Subject: Proposals for the amendment to Annex 14, Volume I and the PANS-ATM (Doc 4444) relating to
the runway incursion warning system (ARIWS)

Action required: Comments to reach Montréal by
13 October 2015

Sir/Madam,

1. I have the honour to inform you that the Air Navigation Commission, at the eight meeting of
its 198th Session and the tenth and eleventh meetings of its 199th Session, held on 10 March, and 18
and 23 June 2015 respectively, reviewed proposals originated by the Aerodromes Panel (AP) to amend
the Standards and Recommended Practices (SARPs) in Annex 14 — Aerodromes, Volume I —
Aerodrome Design and Operations with consequential amendments to the Procedures for Air Navigation
Services — Air Traffic Management (PANS-ATM, Doc 4444) relating to the autonomous runway
incursion warning system (ARIWS). The Commission authorized the transmission of these proposals to
Member States and appropriate international organizations for comments.

2. The proposals to Annex 14, Volume I are contained in Attachment A. The proposals to
PANS-ATM (Doc 4444) are contained in Attachment B. To facilitate your review of the proposed
amendments, the rationales for the amendments have been provided in a text box immediately following
each proposal.

3. In examining the proposed amendments, you should not feel obliged to comment on
editorial aspects as such matters will be addressed by the Air Navigation Commission during its final
review of the draft amendment.

4. May I request that any comments you wish to make on the amendment proposals be
dispatched to reach me not later than 13 October 2015. The Air Navigation Commission has asked me to
specifically indicate that comments received after the due date may not be considered by the Commission
and the Council. In this connection, should you anticipate a delay in the receipt of your reply, please let
me know in advance of the due date.
5. For your information, the proposed amendment to Annex 14, Volume I and the PANS-ATM (Doc 4444) is envisaged for applicability on 10 November 2016. Any comments you may have thereon would be appreciated.

6. The subsequent work of the Air Navigation Commission and the Council would be greatly facilitated by specific statements on the acceptability or otherwise of the amendment proposals.

7. Please note that for the review of your comments by the Air Navigation Commission and the Council, replies are normally classified as “agreement with or without comments”, “disagreement with or without comments” or “no indication of position”. If in your reply the expressions “no objections” or “no comments” are used, they will be taken to mean “agreement without comments” and “no indication of position”, respectively. In order to facilitate proper classification of your response, a form has been included in Attachment C which may be completed and returned together with your comments, if any, on the proposals in Attachments A and B.

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

Raymond Benjamin
Secretary General

Enclosures:
A — Proposed amendment to Annex 14, Volume I
B — Proposed amendment to PANS-ATM
C — Response Form
NOTE ON THE PRESENTATION OF THE PROPOSED AMENDMENT

The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

- Text to be deleted is shown with a line through it.

- New text to be inserted is highlighted with grey shading.

- Text to be deleted is shown with a line through it followed by the replacement text which is highlighted with grey shading.
CHAPTER 1. GENERAL

1.1 Definitions

*Autonomous runway incursion warning system (ARIWS).* A system which provides autonomous detection of a potential incursion or of the occupancy on an active runway and a direct warning to a flight crew or a vehicle operator.

... 

CHAPTER 9. AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATIONS

... 

**Insert** new text as follows:

9.12 Autonomous runway incursion warning system

*Note 1.*—Attachment A, Section 21, provides a description of an autonomous runway incursion warning system (ARIWS) and information on its use.

*Note 2.*—The implementation of an ARIWS is a complex issue deserving careful consideration by aerodrome operators, air traffic services and States and in coordination with the aircraft operators. The inclusion of detailed specifications for an ARIWS in this section is not intended to imply that an ARIWS has to be provided at an aerodrome.
Characteristics

9.12.1 Where an ARIWS is installed at an aerodrome:

a) it shall provide autonomous detection of a potential incursion or of the occupancy on an active runway and a direct warning to a flight crew or vehicle operator;

b) it shall function and be controlled independently of any other visual system on the aerodrome;

c) its visual aid components, i.e. lights, shall be designed to conform with the relevant specifications in 5.3; and

d) failure of part or all of it shall not interfere with normal aerodrome operations. To this end, ATC shall be able to partially or entirely shut down the system.

Note 1.—An ARIWS may be installed in conjunction with enhanced taxiway markings, stop bars or runway guard lights.

Note 2.—It is intended that the system(s) be operational under all weather conditions, including low visibility.

Note 3.—An ARIWS may share common sensory components of an SMGCS or A-SMGCS, however, it operates independently of either system.

9.12.2 Where an ARIWS is installed at an aerodrome, information on its characteristics and status shall be provided to the appropriate aeronautical information services for promulgation in the AIP with the description of the aerodrome surface movement guidance and control system and markings as specified in Annex 15, Appendix 1, AD 2.9.

End of new text.

Origin:

AP/2-WP/26 (Report of the meeting), VAWG/10-DP/16, VAWG/11-DP/09, VAWG/11-DP/16, APWG/2-DP/14, AP/3-WP/17, ATMOPSP/3-WP/2

Rationale:

AP/3 acknowledged that RWSL was being deployed in three different States on three different continents which set the cases for standardization of the lights patterns. The proposal fulfils the remit given by the ANC.

APWG/2 previously focused on the best wording for the applicability clause in Chapter 9 because it was the meeting’s consensus to ensure that “the provisions shall in no way be interpreted as an obligation or a recommendation to install such a system”. Note 2 in 9.12 was written to that purpose.

Attachment A provides a general description of an ARIWS.

Regarding the specifics, only provisions of the visual aids for RWSL are proposed for inclusion in section 5.3 of Annex 14, Volume I.
No amendment to Annex 15 seems necessary as the present specification AD 2.9 may accommodate, at least temporarily, the description of any ARIWS in the remarks field.

After AP/3, and in coordination with the ATMOPS Panel, the last item of 9.12.1 has been added.

A major system implementation (change) like ARIWS will be supported by a safety assessment (PANS-Aerodromes, section 2.4.4, Management of change refer).

---

INITIAL PROPOSAL 2

ATTACHMENT A. GUIDANCE MATERIAL
SUPPLEMENTARY TO ANNEX 14, VOLUME I
(referred to in section 9.12)

Insert new text as follows:

21. Autonomous runway incursion warning system (ARIWS)

Note 1.—These autonomous systems are generally quite complex in design and operation and, as such require some level of involvement by all levels of the industry, from the regulating authority to the end user. This guidance is offered to provide a more clear description of the system(s) and offer some suggested actions required in order to properly implement these system(s) at an aerodrome in any State.

Note 2.—The Manual on the Prevention of Runway Incursion (Doc 9870) presents different approaches for the prevention of runway incursion.

21.1 General description

21.1.1 The operation of an ARIWS is based upon a surveillance system which monitors the actual situation on a runway and automatically returns this information to warning lights at the runway (take-off) thresholds and entrances. When an aircraft is departing from a runway (rolling) or arriving at a runway (short final), red warning lights at the entrances will illuminate, indicating that it is unsafe to enter or cross the runway. When an aircraft is aligned on the runway for take-off and another aircraft or vehicle enters or crosses the runway, red warning lights will illuminate at the threshold area, indicating that it is unsafe to start the take-off roll.
21.1.2 In general, an ARIWS is built up out of an independent surveillance system (primary radar, multilateration, specialized cameras, dedicated radar, etc.) and a warning system in the form of extra airfield lighting systems connected through a processor which generates alerts independent from ATC directly to the concerned actors.

21.1.3 An ARIWS does not require circuit interleaving, secondary power supply or operational connection to other visual aid systems.

21.1.4 In practice, not every entrance or threshold needs to be equipped with warning lights. Each aerodrome will have to assess its needs individually depending on the characteristics of the aerodrome. There are several systems developed offering the same or similar functionality.

21.2 Flight crew actions

21.2.1 It is of critical importance that flight crews understand the warning being transmitted by the ARIWS system. Warnings are provided in near real-time, directly to the flight crew because there is no time for “relay” types of communications. In other words, a conflict warning generated to ATS which must then interpret the warning, evaluate the situation and communicate to the aircraft in question, would result in several seconds being taken up where each second is critical in the ability to stop the aircraft safely, and prevent a potential collision. Pilots are presented with a globally consistent signal which means “STOP IMMEDIATELY” and must be taught to react accordingly. Likewise, pilots receiving an ATS clearance to take-off or cross a runway, and seeing the red light array, must STOP and advise ATS that they aborted/stopped because of the red lights. Again, the criticality of the timeline involved is so tight that there is no room for misinterpretation of the signal. It is of utmost importance that the visual signal be consistent around the world.

21.2.2 It must also be stressed that the extinguishing of the red lights does not, in itself, indicate a clearance to proceed. That clearance is still required from air traffic control. The absence of red warning lights only means that potential conflicts have not been detected.

21.2.3 In the event that a system becomes unserviceable, one of two things will occur. If the system fails in the extinguished condition, then no procedural changes need to be accomplished. The only thing that will happen is the loss of the automatic, independent warning system. Both ATS operations and flight crew procedures (in response to ATS clearances) will remain unchanged.

21.2.4 If the system fails in the illuminated condition, then alternative procedures should be employed. It will be up to the individual authority to establish those procedures depending on their own circumstances, but it must be remembered that flight crews are instructed to “STOP” at all red lights, so if it becomes necessary for crews to cross an illuminated array, they should do so under specifically worded ATS clearances, and possibly with a follow-me vehicle leading. Alternatively, the affected portion of the system, or the entire system can be shut off until repaired, reverting to the extinguished scenario described in 21.2.3 above.
21.3 Aerodromes

21.3.1 An ARIWS does not have to be provided at all aerodromes. An aerodrome considering the installation of such a system may wish to assess its needs individually, depending on traffic levels, aerodrome geometry, ground taxi patterns, etc. Local user groups such as the Local Runway Safety Team (LRST) can be of assistance in this process. Also, not every runway or taxiway needs to be equipped with the lighting array(s) and not every installation requires a comprehensive ground surveillance system to feed information to the conflict detection computer.

21.3.2 Although there may be local specific requirements, some basic system requirements are applicable to all ARIWS:

a) the control system and energy power supply of the system must be independent from any other system in use at the aerodrome, especially the other parts of the lighting system;

b) the system must operate independently from ATS communications;

c) the system must provide a globally accepted visual signal that is consistent and instantly understood by crews; and

d) there must be an alternative action plan in the case of failure of a portion of, or the entire system.

21.4 Air traffic services

21.4.1 The ARIWS is designed to be complementary to normal ATS functions, providing warnings to flight crews and vehicle operators when some conflict has been unintentionally created or missed during normal aerodrome operations. For example, ground control or tower (local) control has provided a clearance to hold short of a runway but the flight crew or vehicle operator has “missed” the hold short portion of their clearance and tower has issued a take-off or landing clearance to that same runway, and the non-read back by the flight crew or vehicle operator was missed by air traffic control. The ARIWS will provide a direct warning.

21.4.2 In any case where a clearance has been issued and a crew reports a non-compliance due to “red lights”, or aborting because of “red lights”, then it is imperative that the controller immediately assess the situation and provide additional instructions as necessary. It may well be that the system has generated a false warning or that the potential incursion no longer exists; however, it may also be a valid warning. In any case, additional instructions and/or a new clearance need to be provided. In a case where the system has failed, then alternative procedures will need to be put into place as described in 21.2.3 and 21.2.4 above. In no case should the illumination of the ARIWS be dismissed without confirmation that, in fact, there is no conflict. It is worth noting that there have been numerous incidents avoided at aerodromes with such systems installed. It is also worth noting that there have been false warnings as well, usually as a result of the calibration of the warning software, but in any case, a confirmation of the potential conflict existence or non-existence must be done.
21.4.3 While many installations may have a visual or audio warning available to ATS personnel, it is in no way intended that ATS personnel be required to actively monitor the system. Such warnings may assist ATS personnel in quickly assessing the conflict in the event of a warning and help them to provide appropriate further instructions, but the ARIWS should not play an active part in the normal functioning of any ATS facility.

21.4.4 Each State, and perhaps each aerodrome where the system is installed will develop procedures for alternative operations depending upon their unique situation. Again, it must be stressed that under no circumstances should pilots or operators be instructed to “cross the red lights” without some additional mitigation in place such as a follow-me vehicle or a specific confirmation of the failure of the system at that specific point. As indicated previously, the use of local runway safety teams can greatly assist in this development process.

21.5 Promulgation of information

21.5.1 Information on the characteristics and status of an ARIWS at an aerodrome are promulgated in the AIP section AD 2.9 and its status updated as necessary through NOTAM or ATIS in compliance with Annex 14, Volume I, 2.9.1.

21.5.2 Aircraft operators are to ensure that flight crews documentation include procedures regarding ARIWS and appropriate guidance information.

21.5.3 Aerodromes may provide additional sources of guidance on operations and procedures for their personnel, aircraft operators, ATS and third parties personnel who may have to deal with an ARIWS.

<table>
<thead>
<tr>
<th>Origin:</th>
<th>Rationale:</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP/2-WP/26 (Report of the meeting), VAWG/10-DP/16, VAWG/11-DP/09, VAWG/11-DP/16, APWGs/2-DP/14, AP/3-WP/17, ATMOPSP/3-WP/2</td>
<td>Refer to the rationale under Initial Proposal 1.</td>
</tr>
</tbody>
</table>

...
5.3.30 Runway status lights

Introductory Note.— Runway status lights (RWSL) is a type of autonomous runway incursion warning system (ARIWS). The two basic visual components of RWSL are runway entrance lights (RELs) and take-off hold lights (THLs). Either may be installed by itself, but the two components are designed to be complementary to each other.

Location

5.3.30.1 Where provided, RELs shall be offset 0.6 m from the taxiway centre line on the opposite side to the taxiway centre line lights and begin 0.6 m before the runway-holding position extending to the edge of the runway. An additional single light shall be placed on the runway 0.6 m from the runway centre line and aligned with the last two taxiway RELs.

5.3.30.2 RELs shall consist of at least five light units and shall be spaced at a minimum of 3.8 m and a maximum of 15.2 m longitudinally, depending upon the taxiway length involved, except for a single light installed near the runway centre line.

5.3.30.3 Where provided, THLs shall be offset 1.8 m on each side of the runway centre line lights and extend, in pairs, starting at a point 115 m from the beginning of the runway and, thereafter, every 30 m for at least 450 m.

Note.— Additional THLs may be similarly provided at the starting point of the take-off roll.

Characteristics

5.3.30.4 Where provided, RELs shall consist of a single line of fixed in pavement lights showing red in the direction of aircraft approaching the runway.

5.3.30.5 RELs shall illuminate as an array at each taxiway/runway intersection where they are installed less than 2 seconds after the system determines a warning is needed.

5.3.30.6 Intensity and beam spread of RELs shall be in accordance with the specifications of Appendix 2, Figures A2-12 and A2-14.

Note.— Consideration for reduced beam width may be required for some REL lights at acute angled runway/taxiway intersections to ensure the RELs are not visible to aircraft on the runway.
5.3.30.7 Where provided, THLs shall consist of two rows of fixed in pavement lights showing red facing the aircraft taking off.

5.3.30.8 THLs shall illuminate as an array on the runway less than 2 seconds after the system determines a warning is needed.

5.3.30.9 Intensity and beam spread of THLs shall be in accordance with the specifications of Appendix 2, Figure A2-x.

5.3.30.10 **Recommendation.**— *RELs and THLs should be automated to the extent that the only control over each system will be to disable one or both systems.*

---

**Origin:**
AP/2-WP/26 (Report of the meeting), VAWG/10-DP/16, VAWG/11-DP/09, VAWG/11-DP/16, APWGs/2-DP/14, AP/3-WP/17, ATMOPSP/3-WP/2

**Rationale:**
This entirely new section is proposed to establish the lighting configuration for a runway status lights system (RWSL), which is an ARIWS. The configurations described are being installed over the next few years at major United States airports. Additionally, development of similar RWSL systems around the world by at least two other States has prompted this proposal for the configuration. The primary concern is to provide a direct, independent warning of a potential conflict to the flight crew. As such, the warning must be universally recognized and reacted to very quickly due to the dynamic nature of the conflict. Therefore, it is essential to establish a common lighting configuration globally to ensure the greatest possible recognition and least possible reaction time to the warning. Much research has been accomplished in the United States by MIT Lincoln Laboratories and by MITRE Corporation before the current configuration was agreed to. Prototype systems have been installed at San Diego (KSAN), Dallas-Fort Worth (KDFW), Los Angeles (KLAX) and Boston (KBOS). Information derived from those prototype installations has been used to develop the final configuration of lights proposed here.

For 5.3.30.3, the “starting at a point 115 m from the beginning of the runway” has been complemented as there are variations of aircraft types operating from a given aerodrome, as well as indistinctness in where the start for the 115 m commences in the event of an intersection take-off. The THL is to start where the pilot can best visually identify the THL which is where the “rear landing gear reaches the point where the runway centre line and taxiway centre line merges (in other words the aircraft is correctly aligned with the runway centre line)”. For example, if the smallest aircraft intending to use a given runway is a SAAB 340B, when the rear landing gear of the aircraft intending to take-off reaches the point where the runway centre line and taxiway centre line merge and taking the blind area into consideration, it is possible to visually identify the THL 16.3 m ahead. Therefore, the starting point of the THL may become that position. However, a sufficient distance shall separate the THLs from the side rows of lights for precision approach runways in order not to confuse the identification of the threshold. Original intention of the design was 112.5 m, but some flexibility is required to cater to aerodrome specifics and intersection...
take-offs. The same reasoning applies to THLs length which need some flexibility around the target value of 450 m to accommodate the case of multiple intersection take-off entries. Given the variety of situations at the limited planned RWSL installations (less than thirty presently), it was considered that the proposed 5.3.30.3 captured the basic principle and essence of the requirements and that local adaptations could be left to the discretion of the State.

Intensity and beam spread of RELs shall be in accordance with the specifications of Appendix 2, Figures A2-12 and A2-14. The notes of Figure A2-14 needed to be detailed. Intensity and beam spread of THLs shall be in accordance with the specifications of Appendix 2, new Figure A2-x.

INITIAL PROPOSAL 4

APPENDIX 2. AERONAUTICAL GROUND LIGHT CHARACTERISTICS

...  

Editorial Note.— Modified Notes of Figure A2-14.

Notes:

1. Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve. This does not apply to runway entrance lights (RELs).

2. Increased intensities for RELs shall be twice the specified intensities, i.e. minimum 20 cd, main beam minimum 100 cd and minimum average 200 cd.

See collective notes for Figures A2-12 to A2-21.
Editorial Note.— Insert new isocandela diagram for THLs in Appendix 2.

Notes:

1. Curves calculated on formula: \( \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \)

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.0</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>7.0</td>
<td>8.5</td>
</tr>
</tbody>
</table>

2. See collective notes for Figures for A2-1 to A2-xx.

Figure A2-x. Isocandela diagram for take-off and hold lights (THL) (red light)

End of new text.
ATTACHMENT B to State letter AN 4/1.1.56-15/51

PROPOSED AMENDMENT TO
PROCEDURES FOR
AIR NAVIGATION SERVICES
AIR TRAFFIC MANAGEMENT

The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

Text to be deleted is shown with a line through it.  text to be deleted

New text to be inserted is highlighted with grey shading.  new text to be inserted

Text to be deleted is shown with a line through it followed by the replacement text which is highlighted with grey shading.  new text to replace existing text
15.7.5 Autonomous runway incursion warning system (ARIWS)

Note 1.— The generation of ARIWS warnings is a function based on surveillance data. The objective of the ARIWS function is to assist flight crews and vehicle drivers in the prevention of runway incursions by generating, in a timely manner, a direct warning of a possible runway hazard making it unsafe to enter, to cross a runway or to take-off.

Note 2.— The function of ARIWS is to operate independently from ATC, and the warnings are generated for pilots and vehicle drivers.

15.7.5.1 In the event an ARIWS warning is generated that conflicts with the ATC clearance, the following action shall be taken by flight crew and vehicle drivers:

a) The flight crew or vehicle driver shall give priority to the ARIWS warning over the ATC clearance. They shall not proceed onto the runway or commence the take-off roll. The flight crew or vehicle driver shall inform the controller of the ARIWS warning and await further clearance; and

b) In the event the aircraft or vehicle has initiated actions to comply with a clearance that conflicts with the warning, the flight crew or the vehicle driver shall use the warning to exercise their best judgement and full authority in the choice of the best course of action to resolve any potential conflict. The controller should be informed, when practicable, of the ARIWS warning.
15.7.5.2 ATS units shall have procedures in place for situations when controllers are informed of ARIWS warnings, including how to disable the ARIWS in case of malfunctions.

---

**End of new text.**

*Renumber subsequent paragraphs accordingly*

<table>
<thead>
<tr>
<th>Origin:</th>
<th>Rationale:</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLTOPSP/1-WP/25</td>
<td>Coordination occurred between the ATMOPSP and FLTOPSP to agree on this amendment proposal for the PANS-ATM. The proposal does not create any requirement to implement the ARIWS system whatsoever. It merely caters for uniform application of ARIWS systems and aims at standardizing the reaction from crew and ATC in case of activation as well as in cases of system malfunction.</td>
</tr>
</tbody>
</table>

The two panels concluded that there was no need for new phraseology.

To remain consistent within PANS-ATM, vehicle driver is used instead of vehicle operator.

Since an ARIWS is designed to operate independently of ATC as a “safety net” system, Chapter 15 was considered an appropriate location for the provisions.

Note that 15.7.5.1 b) includes the following sentence taken from ACAS provisions: “Nothing in the procedures [...] shall prevent pilots-in-command from exercising their best judgement and full authority in the choice of the best course of action to resolve a traffic conflict or avert a potential collision”. It allows appropriate discretion for ARIWS as it does for ACAS.
RESPONSE FORM TO BE COMPLETED AND RETURNED TO ICAO TOGETHER WITH ANY COMMENTS YOU MAY HAVE ON THE PROPOSED AMENDMENTS

To: The Secretary General
    International Civil Aviation Organization
    999 Robert-Bourassa Boulevard
    Montréal, Quebec
    Canada, H3C 5H7

(State) ____________________________

Please make a checkmark (✓) against one option for each amendment. If you choose options “agreement with comments” or “disagreement with comments”, please provide your comments on separate sheets.

<table>
<thead>
<tr>
<th>Amendment</th>
<th>Agreement without comments</th>
<th>Agreement with comments*</th>
<th>Disagreement without comments</th>
<th>Disagreement with comments</th>
<th>No position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amendment to Annex 14 — Aerodromes,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume I — Aerodrome Design and Operations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Attachment A refers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amendment to PANS-ATM (Doc 4444),</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedures for Air Navigation Services — Air</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic Management (Attachment B refers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* “Agreement with comments” indicates that your State or organization agrees with the intent and overall thrust of the amendment proposal; the comments themselves may include, as necessary, your reservations concerning certain parts of the proposal and/or offer an alternative proposal in this regard.

Signature ____________________________ Date ____________________________

— END —