a runway, it shall contain an explicit clearance to either “cross” or “hold short of that runway.” Holding short of a particular runway means that the aircraft or vehicle should hold no closer to the runway than the prescribed runway-holding position.

In an effort to expedite the flow of traffic, aircraft may be permitted to taxi on the runway-in-use, provided that no delay or risk to other aircraft will result. Particularly during darkness or low visibility conditions, allowing an aircraft to taxi on the runway-in-use while another aircraft is lined up waiting for take-off clearance should be avoided.

Likewise, a controller should avoid lining up a departing aircraft on the runway prematurely. If the estimated departure is more than two minutes into the future, the best place for a departing aircraft to hold is on the taxiway at the designated runway holding position.

Take-off clearance may be issued to an aircraft when there is reasonable assurance that the proper separation will exist once the aircraft commences take-off. When an ATC clearance is required prior to take-off, the take-off clearance shall not be issued until the ATC clearance has been transmitted to and acknowledged by the aircraft concerned. The take-off clearance shall be issued when the aircraft is ready for take-off and at or approaching the departure runway and the traffic situation permits. To reduce the potential for misunderstanding, the take-off clearance shall include the designator of the departure runway.

An aircraft may be cleared to land when there is reasonable assurance that the prescribed runway separation in relation to preceding traffic will exist when the aircraft crosses the runway threshold. It should also be noted, however, that ICAO procedures allow only one aircraft at a time outside the threshold to be cleared to land. Later aircraft in the approach sequence receive their landing clearance when they are “number one”.

Unless the runway cannot be seen from the control tower due to reduced visibility, make it second nature to you as a controller to always scan the runway prior to issuing a take-off or landing clearance. And maintain a close watch of the manoeuvring area whenever runway operations are on-going.

Sometimes “blind spots” occur in places on the aerodrome that the controller is unable to see from the tower. If the controller is unable to determine, either visually or by radar, that a vacating or crossing aircraft has cleared the runway, pilots shall be requested to report when they have completely vacated the runway. This report shall only be made when the entire aircraft is well clear of the runway.

Because weather is so unpredictable, it is important for ATC to monitor the movements of weather patterns throughout the greater aerodrome area, in co-operation with the meteorological office assigned to support operations at the aerodrome. As deteriorating weather moves into the area, controllers and pilots alike must maintain the highest level of alertness. There are a few things controllers can do to help stay alert and up-to-date during low visibility operations.

The use of advanced surface movement guidance and control systems is invaluable during periods of low visibility operations. Such equipment may allow the controller to know the precise location and movements of aircraft and vehicles on the aerodrome. And since most types of this equipment have audible warning proximity alarms associated with them, many runway incursions can be prevented by merely monitoring the system regardless of the weather conditions, making sure it is “on” at all times. In particular, this type of equipment may be helpful in places on the manoeuvring area that cannot be easily seen by the control tower.

Operations during darkness are another concern for controllers, pilots and vehicle drivers. Controllers normally sit high above the aerodrome, affording them the best view possible. From such a height, aircraft and vehicles can more easily be distinguished from other objects on the airport than from points on the ground. In view of that it is more difficult for aircraft and vehicles to find their way around the airport in darkness, extra care must be taken by ATC in the control of aircraft and vehicles on the aerodrome from dusk to dawn.

As we descend from the height advantage of the tower, we can see that there is a lot of definition lost as we get closer to the ground. In an effort to eliminate confusion, aerodromes are lit in a standardized fashion.

In the event that the controller becomes aware of a runway incursion, the following immediate action must be taken:

Cancel the take-off clearance for a departing aircraft, or instruct a landing aircraft to execute a missed approach or go-around. In this context, the pilots concerned must be informed of the position of the potential incursion in relation to the runway.

States and international organizations are working hard on improving runway safety. In their accident and incident prevention efforts, they seek to draw upon experience from previous occurrences. Therefore, it is important that after any runway incursion, controllers as well as pilots and vehicle drivers file an incident report. This will provide a basis for future work on accident and incident prevention.

## **Communications**

Communicating is the art and technique of using words effectively to convey information or ideas.

In normal speech at home, at a business meeting and on the telephone, we often use different interchangeable words to convey the same ideas or concepts. This is not appropriate in radiotelephony speech in aviation.

It is crucial to be able to convey instructions and information to pilots in the most concise way possible, using the fewest number of words and the least possible “air-time”, while still ensuring that the recipient has fully understood and will act upon the message.

ICAO has developed standard phraseology with the intent of avoiding the possibility of conveying confusing meanings, thus contributing to the safety of operations both in the air and on the ground. ICAO has also adopted language proficiency Standards for the communication between pilots and controllers.

Once we have mastered the phrases used in air traffic control, we must be able to convey these messages to the appropriate pilots. Oftentimes, there will be multiple aircraft on the same radio frequency with call signs that sound similar. When this happens, it is imperative to use the full call sign when communicating with these aircraft.

Sometimes, aircraft call signs, although different, “sound” similar on the radio. Whenever the possibility of this exists, the controller may instruct an aircraft to temporarily change the type of radiotelephony call sign, in the interest of safety, when similarity between the call signs of two or more aircraft is such that confusion might be likely to occur.

When different types of call signs are being used, it may be necessary to mark this in an appropriate way on the flight progress strip.

Certain key words are used in conjunction with specific phrases. With regard to runway and taxiway movements, the word “cleared,” for example, is only used in conjunction with a clearance to take off or land, and should not be used as an instruction to cross a runway or taxiway.

Likewise, the word “take-off” is normally only used in phrases like “cleared for take-off” or “take off immediately”. By carefully selecting the words we use to communicate, misunderstandings can be drastically reduced.

It is important to note that although it would be highly desirable that ICAO standard phraseologies were used universally, the fact is that at present, differences between States do exist in this respect. For example, the ICAO standard phraseology to line up an aircraft on a runway is “line up” or “line up and wait,” but in some States other phrases are prescribed, like “position and hold” or “taxi to position and wait”. In ICAO standard phraseology, “taxi to holding position” means to hold short of the runway. It is easy to see how confusion might arise because of these differences and ICAO is thus currently active seeking to harmonize them.

The issuance of conditional clearances requires that the utmost care be taken to avoid any misunderstanding. Phrases such as “behind landing aircraft” or “after departing aircraft” shall not be used for movements affecting active runways, unless the appropriate controller and pilot both see the aircraft or vehicles concerned. Conditional clearances involving an active runway should never be issued to vehicles.

A conditional clearance shall be given in the following order and consist of: the aircraft call sign, the condition, the clearance, a brief reiteration of the condition.

For example: “AIR CANADA 453, BEHIND BAE 146 ON SHORT FINAL, LINE UP, BEHIND”

All too often, controllers give pilots carefully constructed directions using proper phraseology, only to be answered by the pilot saying, “Roger.” However, it is **mandatory** for the pilot to read back certain instructions to verify their accurate relay. In relation to runway operations these instructions involve clearances and instructions to enter, land on, take off on, hold short of, cross and backtrack on any runway, whether active or not. Taking the extra time to ensure complete understanding will result in safer operations.

Now that we have established the importance of using proper phraseology and read-back, we need to focus on another type of error that is a result of communication misunderstandings: readback and hearback errors.

It is essential that controllers always listen carefully to the read-back clearances and instructions. A readback error occurs when ATC reads a clearance or instruction to a pilot, and the pilot repeats the instruction back to the controller incorrectly. Listen to this and see if you can catch the error:

Did you catch it? The instruction was to “taxi to runway one three via taxiway papa and november. Hold short of runway two three.” When the pilot read the instruction back, “OK, taxi runway one three via taxiway november, hold short of runway two three,” s/he left out the “taxiway papa” portion of the clearance. If you did not catch the readback error, you have fallen victim to the other error we are going to discuss – hearback errors.

In this case, the controller, having misheard the pilot, confirmed the incorrect instructions by saying, “correct.” This is an example of a hear-back error. The controller may have “thought” he or she heard the correct readback, but in reality, confirmed an error.

Be alert for what is termed “expectation bias,” which simply means that we often hear – or at least we think we do – what we *expect* to hear. This can happen to pilot, controllers, vehicle drivers, or anyone engaged in radiotelephony. As an illustration, consider this scenario: At a large international airport a Boeing 737 and a Cessna 210 were both cleared to line up and wait on different, but intersecting, runways. The 737 was then cleared for takeoff, which the crew acknowledged. Unfortunately, the Cessna pilot, *expecting to hear “cleared for takeoff” for himself* started his takeoff without fully comprehending the transmission. The controller did not pick up on a duplicated acknowledgement from two different aircraft. The two aircraft met at the intersection, and only a dangerously early rotation by the 737 pilot enabled both aircraft to escape a collision. The miss distance was only 30 metres.

This brings us to our last point in the phraseology portion of this section – linguistics principles.

It is important to maintain a steady and consistent speech speed. In an effort to minimize the amount of clarification time needed to correct slurred or rapid controller instructions, controllers need to speak clearly, and enunciate every word.

Attention should be placed on microphone placement to allow for clear and unobstructed speech.

The use of proper phraseology, clarification of similar sounding call signs, and knowing what pitfalls exist, and how to avoid them, all add to the safety of airspace and aircraft in the airport operations environment. By using the simple, yet effective, techniques shown in this section, aviation can be both efficient and safe.

## **Equipment**

As air traffic controllers, we are surrounded by electronic equipment everywhere we turn. As we look around the facility, we see communication panels, radar monitors, flight strip computers and printers, weather monitors and a plethora of other items there to give us the tools we need to effectively do our jobs. As the shift starts, there are a few things we need to do to ensure safe operations.

Just before the shift starts, a check of all equipment should be done to confirm that it is all in working order. Such checks would include: verification that all available lighting is working properly, and that all communication equipment is functioning. If the control tower is equipped with surface movement radar or other advanced surface movement guidance and control systems, these should be checked to ensure that they are serviceable. It is better to find a malfunction in the equipment now, than to wait until difficulties arise and an incident occurs.

As the pre-shift equipment check is being completed, any discrepancies found should be logged in a maintenance log book for corrective action to take place. This basic system has proven to be an effective means of communicating discrepancies to the correct department for repair.

It is also important that all visual aids on the aerodrome are checked on a regular basis to ensure they are working properly and are easily visible. This task is normally undertaken by aerodrome maintenance staff.

Under normal circumstances, controllers have access to various equipment to assist in safely guiding aircraft on and in the vicinity of the aerodrome. It is important, especially during low visibility operations, to keep the following actions in mind when Advanced Surface Movement Guidance and Control Systems are either not provided or unserviceable.

When A-SMGCS is either not provided or are unserviceable during low visibility operations, it is imperative that all aircraft and vehicles report having vacated active runways. This is to be interpreted such that the entire vehicle or aircraft should have passed the relevant runway-holding position before the runway can be considered to be vacated.

By having the aircraft report airborne, the controller, can be assured that the aircraft is no longer on the active runway. This will allow the controller, to line up the next aircraft for departure.

Ergonomics is a relatively new concept, but can prove to be extremely effective when incorporated into the workplace.

Ergonomics is defined as the applied science of equipment design, as for the workplace, intended to maximize productivity by reducing operator fatigue and discomfort. In short, ergonomics is the art of placing equipment in such a fashion that it is both accessible quickly by the operator, yet, not obtrusive when not needed.

This workplace could definitely benefit from the application of ergonomic design. These people cannot only injure themselves or someone else by doing this, but the necessary equipment needed is not in a place where it can be easily accessible.

In this case, each individual controller can determine the appropriate placement for each item that is needed to do the job. Movable computer monitors, phone equipment that is easily accessible, and a customizable working environment all lead to a more productive employee – a safer employee.

### **Human Factors**

As controllers, it is crucial that situation awareness, or a complete mental picture of all traffic, is not lost at any point during a given shift. It involves knowing the positions and intentions of all aircraft and vehicles that are under your control. Complete situation awareness also involves being cognizant of all hazards on the manoeuvring area. Loss of situation awareness has been a contributing factor in many aircraft disasters – most notably, one that claimed 583 lives – the deadliest accident in civil aviation history.

A loss of situation awareness, in combination with radio miscommunication, led the pilot to “believe” he was cleared for take-off, which was however not the case. He commenced his take-off roll, and after an early rotation subsequently collided with the second aircraft which had not yet vacated the runway.

We have emphasized that controllers, in the interest of safety, disseminate instructions and information to any aircraft, vehicle or personnel on or near the manoeuvring area in a timely manner using clear and concise Standard Phraseology. This will help maintain and improve the situation awareness of everyone listening to your radio frequency.

With that said, there are a number of distractions in the workplace that may impair our situation awareness.

Surges or peaks in traffic must never lead to controller overload. It is the responsibility of management to ensure that workload is not allowed to reach the level where the controller might suffer the loss of situation awareness.

But just as an overloaded controller might lose his or her situation awareness, experience has shown that the opposite case, with a very low level of traffic, also carries the risk of controllers becoming bored and losing situation awareness due to that their attention has been diverted to other activities on the sidelines of their control responsibilities.

Working as a team is essential in a multi-crew control tower. In such an environment no person is an island unto himself or herself. Each controller and assistant should be aware of the duties and responsibilities of the others, and within the limits of their expertise they should be prepared to lend a hand to their colleagues, when required.

Memory aids such as flight progress strips assist controllers in maintaining a high level of situation awareness, for example previously issued instructions for aircraft to “line up and wait” on an active runway. As workload increases, these aids become even more essential in assisting the controller in safely moving traffic.

Just as in a flight deck environment the concept of a “sterile cockpit” has emerged, meaning that during operations on or near the airport no other distractions are allowed to interfere with the operation of the aircraft, the importance of a “sterile control tower” needs to be emphasized. The controller must ensure that his or her attention is not split between control duties and other extraneous activities like reading a newspaper or watching TV.

Being fatigued can cause a person to mentally shut down, even if for only a second, and lose “the big picture.” Once situation awareness is lost, for a tired person it may take several minutes to fully regain it.

By receiving a thorough briefing, the relieving controller is made aware of all aircraft and vehicles over which he or she is about to assume control. This provides the opportunity to ask questions for clarification. Special attention should be paid to any unusual situations, including equipment aerodrome maintenance work which might involve substantial vehicle traffic or equipment malfunctions. By this process, situation awareness is transferred to the relieving controller.

All controllers should receive re-current training, which is one of the key factors in maintaining runway safety. A good training programme will assist in fostering a safety culture. For example, it is a good idea for staff to meet periodically and discuss how to manage traffic flow under various circumstances, for example in situations involving bad weather.

Another training tool that provides a good way to maintain and enhance safe operations is a bulletin board in the break-room, using posters and pictures to remind controllers of runway safety issues. Devoting part of the board to NOTAMs and procedural changes may also assist in the effective implementation of new procedures.

As old equipment is updated and new equipment installed, it is important to make a training schedule that affords each controller the opportunity to be removed from the regular working environment, in order to learn how to properly use the new devices. It will be crucial to the safe implementation of the equipment that each controller is trained in every facet of the equipment, ideally including some basic troubleshooting techniques.

Most people that have a family and full-time job lead what may be described as a double life. In this respect, air traffic controllers are no different from anyone else. However, keeping in mind that controllers typically work under stressful conditions, often on a rotating schedule, they must ensure that the demands of their private lives do not encroach upon the requirement for adequate rest prior to commencing work.

Otherwise, coupling the inherent stress associated with rotating shifts with external stresses in their personal lives might be a recipe for disaster.

Stress can be defined as a mentally or emotionally upsetting condition occurring in response to adverse external influences. Such symptoms can include increased heart rate, a rise in blood pressure, muscular tension, irritability and depression. Stress is something that all people have; however, it is inherent to some jobs in particular. Air traffic control is one of these jobs. Most controllers are under constant stress throughout the work day as they try to delicately balance the “orchestra” of airport operations.

When a person is under a great deal of mental anguish or pressure in his or her personal life, he or she should carefully consider whether it is appropriate to take on operational duties. The consequences of working under mental anguish or pressure may be very serious indeed.

Finding an outlet that fits your interests and lifestyle is one of the keys to being a successful controller. One essential aspect is getting sufficient rest before going into work. This can help a person maintain focus at work, and substantially facilitate maintaining situation awareness.

Ultimately, a complete awareness of operational surroundings is key in any aspect of aviation, but is particularly relevant in aerodrome operations, where the close proximity of all operating aircraft and controllers requires a constant surveillance and understanding of the surrounding environment.

In this section, we have seen the crucial role that Procedures, Communications, Equipment and the Human Factor play in this situation awareness and the effect that each of these can have on the ability to reduce or remove completely the threat of runway incursion and other such incidents, in day-to-day operations. Ultimately, the, “human element” can be both the strongest and weakest link in the operations chain.

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## FLIGHT OPERATIONS

At first, the taxi to and from the runway appears to be the most simple part of a flight. After all, you are moving at a very slow speed, and there is usually an Air Traffic Controller to monitor you. But as we all know, sometimes even a simple procedure can become dangerous if mistakes are made. Inadvertently crossing, landing or taking off on the wrong runway is a very serious mistake indeed.

Mistakes—we all make them—pilots, Air Traffic Controllers, service vehicle drivers, or even a security guard who leaves a gate unlocked. But why do they occur? For some it is just a lack of knowledge or training. But many errors, especially those that result in runway incursions, are due to a failure to gain or maintain good Situation Awareness.

Simply put, Situation Awareness is a case of having the three “R’s”: Knowing the *Right* information, at the *Right* time, and *Reacting* to it appropriately. If we have all the information we need, and we apply the proper procedures, getting safely to and from where we need to go becomes easy.

Good Situation Awareness means that pilots know where they are, the desired route to their destination, and any obstacles, hazards or rules to be followed along the way. At aerodromes with control towers, what the controllers intend and what the pilots understand must match exactly. If not, good Situation Awareness cannot occur, either for pilots or for ATC.

So if good Situation Awareness is essential for safe operations, how do we gain and maintain it? Another way of saying this is “How and why do pilots lose their Situation Awareness bearings, and make critical mistakes as a result?” Research has shown that the following factors often result in diminished Situation Awareness:

- Incomplete or misunderstood communications
- Lack of Planning
- Workload peaks
- Distractions
- Loss of visual cues

Let’s examine each to see how they may affect Situation Awareness. By far the most important cause of poor Situation Awareness induced mistakes is communication problems.

Communication difficulties most often result from one or both of the following:

- Use of non-standard phraseology
- Lack of language proficiency

These communication shortcomings cause a discrepancy between what ATC intends and the pilots understand, and vice versa. Clear, accurate and timely communications are essential in establishing and

updating the “shared mental picture” necessary for good situation awareness. Here are some ways to ensure that transmissions are fully understood.

- Use standard phraseology, both in requests and acknowledgements.
- Use readbacks of taxi instructions, to include runway in use, any runways to be entered, landed on, taken off from, held short of, crossed, back-tracked upon, and all holding instructions.  
--Remember: Use of the word “roger” or “wilco” does not constitute a read-back.
- Use full call signs.
- Clear up uncertainties as they occur, before proceeding, either by use of in-cockpit resources, or by contacting ATC.
- If different primary languages are used by ATC and pilots, when using the common language speak as slowly and clearly as needed to ensure comprehension.
- Always monitor and announce intentions on the common frequency at uncontrolled aerodromes.
- Write down taxi instructions if unfamiliar, and have the aerodrome diagram in hand during movements.
- It is important to note that although it would be highly desirable that ICAO standard phraseologies were used universally, the fact is that at present, differences between States do exist in this respect. For example, the ICAO standard phraseology to line up an aircraft on a runway is “line up” or “line up and wait,” but in some States other phrases are prescribed, like “position and hold” or “taxi to position and wait”. In ICAO standard phraseology, “taxi to holding position” means to hold short of the runway. It is easy to see how confusion might arise because of these differences and ICAO is thus currently active seeking to harmonize them.
- Similar call signs can also generate confusion – be alert for them.
- Avoid what is termed “expectation bias,” which simply means that we often hear – or at least we think we do – what we *expect* to hear. As an illustration, consider this scenario: At a large international airport a Boeing 737 and a Cessna 210 were both cleared to line up and wait on different, but intersecting, runways. The 737 was then cleared for takeoff, which the crew acknowledged. Unfortunately, the Cessna pilot, *expecting to hear “cleared for takeoff” for himself* started his takeoff without fully comprehending the transmission. The two aircraft met at the intersection, and only a dangerously early rotation by the 737 pilot enabled both aircraft to escape a collision. The miss distance was only 30 meters.
- Obey stop bars if illuminated, even if clearance across the runway has been previously received. ATC may have had a radio failure, or your aircraft might have one.
- Monitoring ATC transmissions to other aircraft, and picturing their positions and movement is an important component of maintaining good Situation Awareness – it takes some effort, but work at it. Be particularly aware of clearances while you are in the air as well as on the ground. The same applies to visualizing aircraft actions at an uncontrolled aerodrome based on the pilots’ self announcement.

On an operational note, remember that a departing aircraft's takeoff clearance is never issued until the en-route clearance has been transmitted to and acknowledged by the aircrews concerned.

As you might suppose, and as aerodromes have grown and increased in complexity, taxi routes have become more complex as well. Consider O'Hare International in Chicago.

There are 14 different runways to taxi to or from and usually several routes for each, as well as two different ground control frequencies. Obviously, prior preparation and planning is in order here, but the same applies to less busy aerodromes as well. The first and most basic step is to have an aerodrome diagram in hand during the taxi, both in and out.

Without this simple measure, situation awareness can rapidly degrade. At the gate, or prior to descent, review and familiarize yourself with the field layout and probable taxi route options. Include NOTAMS and ATIS information in your review and make sure all flight deck crew are briefed. In particular, know the runways along your taxi route. Identify parallel runways and confirm your use of right, left or center. Brief hotspots, which are locations where aircrew have historically become confused and runway incursions resulted. These are marked on some aerodrome charts, but their usage is not universal.

Properly employed, these planning measures will help reduce the next Situation Awareness impediment, workload peaks. Every pilot knows that if workload goes up too high his ability to monitor the environment goes down. Usually this is a circumstance that occurs in the air, for example, during instrument approaches, when the work level is typically very high.

However, the same can be found on the ground during taxi operations as well. Time constraints, company and ATC demands, etcetera, diminish our knowledge of precisely where we are on the aerodrome, or what other aircraft are doing. Quite often the result is an inadvertent entry into or across a runway and a procedural violation for the crew, if not an outright accident.

The solution, in addition to maximizing planning and preparation before taxi, is to resist the demands that compromise safety. We all want to cooperate to maximize the efficiency of operations, but not at the expense of safe operation. Flight instructors and check airmen also should employ good judgment so they won't boost the workload so high that a runway incursion becomes more than a remote possibility.

Distractions are an inevitable part of flight activities, to include ground operations. Usually distractions are manageable, but should they happen at the wrong time and are of sufficient magnitude, an accident may occur. At one time or another practically every pilot has climbed or descended through an assigned altitude because of something that happened in the flight deck that diverted attention away from the proper operation of the aircraft.

The same thing happens on the ground, but instead of flying through an altitude, the pilot taxis across a runway without clearance. Distractions can be minimized by employing "sterile cockpit" procedures during taxi—this is the elimination of all conversation and activities not directly related to safe conduct of the flight. But some distractions we can't control or predict – ATC or company queries, caution or warning lights, or priority cabin-crew requests, for example.

In these cases, we need to minimize their impact by dividing crew duties so that the entire flight deck is not fixated on the distraction. Depending on the source, advise the person or agency to standby until the aircraft's position is certain. It should be noted that even essential information, such as a route clearance, can be a distraction from the primary task at hand, which is trying to find your way safely to the designated

runway. If in a multipilot aircraft make sure only one member is “head down” at anytime, and if single pilot, stop the aircraft in order to copy anything but the simplest clearance.

Finally, adopt sterile flight deck rules to minimize self-generated distractions. Updating logbooks, eating and non-pertinent personal conversations are all examples of activities that divert attention from the assigned task.

While the great majority of runway incursions occur during good visibility conditions, the worst accidents typically happen during periods when visual cues are lost or severely diminished by darkness, fog, dust, or rain, or even facing the sun when it is at a low angle..

Low visibility operations require special precautions, because almost without exception, Situation Awareness is reduced. What can be done? First and foremost is to stop and ask for help anytime you are not certain of your position. ATC would much prefer to provide a detailed progressive taxi than to have an aircraft inadvertently end up on a runway. If necessary, a “follow-me” vehicle can be dispatched at many aerodromes.

Use lights as appropriate to make your aircraft is more visible.

At unfamiliar airports, assign a crew member to provide a running update of the aircraft’s progress on the taxi chart.

Once on the runway, check the compass and directional gyro – is the heading the same as the active runway? If it is an ILS or MLS equipped runway, do you see the centerline guidance needle where it should be?

Also, on both takeoff and landing use Collision Avoidance Systems to increase Situation Awareness – this is especially important in low visibility operations.

In addition to the aforementioned procedures to help gain and maintain Situation Awareness the following steps are good operating procedures that should be employed during all taxi activities.

- First, last and always – always look for conflicts and be prepared to react to them! Even the most experienced controllers sometimes make mistakes. A good scan is often the last defense against disaster.
- Follow progress on aerodrome charts– if possible, designate an available crewmember to do so as a primary activity.
- Taxi clear of the active runway as soon as is safely possible after landing.
- If confused when taxiing, do not stop on a runway – taxi clear and notify ATC for guidance.
- Use all exterior lights when crossing an active runway.
- When in a “line up and wait” position, use all lights except strobes and landing lights. When starting takeoff roll, turn on landing light and strobes.
- Always use good Crew Resource Management procedures – use all the resources available, divide the workload, and make sure all crewmembers feel free to speak up.

- At an uncontrolled field, be alert for aircraft using different runways
- If you have been lined up for departure on a runway and have waited for takeoff clearance for more than two minutes, particularly during darkness or in low visibility conditions, query the controller. He or she may have inadvertently forgotten about you.
- Avoid “Get-home-itis”—this is a serious compromise to good judgment and decision-making that is caused by a compelling desire to be somewhere else or achieve a goal. It may be, as the name infers, to get home, but it could also be to the desire to land, cross a runway, get airborne, or any other aerodrome operation. Anytime you feel that you “must” do something, examine your motivation—if safety is not your first priority, you have arrived at a wrong decision.

There are other actions that pilots can take to reduce the likelihood of runway incursions, but the measures discussed have proven to be highly effective in promoting runway safety. Review them on a regular basis to ensure you are using them to the utmost. Please note that this discussion assumes that you have a proper level of proficiency in interpreting runway signs and markings. If not, or for review, please complete the aerodrome and ground aids section of this CD. When ready, proceed to the quiz area to test your knowledge of runway safety.

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## AERODROME AND GROUND AIDS

A significant part of the runway incursion problem facing aviation today concerns itself with the proper design, management, and use of aerodrome ground aids. These aids are strategically placed on aerodromes to help in the movement of aircraft and vehicles and to make these operations safer for all who use the system.

ICAO defines runway incursion as: “any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for landing and take-off of aircraft.” The term ground aid commonly refers to aerodrome signs, markings, lighting, or any other apparatus or object that is utilized to help guide the users of the aerodrome safely about the field. It also includes the more recent and sophisticated gear found at larger and busier airports, such as Surface Surveillance Systems and Advanced Surface Movement Guidance and Control Systems.

We must not overlook the importance of proper utilization and management of ground aids as a central link to aviation safety. Correct design and use of airport ground components is as important to aviation safety today as is the accurate design and use of a modern airliner’s most sophisticated electronic fuel control system. In fact, given the dynamics of human interaction associated with the constant and daily use of these essential aviation components, a strong argument could be made for assigning it an even greater and more significant level of importance than has previously been granted by the world aviation community.

Aerodrome ground aids serve a variety of users that may range from pilots, mechanics, maintenance and security personnel, to baggage handlers, clean-up crews and grounds keeping personnel, all of which have potential access to the runway, and all of which carry their own and unique set of human frailties and limitations. This segment addresses not only pilots and air traffic controllers, but all people who, under normal or abnormal conditions, would have use and access to the aerodrome ground aid system and its components. In addition... it is also worthy to note that the innovations and sophistication at some aerodromes today may contrast greatly with simplicity and lack of sophistication found at other aerodromes only a few flying hours away. This phenomenon has brought to light significant training gaps among the system’s users, and it underscores the need for pilots and ground personnel to reach beyond rote learning in attempting to understand all airport ground aids and their function. This segment of the runway incursion toolkit, therefore, seeks to also provide the aviation community with an enhanced awareness of all the major problems and issues associated with the use of aerodrome ground aids in the alleviation of runway incursion events.

- First and foremost it is important to emphasize that effective and consistent training in the use of airport ground aids is crucial in reducing the runway incursion problem. Any discussion of aerodrome ground aids must first address system-user training.
- It is therefore essential that all personnel having access to the aerodrome grounds, and to the aerodrome ground aids, partake in some form of training.
- A training programme should be well coordinated and should make ample use of standards, recommended practices, and guidance material as outlined in Annex 14 and associated technical manuals. ICAO also has in place a standard which suggests on-site procedures for managing individual changes to the already-established rules effecting ground operations.

- This standard for managing changes is found in ICAO Annex 11 standard paragraph 2.26.5. It outlines steps that should be taken before aerodrome rules that may affect ground operations can be changed by ATC. It is particularly important that all *managers* and supervisors be made aware of this ICAO standard when receiving their own supervisory training.
- Effective training should also be tailored to individual needs according to specific duties and functions. An airline flight crew, for example, would need far more comprehensive training, than say, a ground vehicle driver, or grounds-keeping crew. Likewise, aerodrome security personnel and aerodrome managers would need different training. It is therefore important to remember that useful and effective training must be tailored to individual needs.
- Of equal importance is a consistent form of recurrent instruction that is part of the training programme. This ensures that all users are aware of, and understand, any new additions or changes to the system.
- Finally, it is also important not to forget that any training program's effectiveness, to be meaningful, must be properly appraised by means of clear and valid evaluation tools.
- One of the primary causes of runway incursions is the lack of familiarity with the aerodrome and its layout
- It is as important for ground vehicle drivers to have on-site training experience in getting to know the layout of aerodrome signs, markings and lighting, as it is for pilots to have multiple taxiing experiences about a busy aerodrome before being allowed to fly there as pilot-in-command.
- For proper learning to occur, in any situation, the learner must be an active participant in the process. All aerodrome user training must include actual visits to the field and actual on-site familiarization with the airport layout and its ground aids. ICAO standard aerodrome charts can help facilitate this task.
- A very common problem leading to confusion, while taxiing or moving about the aerodrome, is that signs and markings are often allowed to significantly weather or fade. In addition, signs and markings are sometimes also incorrectly placed.
- Deficiencies found in airport markings and visual aids have been identified as a leading problem affecting runway safety.
- Faded signs or incorrectly placed signs are often the result of poor maintenance schedules and improper or infrequent inspections.
- It is important that a rigid and fail-safe ground maintenance schedule, one that includes an updated checklist, be established at all aerodromes. Frequent and random inspections should always be in place to gauge the effectiveness of any ground aid maintenance programme.
- Inclement weather can notably reduce visibility and obscure important aerodrome ground aids, thus contributing to the runway incursion problem.

- Proper understanding of inclement weather limitations can help prevent human error.
- Signs, markings, and lighting can be obstructed by snow, slush, sleet or even dust. Pilots and ground crews have been known to make serious mistakes while operating in such conditions.
- It is crucial that all airport operations be restricted or even stopped when markings, signs, and lights, become obstructed or obscured.
- Human beings have significant performance limitations caused by degradation of situational awareness. Fatigue, disruption in body rhythms, and sleep disturbance, are common factors leading to human performance degradation.
- Proper rest and sleep are necessary ingredients in avoiding these human performance problems.
- *Procedures for Air Navigation Services — Aircraft Operations, Volume I — Flight Procedures* (Doc 8168) Part IX, Ch. 1, addresses these vulnerabilities and should be reviewed by all system users.
- All personnel who have access to the airport environment should comply with rest rules and duty time limitations as applicable to their operation, and all aerodrome ground operations training programs should include this topic as appropriate to the individual user of the system.
- Understanding the proper meaning of aerodrome signs, markings, and lights, is essential to safe operations on the ground.
- Standards and recommended practices for aerodrome ground aids were first adopted by the ICAO Council in 1951 and detailed in Annex 14 to the ICAO Convention. A comprehensive history of amendments is found in table A of the Annex.
- PANS-ATM Chapter 7 lists the procedures of ATC for aircraft under their control to achieve a safe, orderly and expeditious flow of traffic on the ground.
- Aerodrome ground aids generally come in the following forms: markings, signs, and light.
- Ground aids were designed to be best interpreted from the cockpit of aeroplanes and not necessarily by pedestrians or motor vehicle drivers. Sometimes this causes unique perceptual difficulties for non-aviator personnel who must switch from road signs to airport signs in a relatively short period. It is therefore important that appropriate training be provided for all who use the system - not just pilots and controllers.
- In the following sections we will briefly address some of the most important points to know about these aids.
- First, all runway markings are white. This is important because it differentiates them from taxiway markings.

- A runway side stripe marking should always be provided for a precision approach runway...even at locations where there is a distinct visual contrast between the runway and its adjoining shoulders or the surrounding terrain.
- All taxiway markings are yellow. This is important because it differentiates them from runway markings.
- Runway-holding position markings - Pattern A .

This pattern will be encountered in the following situations:

- a) Along a taxiway, at the intersection of that taxiway and a runway
  - b) At an intersection of a runway with another runway where the former runway is a part of a standard taxi route
  - c) At the end of a taxiway where that taxiway meets the runway
- Runway holding position markings – Pattern B  
This pattern is displayed along the runway holding position where two or three runway holding positions are provided (such as Category II and III ILS operations). They are placed at the runway holding positions farthest from the runway. Pattern A will then be found at the position nearest to the runway.
  - Intermediate holding position markings  
These holding position markings are established at any point other than a runway-holding position where it is desirable to define a specific holding limit such as taxiway intersections.
  - Now let's look at aerodrome signs:  
These are divided into two main groups:
    - 1) Mandatory instruction signs; and
    - 2) Information signs.
  - For ease in understanding the system, the latter (information signs), can be further subdivided into three general sub-categories:
    - 1) those offering information on location
    - 2) those offering information on destination, and
    - 3) those offering information on direction.

Once this basic categorizing of aerodrome signs is understood, comprehension of the system should become easier.

- Let's first briefly look at some important mandatory instruction signs: Mandatory instruction signs have a red background with a white inscription: Aircraft or vehicles are not allowed to proceed beyond such signs unless specifically authorized by the control tower! In other

words, it becomes “mandatory” to have received control tower permission before proceeding beyond such signs...

- Runway designation signs: There are two types. Their purpose is to indicate a runway-holding position at either
  - 1) a runway extremity or
  - 2) where taxiways and runways meet. They shall be located at each side (end) of the runway-holding position marking.
- Runway holding position signs: these are used at runway-holding positions established on a taxiway if the location or alignment of the taxiway is such that a taxiing aircraft or vehicle can infringe an obstacle limitation surface or interfere with the operation of radio navigation aids. They shall be located at each side (end) of the runway-holding position marking.
- Category I ILS holding position signs  
Indicates Category I ILS runway-holding position.  
They are located on each side of the runway-holding position marking.
- Category II ILS holding position signs  
Indicates Category II runway-holding position.  
They are located on each side of the runway-holding position marking.
- Category III ILS holding position signs  
Indicates Category III runway-holding position at the runway threshold.  
They are located on each side of the runway-holding position marking.
- NO ENTRY sign: This sign indicates that entry to an area is prohibited. These signs are located at the beginning of the area to which entrance is prohibited, on each side of the taxiway.
- Road holding position sign: A road holding position sign shall be provided at all road entrances to a runway.
- Now let's look at Information signs...these employ a combination of yellow and black colours...and remember, as mentioned before, they can be loosely classified according to the type of information they provide: location, destination, or direction.
- Here are examples of location signs: Location signs consist of an inscription in yellow on a black background, and when it is a stand-alone sign, it will have a yellow border (Note: this is the only case where a sign will have a border; all other information signs will have a yellow background with black inscription.)
- Here are examples of Destination signs.
- Here are examples of Direction Signs.
- Additional information signs: Some information signs fall outside of the three categories of location, destination or direction. Below are some examples:

- Runway Exit sign: provided where there is an operational need to identify a runway exit.
- Intersection take-off sign: This sign is provided where there is an operational need to indicate the remaining take-off run available (TORA) for intersection take-offs. This sign is located on the left-hand side of the entry taxiway.
- Signs can also be found associated with markings and associated with other signs.
- The following are some examples.
- ICAO Annex 14 Volume 1 states that “A location sign shall be provided in conjunction with a direction sign except that it may be omitted where an aeronautical study indicates that it is not needed.”
- “A location sign shall be provided with a runway designation sign except at a runway/runway intersection.”

Let's now look at aerodrome light.

- Two important lights from a runway incursion safety standpoint are stop bars and runway guard lights.
- These lights are placed at strategic locations to raise attention and prevent unauthorized aircraft or vehicles from inadvertently entering the runway.
- All traffic shall stop and hold at all lit stop bars, and may proceed further only when the stop bar lights are switched off by the controller.
- Runway guard lights have two standard configurations:

#### **Configuration A**

A pair of unidirectional flashing lights on each side of the taxiway.

#### **Configuration B**

Unidirectional flashing yellow lights across the taxiway spaced at intervals of 3 metres. These lights should not be co-located with a stop bar.

This concludes the Aerodrome Ground Aids segment of the Runway incursion toolkit. Now please go the quiz available for this topic.



## MANAGEMENT RESPONSIBILITIES

In this section we discuss issues that are best addressed by personnel in management and supervisory roles at aerodromes of any size and complexity. Although the focus of the discussion is directed at the senior manager, the information following is applicable to managers and supervisors at every level, to include ATC and airline leadership.

What is the role of a manager in promoting good runway safety? After all, he or she is pretty far removed from the daily activities that result in runway incursions. Managers do not give directions to pilots taxiing about the aerodrome, nor taxi the aircraft themselves; they don't train vehicle operators or repaint weathered signs. So how do managers affect safety? Here is a list of principles that have been found to be effective:

- Managers do things that operators cannot, such as obtaining resources and providing training;
- Managers set effective policy and rules;
- Managers have the authority to correct problems at a comprehensive level;
- Managers hire the right people;
- Managers set the organization priorities and tone.

Properly done, these measures will always have a positive effect on runway safety, and safety in general. Let's examine each of the principles to see how they affect safety.

- Managers do things that operators cannot. Chief among these is to be an advocate for the organization, and its safety and security. Using facts and figures, good managers make educational and compelling arguments for needed runway safety improvements. These proposals may be for new equipment, better training, or even for improved conditions for the security guards keeping unauthorized people out of the runway environment. Managers fight hard to protect safety programs from inevitable budget cuts, because they know that the most expensive safety program costs far less than a single runway collision.
- Managers set effective policies and rules. At the operational level, individuals have the responsibility to implement policies, and they may do it well, but the real value of the policies is derived at the point of creation. Simply put, managers give operators the tools and structure to make good decisions by the rules, policies and regulations they devise. Aviation already has plenty of rules and regulations from higher authorities that must be implemented, so the intent is not to add another layer of suffocating restrictions; rather, managers have an opportunity to craft straightforward and well-designed policies to address specific safety issues at their aerodrome. This is the essence of good management.
- Managers have the ability to correct problems at a comprehensive level. For example, managers can order repainting of weathered signs, and find the money to do so. Managers can redesign taxi routes to reduce runway incursion potential, or even lobby successfully for construction of new taxiways. Managers, using collected data and

statistics, can address problems that may not be readily visible to individual Air Traffic Controllers. There are many other examples of what managers can do to find solutions to problems that are beyond the reach of staff employees.

- Managers hire the right people. As many managers have noted through the years, it is remarkable how many problems resolve themselves simply by hiring motivated, highly competent people. To a large degree, no supervisor is better than the people who work for him, to include subordinate supervisors. Managers must ensure that their employees are dedicated, motivated and abide by the appropriate safety rules and regulations. This is clearly an area where managers can make a large difference.
- Managers set the organization's priorities and tone. This is the area where managers have to be leaders. If, through your words, actions and policies, you communicate to the organization that you are serious about runway safety, the chances are very good that subordinates will think safety is important as well, and act accordingly. The opposite is also true; poor leadership on safety issues will virtually guarantee a poor safety record.

Having established the guiding principles that good managers employ, let us turn to specific actions that can be taken in each of the areas. Before doing so however, we should also establish a basic principle of system safety.

Bad system design equals human error equals incidents and accidents. While it is true that some error is due to individual negligence or willful misconduct, in the great majority of instances, it is the operational system itself that is at fault. Whether they be pilots, Air Traffic Controllers or vehicle drivers, those at the operational level are generally trying to do their best, but sometimes make mistakes anyway. Many times this can be traced back to some part of operations or training that is deficient to the point they virtually ensure people will frequently make errors. Although individuals must always be accountable for their actions, the real solution is to go back to the *source* of the mistakes and correct that. In some cases this may be as simple as repainting and highlighting hard-to-see markings that have often been overlooked by taxiing pilots. Or it may be a change in the training curriculum for drivers to address a weak spot in their instruction. One guiding concept is to look beyond punishing individuals for mistakes, so as to address the flaws in the system that prompted the mistakes in the first place.

With this in mind, what are specific actions managers can take to reduce the potential for runway incursions?

If not already in place, a safety management system must be established for the aerodrome. This is a major, comprehensive program for the management of safety in all operational and administrative areas. It is beyond the scope of this CD to address such a considerable undertaking; consult the appropriate international references, such as Annexes 11, 14, and the PANS-ATM, Manual of Certification of Aerodromes, Manual of Safety Management for AIS, plus regional or national requirements. If a high-level safety program is already established, confirm that all infrastructure, policies and procedures are ICAO compliant.

At a lower level, establishment of a local Runway Safety Team is essential. This team should be composed of representatives from the airlines, general aviation, ATC, aerodrome operations, and any organization that employs large numbers of drivers on the field. These are people who see problems on a daily basis, and are often in a position to discuss the cause and propose solutions. They are an invaluable resource for an airport manager, and should be utilized extensively. One immediate purpose the runway safety committee can serve is to initiate a runway safety awareness campaign. On a continuing basis, the campaign should be revitalized and refreshed with new materials and approaches, so as to prevent staleness from creeping in.

In their role as informed advocates, managers should stay abreast of the evolving technology available for the reduction of runway incursion potential. While much of it may not be affordable or suitable at your location, some of it will be. Only by investigation, study and research will you be in a position to advocate and budget for the technology right for you. This might be a primary responsibility of one of the Runway Safety Team members.

A large part of management involves supervision, including individuals, operations and infrastructure. While some part of this is always done by review of records and reports, a large part can be done first hand. When was the last time you got into an aerodrome vehicle and drove along the security fence line? Have you examined the visibility of signs and markings at night or in bad weather? Or talked to individual pilots and controllers and asked them their opinion of where runway incursions were likely to occur, and why? Quizzed a vehicle driver as to correct procedures, to verify the adequacy and standardization of training?

These and other similar techniques demonstrate your interest in safety, provide alternate sources of information and provide a basis for first-hand impressions. Often you will see things that need your attention. *Take prompt action*, for example if signs need repainting or replacement, start the process. Then follow up to see that it has been accomplished properly.

One of the most useful functions of management is the collection of data; incidents, accidents, and trends. Make sure your definitions are ICAO compliant (for example, runway incursions) and that the information is accurate and timely; it is the basis for effective safety management. A good example is the identification of G aerodrome “hotspots,” those intersections where runway incursions are historically most likely to occur. This information must be placed in the hands of users, which can be done by a variety of means. An aerodrome diagram, with hotspots charted, such as in the example developed by Brussels National Airport, is an excellent educational tool. It can be distributed to pilots in kneeboard form, displayed on walls in a poster format, and can be the subject of presentations at safety meetings.

Collected data may also be the justification for major innovations, such as taxi route changes, or even the building of new “pilot friendly” taxiways. We should keep in mind that not only drivers and pilots end up on runways; sometimes unauthorized pedestrians do as well. Aside from the obvious security hazard to aviation, the danger to the trespassers, often children, is extreme. Securing the aerodrome from such intrusions is a basic management responsibility, and breaches should not require extraordinary actions by pilots or controllers to prevent a disaster. It is also the responsibility of management to create a proper safety atmosphere. This includes establishing a “no-blame” policy consistent with the aforementioned principle that bad system design are vulnerable to human error. Concurrent with this is establishment of a safety reporting system, where people can report safety problems in a confidential manner, and thus feel free to be totally forthcoming. Such systems have long proven to be the source of valuable data and suggestions, with very little, if any, expense to the organization.

Finally, managers affect training. They authorize or require it, approve curricula, determine effectiveness, and make changes. To a large extent, an organization is only as good as its training. Some personnel, notably pilots and controllers, will already have training as prescribed by regulatory authorities, but may be subject to additional local instruction. Additionally, others, such as vehicle operators, will be almost exclusively locally trained. To be effective, training must be tailored to the user group – driver training for drivers, pilot training for pilots, for example. Occasionally however, joint training maybe warranted, especially in those areas, such as runway incursions, where common problems and interactions must occur. Managers must examine and decide when and how this makes sense. No matter the format however, training must be standardized so that the quality of instruction does not vary from one class to the next, and to ensure personnel are getting exactly what they need. Instruction must be evaluated, it must be ongoing and competencies must be demonstrated. The guarantee of the integrity of training programs is a mandatory

management obligation. This is increasingly important with the adoption of new ICAO standards that strengthen requirements for language proficiency for pilots and air traffic controllers.

This section concludes with a quiz to test your understanding of the material presented. This provides one method of self evaluation, but the real test of the material is this: what are *you* going to do to ensure all appropriate personnel review and benefit from this ICAO Runway Safety Toolkit?

Remember: No aerodrome can be safe if managers are not doing their part!

— END —