Aerodrome – Describe the Operational Use of Stop Bars
and Produce ICAO Amendment Proposal

Presented by TOC

Summary

ICAO prescribes the use of stop bars in low visibility operations and at aerodromes with complex lay-outs. The installation requirements of stop bars are addressed by ICAO in Annex 14. TOC has investigated the operational use of stop bars and the Human Machine Interface (HMI). Considering the IFATCA Stop Bar Survey and continued study by TOC, this paper is recommending an ICAO Amendment Proposal on changes within ICAO documentation. Furthermore this paper provides guidance on the operational use and HMI of stop bars.

1. Introduction

1.1 Stop bars are established at numerous airports all over the world for runway safety and are considered to be a safety net to prevent runway incursions. The majority of stop bars are installed for low visibility procedures, although some stop bars are used at airports with complex and confusing lay-outs, and/or multiple runway crossings.

1.2 The Technical and Operations Committee (TOC) was tasked to investigate and describe the operational use of stop bars and the Human Machine Interface (HMI).

1.3 ICAO has published extensive documentation on the operational use and installation of stop bars. The subject of stop bars has been discussed in many previous published IFATCA Working Papers and Surveys. The objective of this paper is to summarize and discuss publications on stop bars, and conclusively come up with an ICAO Amendment Proposal to align ICAO documentation.

2. Discussion

2.1 Definition of a stop bar: A row of red, unidirectional, steady-burning in-pavement or elevated lights installed across an entire taxiway or runway, and elevated steady-burning red lights on each side.
Stop bars were originally developed as a safety net to prevent traffic entering inadvertently an active runway. This is also considered in ATM to be a 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 take off of aircraft” (ICAO Doc 4444 PANS/ATM).

2.1.1 When a controller instructs traffic to enter a (by stop bars) protected area, the controller is supposed (according to ICAO Standards) to switch off the relevant stop bar to allow traffic to cross.

2.2 Published ICAO text on stop bars

2.2.1 ICAO Annex 2 Rules of the Air:

3.2.2.7.2 An aircraft taxiing on the manoeuvring area shall stop and hold at all runway holding positions unless otherwise authorised by the aerodrome control tower

3.2.2.7.3 An aircraft taxiing on the manoeuvring area shall stop and hold at all lighted stop bars and may proceed further when the lights are switched off.

ICAO also gives comment in Doc 9870 on this Standard:

This Standard applies both to runways and taxiways where fitted with stop bars. The objective of this Standard is to maintain the integrity of the stop bars, which are intended to protect the relevant part of a manoeuvring area.

2.2.2 ICAO Annex 14 Aerodromes:

5.3.19 Stop bars

Application

Note 1.-- The provision of stop bars requires their control either manually or automatically by air traffic services.

Note 2.-- Runway incursions may take place in all visibility or weather conditions. The provision of stop bars at runway holding positions and their use at night and in visibility conditions greater than 550 m runway visual range can form part of effective runway incursion prevention measures.

5.3.19.1 A stop bar shall be provided at every runway-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 350 m, except where:
a) appropriate aids and procedures are available to assist in preventing inadvertent incursions of aircraft and vehicles onto the runway; or
b) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:
1) aircraft on the manoeuvring area to one at a time; and
2) vehicles on the manoeuvring area to the essential minimum.

5.3.19.2 A stop bar shall be provided at every runway-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions of values between 350 m and 550 m, except where:

a) appropriate aids and procedures are available to assist in preventing inadvertent incursions of aircraft and vehicles onto the runway; or
b) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:
1) aircraft on the manoeuvring area to one at a time; and
2) vehicles on the manoeuvring area to the essential minimum.

Location
5.3.19.5 Stop bars shall be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in 5.3.19.4 are provided, these lights shall be located not less than 3 m from the taxiway edge.

Characteristics
5.3.19.6 Stop bars shall consist of lights spaced at intervals of 3 m across the taxiway, showing red in the intended direction(s) of approach to the intersection or runway-holding position.

2.2.2.1 More ICAO documentation on stop bars in Annex 14 is attached within Appendix B of this paper.

2.2.3 ICAO Doc 4444 PANS/ATM

7.15.7 Stop bars
Stop bars shall be switched on to indicate that all traffic shall stop and switched off to indicate that traffic may proceed.

Note.—Stop bars are located across taxiways at the point where it is desired that traffic stop, and consist of lights, showing red, spaced across the taxiway.

ICAO also gives comment in Doc 9870 on this publication in Doc 4444:

As such, a controller should never issue a clearance to cross a stop bar without first switching off the stop bar. The only exception to this should be when contingency measures are required due to unserviceability. An example of a contingency measure is the use of a follow-me vehicle.

2.2.4 ICAO Doc 9365 Manual of All-Weather Operations

3.2.12 Visual aids are also important for the safe and expeditious guidance and control of taxiing aeroplanes. Annex 14, Volume I, contains specifications for markings, lights, signs and markers. Requirements may vary, but they may for example consist of markings and signs supplemented by taxi holding position lights to denote holding
positions, taxiing guidance signs and markings on the centre lines and edges of taxiways. Centre line lights and stop bars may be selectively operated to indicate the assigned routing as well as for the control of aeroplanes. The Manual of Surface Movement Guidance and Control Systems (SMGCS) Doc 9476 contains guidance on the selection of SMGCS aids and procedures.

5.2.9 Stop bars can make a valuable contribution to safety and ground traffic flow control in low visibility operations. The primary-safety function of the stop bar is the prevention of inadvertent penetrations of active runways and OFZ\(^1\) by aircraft and vehicles in such conditions.

Stop bar should be provided at all taxiways giving access to active runways during limited visibility conditions unless the aerodrome layout, traffic density and applied procedures enable protection by other means at the discretion of the responsible authority.

Stop bars when provided should be used at least in visibility conditions corresponding to RVRs of less than 400 metres. They also may contribute, in conjunction with other elements of the SMGCS, to effective traffic flow when low visibility prevents ATC from effecting optimum flow and ground separation by visual reference.

It may also be advantageous to partly automate the operation of selected stop bars so that the air traffic controller will not be required to operate them manually every time, thus avoiding possible human errors; for example a manual switch-off of a stop bar after issue of a movement clearance would be followed by an automatic re-illumination by the crossing aeroplane, or a “limited visibility” setting on the control panel would automatically illuminate stop bars across taxiways which are not to be used in limited visibilities.

---

2.2.5 ICAO Doc 9476 Manual of Surface Movement Guidance and Control systems (SMGCS)

Stop bars consist of a series of red lights perpendicular to the taxiway centre line at the point where it is desired that an aircraft stop. In general its location coincides with that of the taxiway holding position marking. The lights are operated by air traffic control to indicate when an aircraft should stop and when it should proceed. This is particularly useful when used in conjunction with selectively switchable taxiway centre line lights.

---

2.2.6 ICAO Doc 9870 Manual on the Prevention of Runway Incursions

4.4 Recommendations to pilots
4.4.1 Pilots should never cross illuminated red stop bars when lining up on, or crossing, a runway unless contingency procedures are in use that specifically allow this.

4.5 Recommendations for Air Traffic Service Providers and Air traffic Controllers
4.5.4 Stop bars should be switched on to indicate that all traffic shall stop and switched off to indicate that traffic may proceed.

---

\(^1\) OFZ – Obstacle Free Zone
4.5.5 Aircraft or vehicles should never be instructed to cross, illuminated red stop bars when entering or crossing a runway. In the event of unserviceable stop bars that cannot be deselected, contingency measures, such as follow-me vehicles, should be used.

Appendix B - Best practices on the flight deck

6.3.3 Red stop bars should never be crossed when lining up on or crossing a runway unless, in exceptional cases, the stop bars, lights or controls are reported to be unserviceable, and contingency measures, such as using follow-me vehicles, are in force. In these circumstances, whenever possible, alternative routes should be used.

6.3.14 Never cross red stop bars when entering or crossing a runway unless contingency measures are in force, e.g. to cover cases where the stop bars or controls are unserviceable.

2.3. IFATCA Policy on stop bars:

2.3.1 Recommended practice “Stop bars shall be switched on to indicate that all traffic shall stop. Stop bars shall be switched off to indicate that traffic may proceed when authorized by the aerodrome control tower.” becomes an ICAO Standard.

Contingency procedures should be available for stop bar malfunction.

The ICAO provisions for stop bar related procedures should be made consistent and unambiguous in all relevant ICAO documents.

2.3.2 At the IFATCA 2009 Conference it was decided to add “when authorized by the aerodrome control tower” to ensure that traffic is not allowed to proceed when a stop bar is switched off, which could also occur due to a malfunction.

2.3.3 IFATCA addressed several issues regarding stop bars by the IFATCA Representative on the ICAO Aerodromes Panel (AP), Antonio Travaglione. IFATCA recently submitted a working paper on stop bar issues within the ICAO AP Visual Aids Working Group. This working paper (VAWG-AP.07) addresses the IFATCA Policy and other issues like HMI, 24/7 operation and stop bar installations.

According to IFATCA the following observations can be made regarding contingency procedures:
- Contingency procedures for the case of a stop bar malfunction should be in place at all airports, where stop bars are operated and when in place it should be communicated to all users.
- Contingency procedures should be clear, unambiguous, and they should be standardised throughout all airports.
- Contingency procedures are crucial for the integrity of the stop bars as an important safety net at airports.

2.4 IFALPA Policy

2.4.1 Stop bars shall be selectively switchable by the appropriate aerodrome controller.
2.4.2 Stop bars shall be installed at all aerodromes where a runway crossing is possible, and provided at every runway-holding position serving a runway, including non active runways.

2.4.3 Aircraft shall not cross red stop bars unless contingency measures are in force. Contingency measures should cover all cases where the stop bars or controls are unserviceable.

*Note - Runway incursions may take place in all visibility or weather conditions. The provision of stop bars at runway holding positions and their use during the day or night form part of effective runway incursion prevention measures.*

2.4.4 IFALPA Proposal 2009, add a new paragraph to the existing IFALPA Policy: “STOP BARS shall be used 24 hrs per day irrespective of the weather conditions”.

2.5 Aerodrome design

An aerodrome layout should be designed to facilitate a continuous traffic flow, and stop bars should be located so that they do not block parallel taxiways and negatively affect traffic flow (regardless if CAT I or CAT II/III holding points are being used).

2.6 Stop bar control

2.6.1 Presently there are aerodromes where stop bars are not switchable and pilots are routinely instructed by ATC to cross illuminated stop bars. This way of working influences the mind setting of international pilots and affects safety worldwide. IFATCA and IFALPA have a very clear position on this issue. “Never cross a red bar”. This is also prescribed by ICAO and should create an attitude towards never crossing red lights.

2.6.2 It is important that stop bar procedures are globally consistent. Departing in one State where pilots are routinely instructed by ATC to cross a stop bar at red, and arriving in another State where it is absolutely prohibited to cross a stop bar at red affects safety and is therefore unacceptable.

2.7 Human Machine Interface (HMI)

2.7.1 ICAO has published clear instructions about the location and characteristics of stop bars. Characteristics and installation of the accessory HMI are not thoroughly published. ICAO mentions (Annex 14) that stop bars should be "selectively switchable" and "The provision of stop bars requires their control either manually or automatically by air traffic services." Doc 9365 also advises “to partly automate the operation of selected stop bars so that the air -traffic controller will not be required to operate them - manually every time, thus avoiding possible human errors”.

This clearly implies that stop bars should be controlled by ATC at all time. However nothing is mentioned about the required location or design of the HMI.

The use of stop bars as an effective control tool to regulate ground flow of traffic requires great attention to the system design and the design of its HMIs.

2.7.2 Stop bar system architecture – At present no stipulation exists to design stop bars in such a way that it allows the air traffic controller to separately select and deselect each
individual stop bar from the tower working position. There have been reports that at some airports stop bars are not switchable from the tower or they are switchable only in conjunction with some taxiway lights so that pilots are routinely instructed to cross illuminated stop bars.

2.7.3 Controller interface or HMI - Aerodrome controllers are required to “maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome”. In good visibility condition, this is mainly achieved by controllers’ head-up operations. In low visibility conditions, direct visual observation is usually complemented by electronic surveillance means, obliging controllers mostly to head-down operations. Head-up and head-down operations may present very different characteristics, in relation to controller’s body position in the environment, kinesthetics and ergonomics, to eye movement, to objects requiring controller’s focused attention, etc.. Consequently, stop bars that have to be operated 24/7 shall present an adequately designed controlling interface (HMI), permitting that controllers “maintain continuous watch”, regardless of the visibility conditions, of the surveillance means and, thence, regardless of the head-up or down operations in progress. The location of the HMI should always be close to the position of the dedicated aerodrome controller. The design of the switches should be thus that they are easy to control without a facile possibility to be accidentally switched off.

[HMI Schiphol Amsterdam Airport. The small round white switches control the stop bars.]

2.7.4 Automation - A partly automation of stop bar re-illumination can be considered. To relieve the air traffic controller from additional workload and, also, to prevent a potential failure of the controller to re-illuminate a stop bar in a high workload situation, it is highly recommended to design stop bars in a way that they automatically switch back to red as soon as the intended aircraft or vehicle has passed the stop bar. One important design aspect is that the re-illumination should not be triggered by use of a timer – the given time interval could either be too short (in this case the aircraft or vehicle would have to ask again for approval) or too long (this could be misunderstood by a succeeding aircraft or vehicle to enter or cross the runway). The use of sensors would allow to re-illuminate a stop bar precisely in the moment when the intended aircraft or vehicle has passed the respective runway holding position.
2.7.5 Audio - An automatically accompanying audio signal (i.e. clicking), when switching a stop bar off, has proven at numerous airports, to be an excellent supplement to improve ATCOs situational awareness on runway occupation.

2.7.6 It should be made possible at all time for ATCOs to switch off a stop bar. The reason for this could be emergency situations or maintenance.

The HMI to override a stop bar or the failsafe function should be located within the aerodrome control tower and protected to prevent accidentally switching of the function. The figure below gives a good example.

![Stop Bar Override HMI](image)

*Reset ‘failsafe’ or override stop bar.*

2.8 Operating hours on stop bars

2.8.1 Originally, stop bars were designed mainly for operation under low visibility conditions. However, as it became obvious that they could be used as a very efficient safety net for the protection of runway entry points at all times, it is now under discussion to consider a 24/7 operations mode of stop bars.

Presently most stop bars are not developed to be used 24 hours a day. In low visibility operations it is often not allowed to use runway intersections, this derives that stop bars at intersections are often not selectively switchable, or even switchable by the dedicated controller. Also the HMI is in general not developed to be used 24 hours a day, which results often in an unacceptable increase of controller workload. To change the operations of low visibility stop bars into 24 hour operated stop bars will result in a considerable amount of work, time and cost, which is also not always supported by aerodrome operators that own most of the stop bars.

2.8.2 A very promising field trial with 24/7 stop bars took place in 2008 at Manchester airport in the UK. Aerodrome lay-out and stop bar HMIs were considered suitable for 24/7 operation. The results were promising, but further research is still needed.

2.9 Pilot interface

2.9.1 Sometimes the visibility of a stop bar to pilots is very poor. Stop bar design aspects such as brightness under sunlight conditions may need further research. Stop bars have an inclination that is related to the average traffic at an aerodrome. Some aircraft however have a cut-off angle that makes a stop bar not visible within the first 11 meters from the cockpit (MD80) up to almost 26 meters from the cockpit (B747). This implicates that the stop bar is not visible to the pilots within this range. This is especially
the case when the aircraft has to make a sharp turn to enter the Holding Point when coming from an angled Taxiway.

Part of the problem of crossing a lighted stop bar has also proven to be the distance between the individual lights, which at present is 3 m (see also paragraph 2.2.2 of this document and the referenced paragraph 5.3.19.6 of Annex 14). A spacing of 3 m hardly gives the indication of a red line which is not allowed to be crossed.

As the taxi phase is a busy phase and multiple tasks are performed by pilots in this phase, there is a possibility that pilots will not see the red stop bar.

Trials in the past to supplement the position of the “red” lights with “green” lights did not work as expected: Pilots, although they had to wait for the dimming of the red lights and the illumination of the green light, still crossed the lighted red stop bar.

Stop bars are on steady red “continually” until dimmed by the aerodrome controller. When stop bars are made of a flashing type, like a beacon, the visibility would improve. In example, a blue flashing light on a vehicle of the fire brigade is very good visible in the distance, but if it were to be a steady light, it would be less visible. Also the use of different colours like amber or green should be taken into consideration.

2.10 Stop bars are expected to be an excellent safety net and they should serve as a last resort. However history has proven that stop bars do not always fulfil this function. At Schiphol Amsterdam, a large part of the runway incursions are caused by stop bar violations. These numbers however are also influenced by the assumption of the airport authorities at Schiphol that every stop bar violation has to be considered as a Runway Incursion. This assumption is not always correct and in accordance with the ICAO definition of a Runway Incursion. Considering the position of the stop bar which could be different from the position of the Runway Holding Point a stop bar violation will not always automatically result in the incorrect presence of an aircraft, vehicle or person on the protected area of a runway.

It is evident that the basis should be that it must be absolutely clear to all users that a Holding Point should never be crossed without an ATC clearance.

2.11 The use of stop bars in low visibility procedures or at aerodromes with a confusing layout can be a necessity for runway safety at some aerodromes, but the requirement for a stop bar at every Holding Point is also undesirable. Too many stop bars at an aerodrome can lead to unsafe situations by complicating the ATC operations. Therefore it is also advisable to implement only one stop bar per intersection or to have automation for switching between CAT 1 and CAT 3 operations.

2.12 At some aerodrome stop bars are installed with a ‘failsafe’ function. When a malfunction occurs, this function will set the stop bars automatically on red. This to prevent pilot’s expectation that the aircraft can proceed when the stop bar suddenly switches off, possibly due to a malfunction. The intention for the ‘failsafe’ function is justifiable, but again this occurrence amplifies the basis for never crossing a Holding Point without an ATC clearance.

Furthermore the ‘failsafe’ function needs an, for the ATCO, easy accessible HMI to reset or to override the function. Otherwise it can frustrate the aerodrome operations
considerably. For instance when stop bars of a runway (which is not in use) turn on red, due to a malfunction and without the possibility for the ATCO to reset the ‘failsafe’ function in short time, it will be impossible to cross this runway to reach the dedicated runway for departure. This will lead to a considerable delay for the outbound traffic.

2.13 In August 2008 the Airport Domain Team (ADT) of IFATCA distributed a survey on the usage of stop bars at major airports to 39 selected Member Associations (MAs) in the four Regions of the Federation. Replies were collected until the end of December 2008.

According to outcome of the survey, ICAO should make stop bar related procedures less ambiguous and more consistent across the various documents. This should result in stop bars procedures becoming a training issue for pilots, vehicle drivers and ATCOs. Airport authorities (the owners of nearly all stop bars) should ensure that stop bars (where required) are made switchable by ATCOs. Together with the ATC Provider, the Airport authorities should develop and implement stop bar contingency procedures.

2.14 Runway Status Lights (RWSL)

2.14.1 Runway status lights is a fully automatic, advisory safety system designed to reduce the number and severity of runway incursions and thus prevent runway accidents while not interfering with airport operations. The system operates independent and controller input is not required. RWSL is designed to be compatible with existing procedures.

2.14.2 Runway status lights comprises Runway Entrance Lights (RELs) and Takeoff Hold lights (THLs).

RUNWAY ENTRANCE LIGHTS

Runway Entrance Lights illuminate red when a runway is unsafe to enter or cross due to a high-speed operation on the runway.

TAKEOFF HOLD LIGHTS

Takeoff Hold Lights illuminate Red to indicate an unsafe condition when an aircraft is in position for takeoff and another aircraft or vehicle is on or about to be on the runway in front of it.

To be consistent in appearance with Runway Entrance Lights, Takeoff Hold Lights are placed longitudinally along the runway centreline.

2.14.3 In the United States of America runway status lights have been installed at Dallas/Fort Worth International Airport (DFW), Los Angeles International Airport (LAX), and San Diego International Airport (SAN). The Federal Aviation Authority (FAA) has extended operational evaluations of runway status lights at these test airports indefinitely. According to local controllers the system is, although presently a benefit, not yet fully reliable and pilots need to be more educated to understand the features of the system.

2.14.4 Both stop bars and RWSL are developed to act as a safety net in runway operations. But where stop bars are designed to prevent runway incursions, RWSL is mainly designed to prevent runway accidents. Another important difference is the impact on
controller workload. Where stop bars require considerable controller inputs and increase workload, the RWSL system operates independently. Perhaps further study could demonstrate that both systems, when installed together, amplify each other and increase runway safety. Extensive information on RWSL can be found on www.rwsl.net.

2.15  ICAO Documents

2.15.1 The runway visual range conditions used by ICAO for the requirements of stop bars should be consistent in all ICAO Documents. ICAO Annex 14 mentions RVRs with a value less than 550m, and Doc 9365 mentions a value less than 400m.

2.15.2 More important is the inconsistency within the ICAO documents regarding the traffic that should stop at a lighted stop bar. Annex 2 mentions “aircraft”, Annex 14 “traffic”, Doc 4444 “all traffic”, Doc 9476 “aircraft” and Doc 9870 “aircraft or vehicles”.

According to IFATCA it should be absolutely clear, and published as an ICAO Standard, that “all traffic” should stop at lighted stop bars, and only proceed when the stop bar is switched off and an ATC clearance to proceed is received.

2.15.3 ICAO should publish clear and unambiguous procedures and phraseology for stop bar related contingency procedures. It should be absolutely clear to all users when ATC instructions are issued to cross a stop bar at red it is due to contingency procedures. An example for the phraseology could be: “Due to a stop bar malfunction follow the marshaller and cross the stop bar to line up and wait RWY24”.

3. Conclusions

3.1 Stop bars are not always being used in a manner consistent with ICAO Standards and Recommended Practices for never crossing an illuminated stop bar. This inconsistent use undermines the integrity of stop bars as a safety net.

3.2 The fact that a large percentage of runway incursions is caused by stop bar violations implies that the present installation and/or operation of stop bars does not fulfil its task to serve as a last resort to prevent runway incursions.

3.3 ICAO documentation on stop bar operation is inconsistent.

3.4 Standard phraseology for stop bar contingency procedures does not exist.

3.5 Inadequate ICAO documentation on the operation of aircraft and vehicles regarding stop bars causes the crossing of illuminated stop bars without an ATC clearance.

3.6 The design of many of today’s HMI is inadequate to support ease of operation because of distraction and head down operations.

3.7 IFATCA has no Policy on 24/7 stop bar operation. Many of today’s stop bars are designed for low visibility operations and reduced traffic volumes. Improvements are needed to stop bar implementations before stop bars can be safely and efficiently used 24/7 at normal traffic levels.
4. Draft recommendations

It is recommended that;

4.1 IFATCA policy is:

The stop bar HMI design, location, implementation and automation should prevent an unacceptable increase of workload, distraction and head down operations.

and is included on page 32215 of the IFATCA Technical and Professional Manual

4.2 IFATCA policy is:

The operation of stop bars 24 hours a day is supported by IFATCA provided that the design and implementation of stop bars support operations at normal traffic volumes.

and is included on page 32215 of the IFATCA Technical and Professional Manual

4.3 IFATCA should promote towards ICAO the Amendment Proposal on Stop Bars included within this paper in Appendix A.

5. References

- ICAO Annex 2, Rules of the Air
- ICAO Annex 14, Aerodromes
- ICAO Doc 4444, PANS-ATM
- ICAO Doc 9365, Manual of All-Weather Operations
- ICAO Doc 9476, Manual of Surface Movement Guidance and Control systems
- ICAO Doc 9870, Manual on the Prevention of Runway Incursions
- IFATCA WP 87 2006
- IFATCA WP 92 2008
- IFATCA WP 88 2009
- IFATCA GADT Stop Bar Survey 2009
- Flightsafety August 2008, “Never Cross Red” by Hans Houtman
- ICAO WP VAWG 07 by the IFATCA Aerodrome Panel Representative Antonio Travaglione
- www.rwsl.net
Appendix A

ICAO Amendment Proposal on Stop Bars

Amend ICAO Annex 2 paragraph 3.2.2.7.3 to read:

“An aircraft taxiing on the manoeuvring area shall stop and hold at all lighted stop bars and may proceed further when both the lights stop bar are switched off and the traffic is authorized to proceed by the aerodrome control tower.”

Amend PANS-ATM (ICAO Doc 4444) to read:

7.15.7 Stop bars

Stop bars shall be switched on to indicate that all traffic shall stop and switched off to indicate that traffic may proceed when authorized by the aerodrome control tower.

Note.— *Stop bars are located across taxiways at the point where it is desired that traffic stop, and consist of lights, showing red, spaced across the taxiway.*

Amend Manual on All Weather Operations (ICAO Doc 9365) to read:

5.2.9 Stop bars can make a valuable contribution to safety and ground traffic flow control in low visibility operations. The primary safety function of the stop bar is the prevention of inadvertent penetrations of active runways and OFZ by aircraft and vehicles in such conditions. Stop bars should be provided at all taxiways giving access to active runways during limited visibility conditions unless the aerodrome layout, traffic density and applied procedures enable protection by other means at the discretion of the responsible authority. Stop bars when provided should be used at least in visibility conditions corresponding to RVRs of less than 400 550 metres. They also may contribute, in conjunction with other elements of the SMGCS, to effective traffic flow when low visibility prevents ATC from effecting optimum flow and ground separation by visual reference. It may also be advantageous to partly automate the operation of selected stop bars so that the air traffic controller will not be required to operate them manually every time, thus avoiding possible human errors; for example a manual switch-off of a stop bar after issue of a movement clearance would be followed by an automatic reillumination by the crossing aeroplane traffic, or a “limited visibility” setting on the control panel would automatically illuminate stop bars across taxiways which are not to be used in limited visibilities.

Publish standard phraseology on stop bar contingency procedures in ICAO Doc 4444 paragraph 12.3.4.7- *Circumstances*: "DUE TO A STOP BAR MALFUNCTION FOLLOW THE MARSHALLER AND CROSS THE STOP BAR TO (followed by further instructions)"

ICAO should address procedures on Stop Bars in ICAO Annex 6 Operation of Aircraft and ICAO Doc 8186 Aircraft operations.

ICAO should address the requirements for the design and accessibility of the HMI of stop bars within ICAO Annex 14 paragraph 5.3. Stop bars should comprise an adequately designed controlling interface (HMI), permitting controllers to maintain a continuous watch. The location of the HMI should be integrated in the Controller Working Position (CWP) of the dedicated controller.
Amend Manual on the Prevention of Runway Incursions (ICAO Doc 9870) to read:

4.5.4 Stop bars should be switched on to indicate that all traffic shall stop and switched off to indicate that traffic may proceed when authorized by the aerodrome control tower.

Amend Manual of Surface Movement Guidance and Control systems (SMGCS) (ICAO Doc 9476) to read:

Appendix A 2.4 Stop bars - A stop bar consists of a series of red lights perpendicular to the taxiway centre line at the point where it is desired that an aircraft traffic stop. In general its location coincides with that of the taxiway holding position marking. The lights are operated by air traffic control to indicate when an aircraft traffic should stop and when it should proceed. This is particularly useful when used in conjunction with selectively switchable taxiway centre line lights.

Appendix B

Additional text on stop bars in ICAO Annex 14 Aerodromes:

5.3.19.3 Recommendation.— A stop bar should be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.

5.3.19.4 Recommendation.— Where the normal stop bar lights might be obscured (from a pilot’s view), for example, by snow or rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft, then a pair of elevated lights should be added to each end of the stop bar.

5.3.19.7 Stop bars installed at a runway-holding position shall be unidirectional and shall show red in the direction of approach to the runway.

5.3.19.8 Where the additional lights specified in 5.3.19.4 are provided, these lights shall have the same characteristics as the lights in the stop bar, but shall be visible to approaching aircraft up to the stop bar position.

5.3.19.9 Selectively switchable stop bars shall be installed in conjunction with at least three taxiway centre line lights (extending for a distance of at least 90 m from the stop bar) in the direction that it is intended for an aircraft to proceed from the stop bar. Note.— See 5.3.16.12 for provisions concerning the spacing of taxiway centre line lights.

5.3.19.10 The intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16, as appropriate.

5.3.19.11 Recommendation.— Where stop bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements
at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19. Note.— High-intensity stop bars should only be used in case of an absolute necessity and following a specific study.

5.3.19.12 Recommendation.— Where a wide beam fixture is required, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19.

5.3.19.13 The lighting circuit shall be designed so that:
   a) stop bars located across entrance taxiways are selectively switchable;
   b) stop bars located across taxiways intended to be used only as exit taxiways are switchable selectively or in groups;
   c) when a stop bar is illuminated, any taxiway centre line lights installed beyond the stop bar shall be extinguished for a distance of at least 90 m; and
   d) stop bars shall be interlocked with the taxiway centre line lights so that when the centre line lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa.

Note 1.— A stop bar is switched on to indicate that traffic stop and switched off to indicate that traffic proceed.

Note 2.— Care is required in the design of the electrical system to ensure that all of the lights of a stop bar will not fail at the same time. Guidance on this issue is given in the Aerodrome Design Manual, Part 5.

5.3.20 Intermediate holding position lights
Note.— See 5.2.11 for specifications on intermediate holding position marking.

Application
5.3.20.1 Except where a stop bar has been installed, intermediate holding position lights shall be provided at an intermediate holding position intended for use in runway visual range conditions less than a value of 350 m.

5.3.20.2 Recommendation.— Intermediate holding position lights should be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.