International Civil Aviation Organization

Third Meeting of the Asia Pacific Regional Aviation Safety Team (APRAST/3)

(Bangkok, Thailand, 7 – 10 May 2013)

Agenda Item 6: Breakout Session – RE-6

TIMELY AND ACCURATE REPORTING OF RUNWAY CONDITIONS BY ATS/AIS TO FLIGHT CREW

(Presented by Airports Authority of India)

Summary

The APRAST/1 identified Runway Excursion as a major issue under Runway Safety Enhancement Initiative and requested AAI to be 'Champion' for developing Industry **Best Practices Manual for Timely and Accurate reporting of Runway Condition (RCR) to flight crew by ATS/AIS for Asia Pacific Region**. The industry best practice manual has been prepared and submitted to APRAST for consideration. At present the subject of runway condition reporting, reporting of friction values and the braking distances used by aircraft for stopping after landing or during a rejected take off is **inconclusive**. Primarily based on the ICAO Documents and with reference to the findings and observations made by various research organizations, an attempt has been made in this Working Paper to compare provisions on RCR as contained in various ICAO Annexes/Documents/circular and a few proposals are being made for considerations by the APRAST. These proposals are aligned with various provisions of ICAO Annexes/documents.

1 INTRODUCTION

1.1 The First Meeting of the Asia Pacific Regional Aviation Safety Team (APRAST/1) 20-24 March, 2012 at ICAO APAC Office Bangkok – deliberated extensively on Runway Excursion (RE). It was highlighted in the meeting that lack of uniformity on the reporting of runway surface conditions to flight crew by the ATS/AIS Authorities was one of the major concerns. The inconsistencies in the formats adopted by ATS/AIS Authorities to report the runway surface conditions present an increased risk of runway excursion. All over the world considerable efforts are being made by various organizations – ICAO Friction task Force, TAPLA ARC of USA, European Aviation Safety Agency (EASA – RuFAB), Flight Safety Foundation, National Aerospace Laboratory Netherlands, Accident Investigation Bureau Norway and many others to harmonize – as to when and what is to be reported to flight crew and how flight crew utilizes such information to prevent runway excursion while landing or aborting take off on wet paved runways.

1.2 The APRAST/1 requested Airports Authority of India to be 'Champion' on the subject and develop Industry Best Practices Manual for timely and accurate reporting of runway conditions (RCR) to flight crew by ATS/AIS for Asia Pacific Region.

1.3 The Project was identified as 'RE 6' under Runway Safety Enhancement Initiative.

1.4 In regard to RE 6 the APRAST/1 mandated that while developing the standardized format for RCR, the Champion should adhere only to ICAO form of identification.

2. DISCUSSION

2.1 Milestones

2.1.1 A **Detailed Implementation Plan** (DIP) was submitted to APRAST, containing details of the steps considered essential to follow up the DIP. A draft manual containing industry best practices on RCR by ATS/AIS was submitted to the APRAST and a presentation on the subject was made during APRAST/II meeting held in August 2012. The presentation was based on the Standards and Recommended Practices, and guidance material available in various documents viz

i) **ICAO** Annex 14, Annex 6, Annex 15**,** Airports Services Manual Doc 9137 Part 2 "Pavement Surface Conditions", ICAO Circular 329 – Assessment Measurement and Reporting of Runway Surface Conditions, and the research work published by many organizations/agencies/companies.

ii) **Federal Aviation Administration (FAA), TALPA – ARC** (Take Off And Landing Performance Assessment – Aviation Rule Making Committee) and presentations on TALPA ARC Matrix made by FAA Experts in 33rd Annual Airport Conference, March 3, 2010.

iii) **European Aviation Safety Agency** Research Project EASA.2008/4 – RuFAB - Runway Friction Characteristics Measurement and Aircraft Braking.

iv) **National Aerospace Laboratory NLR, Netherlands** Executive Summary Report, NLR-TP-2005-498- Running Out of Runway – Analysis of 35 years of Landing Overrun Accidents.

v) **Flight Safety Foundation -- Approach and landing Accident Reduction (ALAR) Tool Kit (**ALAR) Runway Safety Initiative (FSF RSI) Briefing Note on Runway Condition Reporting, **Flight Safety Foundation** – Reducing the Risk of Runway Excursions.

vi) **Accident Investigation Board Norway (AIBN**) Report on Winter Operations, Friction Measurements and Condition for Friction Predictions 2011,

vii) **Eurocontrol Skybrary**,

viii) **CAA, UK AIP** – AD 1.1.2 Snow Plan, UK NATS AIC 93/2007 (yellow 247), Manchester Airport Winter Operational Plan 2011-2012, UK CAA, Winter Information Group (WIG) - UK Winter Runway Assessment Trial 2011/2012 & 2012/2013 Trial Plan

ix) **IATA** Runway Excursion Analysis Report2004-2009 (RERR 2nd Edition – Issued 2011)

x) **Transport Canada Aerodrome Safety Circular** ACS 2000-02 Dt 2000.09.15 on Aircraft Movement Surface Condition Reporting (AMSCR) for Winter Operations, and

xi) **International Federation of Air lines Pilots' Association –** Aircraft Design & Operation Briefing Leaflet 12ADOBL03 January 2012 – Certified versus advisory landing data on Boeing aircraft.

xii) International Friction Pavement Association (**IFPA**) – 3rd Annual Runway Certification Workshop – Friction – Science or Fiction, and lots of other literature on the subject available from various sources.

2.1.2 NOTAMs, SNOWTAMs issued by several States/ANSPs in APAC Region, Middle East Region, USSR, Canada and USA were also referred.

2.1.3 To understand the industry best practices in APAC Region a **Survey** was undertaken vide ICAO APAC Office Bangkok State Letter ref.: T 11/21.1 – AP 081/12 (AGA) dated 14 June 2012.

2.1.4. The Regional Aviation Safety Group (RASG) in its meeting held in Delhi during October 2012, approved the DIP on RE 6 as a Priority Safety Enhancement Initiative and also recommended that States respond to the Survey. However, response to the Survey was not encouraging and only 9 States responded. One State in Middle East Region also responded and sent the completed survey questionnaire.

2.1.5 The ICAO/COSCAP-SEA organized a workshop on "State functions and responsibilities regarding the Assessment, Measurement, and Reporting of Runway Surface conditions" from 19th November 2012 to 22nd November 2012 at Bangkok. The fruitful discussions held between the ICAO Friction Task Force Rapporteur and representatives of AAI, helped in gaining deeper understanding of the issues involved in Runway Condition Reporting. AAI team thankfully acknowledges guidance provided by an expert from Boeing Company in understanding the aircraft manufacturer's point of view.

2.2 **The Survey – response and analysis**

2.2.1 The response to Survey revealed that the planning and minimum friction level values notified by some States in APAC Region are higher than those mentioned in DOC 9137 Airports Services Manual Part 2 Table 3-1 "Runway Surface Condition Levels".

2.2.2 Among other observations, the Survey also revealed that some Airport Operators/ ANSPs do not close operations on Runway even when the friction values are reported below the minimum friction. An overview of Survey Findings is attached at Attachment B

2.2.3 In regard to the response on Survey, AAI would like to place it on record that a strong support was received from Qatar Airways in collecting NOTAMs and SNOWTAMs pertaining to Runway conditions particularly from the AIS Authorities of States where runways frequently get affected by various types of contaminants, snow and ice particularly.

2.2.4 AAI also thankfully acknowledges the cooperation and support received from NLR Netherlands, Accident Investigation Board Norway, European Aviation Safety Agency and International Friction Pavement Association (IFPA) in using and referring to their research work done on Runway Condition Assessment and Reporting.

2.3 **Comparative Study of ICAO Provisions**:-

2.3.1 Inconsistencies in ICAO current documents in respect of Runway Surface Conditions:

Annex 6, **ICAO Circular329 AN/191**	**Annex 14** **PANS ATM DOC4444**	**Inconsistencies**
Para 2 2. Definitions of Annex 6 and ***Runway surface condition*.** The state of the surface of the runway: either dry, wet, or contaminated: a) *Contaminated runway*. A runway is contaminated when more than 25 per cent of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by: — water, or slush more than 3 mm (0.125 in) deep; — loose snow more than 20 mm (0.75 in) deep; or — compacted snow or ice, including wet ice. b) *Dry runway*. A dry runway is one which is clear of contaminants and visible moisture within the required length and the width being used. c) *Wet runway.* A runway that is neither dry nor contaminated.	Para 2.9.4 of Annex 14 **Recommendation.—** *Whenever water is present on a runway, a description of the runway surface conditions on the centre half of the width of the runway, including the possible assessment of water depth, where applicable, should be made available using the following terms:* *DAMP — the surface shows a change of colour due to moisture.* *WET — the surface is soaked but there is no standing water.* *WATER PATCHES — significant patches of standing water are visible.* *FLOODED — extensive standing water is visible.* 11.4.3.4.2 of PANS ATM DOC4444 Information that water is present on a runway shall be transmitted to each aircraft concerned, on the initiative of the controller, using the following terms: DAMP — the surface shows a change of colour due to moisture. WET — the surface is soaked but there is no standing water. WATER PATCHES — patches of standing water are visible. FLOODED — extensive standing water is visible.	Annex 6 and Circular 329 consider whole width of runway whereas Annex 14 considers centre half of the width of the runway. Annex 6 and Circular 329 does not classify when there is visible moisture whereas Annex 14 and PANS ATM DOC4444 classifies as DAMP. Annex 6 and Circular 329 consider runway with water, or slush 3 mm (0.125 in) or less deep; loose snow 20 mm (0.75 in) deep or less; or compacted snow or ice, including wet ice as wet runway whereas Annex 14 considers runway wet when the surface is soaked with water but there is no standing water. The subject of runway contamination due to snow, slush or ice is dealt in Para 2.9.9 to 2.9.1.1.

2.3.2 From the description of wet runway, for example, as given in Annex 6, ICAO Circular 3/29 and Annex 14 the following is observed:-

Notwithstanding the exceptional conditions mentioned in the TWO NOTES associated with the definitions of Contaminated runway, Dry runway, Wet runway in Annex 6, a runway which is 25% or less covered by:

i. Water or slush more than 3 mm deep
ii. Loose snow more than 20 mm deep or
iii. Compacted snow or ice including wet ice

is not a contaminated runway and since it is not a dry runway either, it can be considered as a wet runway. Here all the five types of contaminates viz. water, slush, loose snow, compacted snow or ice/wet ice have been considered.

Whereas in Annex 14 para 2.9.4, water is the only contaminant which is considered while describing a wet runway. The subject of runway contamination due to snow, slush or ice is dealt separately in Para 2.9.9 to 2.9.1.1.

Although Annex 14, Chapter 2 Para 2.9.9 **Recommendations states** that whenever a runway is affected by snow, slush or ice and it has not been possible to clear the precipitant fully, the condition of the runway should be assessed and friction co-efficient measured.

2.4 Current state of Runway Condition Reporting:

2.4.1 Airlines operating globally and flight crew crossing state or regional borders are faced with variety of ways in which information is gathered, promulgated and disseminated. A large number of reporting formats exist which are used for informing airlines and flight crews about Runway Surface Conditions. Addition of any other format of information will add to existing variety. It is stated in the **Accident Investigation Bureau Norway** Report SL 2011/10 - Winter Operations, Friction Measurements & Conditions For Friction Predictions, **Executive Summary**'s opening paragraph that "***There is much uncertainty associated with measured/estimated runway friction coefficients (FC) and aircraft braking coefficients (ABC). Hence landing distances or maximum landing weights calculated on the basis of measured/estimated friction coefficients are also uncertain."***

2.4.2 Validation trials of TALPA ARC Matrix conducted in UK, as notified vide "UK WINTER RUNWAY ASSESSMENT TRIALS 2011/12– Trial Report" records that …***Although the resulting data set was small, there was some evidence of correlation between the braking action estimate and the perceived braking action assessed on the runway. The Winter Information Group concluded that the proof of concept has been achieved.*** The results of a similar trial conducted in 2012/13 are awaited.

2.4.2.1 The UK WINTER RUNWAY ASSESSMENT TRIALS 2011/12– Trial Report and the similar Trial Plan carried out in 2012/13 includes a remarkable observation, called '3-Kelvin Spread Rule'. The '3-Kelvin Spread Rule' is included in the Trial Plans (both 2011/12 & 2012/13) as a CAUTION. As it is considered an important observation it is being quoted here for reference, Quote

"***Caution:***

The Norwegian Accident Investigation Board has recently published a report on 'Winter Operations, Friction Measurements and Conditions for Friction Predictions'. The report is based on findings from 30 incidents that have occurred on contaminated runways over the last 10 years in Norway. The report highlights a number of safety indicators from its findings, one of these is the '3-Kelvin-Spread Rule'1. The rule states that at air temperatures of +3°C and below, with a dew point spread of 3ºC or less, the runway surface condition may be more slippery than anticipated on snow and ice. The narrow dew point spread indicates that the air mass is relatively close to saturation which is often associated with actual precipitation, intermittent precipitation, nearby precipitation or fog. How these atmospheric conditions affect braking action is not considered by the rule, however, many of the incidents highlighted in the Norwegian report which relate to insufficient friction were linked to precipitation or deposition of water, liquid or frozen. The validity of the rule may depend on its correlation with precipitation but it may also, at least in part, depend on the exchange of water at the air-ice interface. The rule was observed in 21 out of the 30 incidents related to braking action on ice and snow investigated by Norway. Due to the other variables involved such as surface temperature, solar heating and ground cooling or heating, a small spread does not always mean that the braking action will be poor. The rule may be used as an indicator of slippery conditions but not as an absolute. When these conditions exist it may be appropriate to factor the landing distance above and beyond those factors. Unquote.

2.4.3 It has been recognized that current SNOWTAM form (Annex 15) does not enable consistent reporting of runway contamination.

2.4.4 **EASA RuFAB, Volume 4, 'Operational Friction Measurement and Runway Condition Reporting'** has identified that review of SNOWTAM is required. Attachment C to this WP is referred.

2.4.5 The **Accident Investigation Board Norway (AIBN)** Report on Winter Operations, friction Measurements and Condition for Friction Predictions 2011, also highlights inadequacy of the current format of SNOWTAM in predicting the friction level. The executive Summary, Central Findings, para on Page 6/7 Quote "The uncertainty in predicting the correct friction level is also applicable to the estimation of the friction category from 1 to 5 as per ICAO SNOWTAM format. The figures in the ICAO SNOWTAM table showing measured friction values are in hundredths (1/100) and are independent of the type of friction measuring device that is used. AIP Norway describes the use of friction measuring devices in general and warns that the measurements are associated with such a high degree of uncertainty that the figures should not be reported to more than one decimal place (one tenth, 1/10). The figures from the SNOWTAM table are used in flight operations through the airlines' individual correlation curves/tables which further increases the uncertainty." Unquote.

2.4.6 In regard to definition of Dry runway vis-à-vis Damp runway, it is interesting to note here that during CAA, UK, Winter Runway Assessment Trial 2012/2013 – TRIAL PLAN, wherein an abbreviated version of TALPA ARC Matrix has been tested, a slightly different from ICAO definition of Dry Runway was used i.e. **Dry runway: "***For airplane performance purposes and use of this Table (abbreviated TAPLA ARC Matrix), a runway can be considered dry when no more than 25% of the runway surface area within the reported length and the width being used is covered by visible moisture or dampness"*. Whereas in Annex 6 and ICAO Circular 329, a Dry Runway is defined as *"A dry runway is one which is clear of contaminants and visible moisture within the required length and the width being used. Annex 14, Recommendation* 2.9.4 describes presence of water on runway/operational area surface which is damp as *--DAMP — the surface shows a change of colour due to moisture.*

2.4.7 So far many studies conducted on Runway Friction by various agencies and these have been **INCONCLUSIVE**, & presented **DIVERGENT** views. Based on the mandate given by APRAST that Champion to adhere to ICAO Format of reporting RCR and studies carried out by the AAI Team the following proposals are made.

3. PROPOSALS:

3.1 **Proposal 1**:

3.1.1 Current System of notification of 3 friction levels by States should continue i.e.

a) a design level;

b) a maintenance friction level; and

c) a minimum friction level below which the information that a runway may be SLIPPERY WHEN WET is to be included in NOTAM. This is acceptable in summer/summer like climatic conditions prevailing in APAC Region, where it can be used as all season reporting format.

3.2 **Proposal 2**:

3.2.1 Following qualitative and quantitative description of RCR may be used:

Reporting Term	Runway Surface Conditions
DRY	The surface is not affected by water, slush, snow, or ice. NOTE: Reports that the runway is dry are not normally to be passed to pilots. If no runway surface report is passed, pilots will assume the surface to be dry.
DAMP	The surface shows a change of colour due to moisture. NOTE: If there is sufficient moisture to produce a surface film or the surface appears reflective, the runway will be reported as WET.
WET	The surface is soaked but no significant patches of standing water are visible. NOTE: Standing water is considered to exist when water on the runway surface is deeper than 3mm. Patches of standing water covering more than 25% of the assessed area will be reported as WATER PATCHES.
WATER PATCHES	Significant patches of standing water are visible. NOTE; Water patches will be reported when more than 25% of the assessed area is covered by water more than 3mm deep.
FLOODED	Extensive patches of standing water are visible. NOTE: Flooded will be reported when more than 50% of the assessed area is covered by water more than 3mm deep.

Note: Qualitative description of runway surface indicators is given Annex14, and a quantitative description of runway surface condition indicators is given in Annex6, ICAO circular 329, possibly resulting into the discrepancies highlighted para 2.3.1. The above qualitative and quantitative description of runway surface condition indicators have been used in the CAA UK, CAP493, Manual of Air Traffic Services, Chapter 7 Wet Runways.

3.2.2 **Such description of runway condition indicators is expected to harmonize the utility of such indicators for ATS personnel, flight operations personnel, and the flight crew.**

3.3 **Proposal 3:**

3.3.1 Pilot Reports (PIREPs) provide likely braking action the aircraft may experience but these are subjective and aircraft & time dependent. However these are useful.

3.3.2 The ANSPs may continue to encourage PIREPs and their effective use by ATS/AIS personnel by spreading more and more awareness among industry personnel- the flight crew, flight operational personnel.

3.3.3 The ATC, after receiving PIREPs from preceding aircraft, shall pass to succeeding aircraft e.g.

- *"BRAKING ACTION REPORTED BY (aircraft type, AT (time) GOOD (or MEDIUM or POOR)"*.
- "AQUAPLANING REPORTED BY (aircraft type) AT (time).

3.3.4 ATC should also check PIREP with landed aircraft and pass to subsequent aircraft.

3.4 **Proposal 4**:

3.4.1 Whenever there are hazardous conditions due to snow, ice, slush or standing water associated with snow, slush and ice on the movement area, runway conditions may be reported by the airport operators using the following format: which is based on SNOWTAM and Winter Operations Plan 2012-13,Manchester Airport (available at magworld.co.uk/airfieldoperations)

Runway(designator) surface state is <u>Touchdown Zone</u> XX% coverage, cont aminant Type, Depth XXX mm <u>Mid-Point</u> XX% coverage, Contaminant Type, Depth XXX mm <u>Stop End</u> XX% coverage, Contaminant Type, Depth XXX mm" + Estimated Braking Action is Good, Medium/Good, Medium, Medium/Poor, Poor or Unreliable

3.4.2 ATC shall report on Radio Telephony or through ATIS to flight crew of subsequent flight/s.

3.4.3. When hazardous conditions due to snow, ice, slush or standing water associated with snow, slush and ice are existing on the movement area, SNOWTAM should also be issued in such conditions.

3.5 **Proposal 5:**

3.5.1 The report on Runway Surface Conditions when runway is contaminated should be made available to flight crew at the earliest through NOTAM, ATIS or ATC.

3.5.2 For timely reporting of surface conditions of a contaminated runway by ATC/AIS to flight crew, the Runway Inspection Team (RIT) should pass the runway inspection report on runway condition as soon as possible after the runway inspection. Assessments should be repeated whenever conditions change and in any case 15 minutes before the first movement following any closure of runway.

3.5.3 The ATS/AIS should pass the runway inspection report on runway surface conditions to flight crew as soon as possible, preferably

i) Either before dispatch of Departing Traffic destined for *this airport*- through NOTAM or ATIS (which is accessible through telephone lines also); and

ii) Updated information to be provided again, – PREFERABLY before arriving aircraft establishes final approach track and departing aircraft taxi out.

3.6 **Proposal 6**:

3.6.1 In regard to communication medium used for timely and accurate reporting of runway surface conditions of a contaminated runway by Runway Inspection Team to ATC/AIS, Runway Inspection Team either may use vehicle mounted computerized systems to record the conditions and transmit the resulting report to the ATC/AIS via cellular modem/Wi-Fi/frequency or inform about

runway condition to ATC/AIS directly from runway using Radio Telephony (to SMC or TOWER if National Rules permit), Walkie –Talkie; Cell phones to Tower Supervisor (preferably recorded channel) or mail directly from Tester to all concerned.

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

a. Discuss the Proposals 1 through 6 for possible adoption in ICAO APAC Region.

b. Consider the Industry Best Practices Manual on Timely and Accurate Reporting of Runway Condition by ATS/AIS to Flight Crew for APAC Region for possible adoption by APAC Region.

c. Recommend that on publication of the Final Report of ICAO Friction Task Force, all the proposals mentioned above may fully aligned with the ICAO standards and recommendations and/or guidance material.

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I. DESCRIPTION OF RUNWAY SURFACE CONDITION

Annex 6, Attachment C, ICAO Circular 329(definitions)

***Runway surface condition*.** The state of the surface of the runway: either dry, wet, or contaminated:
a) *Contaminated runway*. A runway is contaminated when more than 25 per cent of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by:
— water, or slush more than 3 mm (0.125 in) deep;
— loose snow more than 20 mm (0.75 in) deep; or
— compacted snow or ice, including wet ice.
b) *Dry runway*. A dry runway is one which is clear of contaminants and visible moisture within the required length and the width being used.
c) *Wet runway.* A runway that is neither dry nor contaminated.
Note 1.— In certain situations, it may be appropriate to consider the runway contaminated even when it does not meet the above definition. For example, if less than 25 per cent of the runway surface area is covered with water, slush, snow or ice, butit is located where rotation or lift-off will occur, or during the high speed part of the take-off roll, the effect will be far more significant than if it were encountered early in take-off while at low speed. In this situation, the runway should be considered to be contaminated.
Note 2.— Similarly, a runway that is dry in the area where braking would occur during a high speed rejected take-off, but damp or wet (without measurable water depth) in the area where acceleration would occur, may be considered to be dry for computing take-off performance. For example, if the first 25 per cent of the runway was damp, but the remaining runway lengthways dry, the runway would be wet using the definitions above. However, since a wet runway does not affect acceleration, and the braking portion of a rejected take-off would take place on a dry surface, it would be appropriate to use dry runway take-off performance.
Annex 14,
Water on a runway
2.9.4 **Recommendation.—** *Whenever water is present on a runway, a description of the runway surface conditions on the centre half of the width of the runway, including the possible assessment of water depth, where applicable, should be made available using the following terms:*
DAMP — the surface shows a change of colour due to moisture.
WET — the surface is soaked but there is no standing water.
WATER PATCHES — significant patches of standing water are visible.
FLOODED — extensive standing water is visible.
2.9.5 Information that a runway or portion thereof may be slippery when wet shall be made available.
2.9.6 A runway or portion thereof shall be determined as being slippery when wet when the measurements specified in10.2.3 show that the runway surface friction characteristics as measured by a continuous friction measuring device are below the minimum friction level specified by the State.
Note.— Guidance on determining and expressing the minimum friction level is provided in Attachment A, Section 7.
2.9.7 Information on the minimum friction level specified by the State for reporting slippery runway conditions and the type of friction measuring device used shall be made available.

2.9.8 **Recommendation.—***When it is suspected that a runway may become slippery under unusual conditions, then additional measurements should be made when such conditions occur, and information on the runway surface friction characteristics made available when these additional measurements show that the runway or a portion thereof has become slippery.*

Snow, slush or ice on a runway

Note 1.— The intent of these specifications is to satisfy the SNOWTAM and NOTAM promulgation requirements contained in Annex 15.

Note 2.— Runway surface condition sensors may be used to detect and continuously display current or predicted information on surface conditions such as the presence of moisture, or imminent formation of ice on pavements.

2.9.9 **Recommendation.—***Whenever a runway is affected by snow, slush or ice, and it has not been possible to clear the precipitant fully, the condition of the runway should be assessed, and the friction coefficient measured.,*

Note.— Guidance on determining and expressing the friction characteristics of snow- and ice-covered paved surfaces is provided in Attachment A, Section 6.

2.9.10 **Recommendation.—***The readings of the friction measuring device on snow-, slush-, or ice-covered surfaces should adequately correlate with the readings of one other such device.*

Note.— The principal aim is to measure surface friction in a manner that is relevant to the friction experienced by an aircraft tire, thereby providing correlation between the friction measuring device and aircraft braking performance.

2.9.11 **Recommendation.—** *Whenever dry snow, wet snow or slush is present on a runway, an assessment of the mean depth over each third.*

II. ASSESSMENT OF RUNWAY SURFACE CONDITIONS

Airport Services Manual DOC 9137 Part II – Pavement Conditions

1.3 Need For Assessment of Runway Surface Conditions

1.3.1 Runway surface friction/speed characteristics need to be determined under the following circumstances:

a) the dry runway case, where only infrequent measurements may be needed in order to assess surface texture, wear and restoration requirements;

b) the wet runway case, where only periodical measurements of the runway surface friction characteristics are required to determine that they are above a maintenance planning level and/or minimum acceptable level. In this context, it is to be noted that serious reduction of friction coefficient in terms of viscous aquaplaning can result from contamination of the runway, when wet, by rubber deposits;

c)the presence of a significant depth of water on the runway, in which case the need for determination of the aquaplaning tendency must be recognized;

d)the slippery runway under unusual conditions, where additional measurements should be made when such conditions occur;

e) the snow-, slush-, or ice-covered runway on which there is a requirement for current and adequate assessment of the friction conditions of the runway surface; and

f) the presence and extent along the runway of a significant depth of slush or wet snow (and even dry snow), in which case the need to allow for contaminant drag must be recognized.

Note.— Assessment of surface conditions may be needed if snowbanks near the runway or taxiway are of such a height as to be a hazard to the aeroplanes the airport is intended to serve. Runways should also be evaluated when first constructed or after resurfacing to determine the wet runway surface friction characteristics.

1.3.2 The above situations may require the following approaches on the part of the airport authority:

a)for dry and wet runway conditions, corrective maintenance action should be considered whenever the runway surface friction characteristics are below a maintenance planning level. If the runway surface friction characteristics are below a minimum acceptable friction level, corrective maintenance action must be taken, and in addition, information on the potential slipperiness of the runway when wet should be made available (see Appendix 5 for an example of a runway friction assessment programme);
b) for snow- and ice-covered runways, the approach may vary depending upon the airport traffic, frequency of impaired friction conditions and the availability of cleaning and measuring equipment. For instance: at a very busy airport or at an airport that frequently experiences the conditions of impaired friction —adequate runway cleaning equipment and friction measuring devices to check the results;
2) at a fairly busy airport that infrequently experiences the conditions of impaired friction but where operations must continue despite inadequate runway cleaning equipment — measurement of runway friction, assessment of slush contaminant drag potential, and position and height of significant snowbanks; and
3) at an airport where operations can be suspended under unfavourable runway conditions but whereas warning of the onset of such conditions is required — measurement of runway friction, assessment of slush contaminant drag potential, and position and height of significant snowbanks.

III Information on runway surface to flight crew.

PANS ATM Doc 4444

6.6 Information fFor Arriving Aircraft

Note.— See Chapter 11, 11.4.3, regarding flight information messages.

6.6.1 As early as practicable after an aircraft has established communication with the unit providing approach control service, the following elements of information, in the order listed, shall be transmitted to the aircraft, with the exception of such elements which it is known the aircraft has already received:
a) meteorological information, as follows:
1) surface wind direction and speed, including significant variations;
2) visibility and, when applicable, runway visual range (RVR);
3) present weather;
4) cloud below 1 500 m (5 000 ft) or below the highest minimum sector altitude, whichever is greater; Cumulonimbus; if the sky is obscured, vertical visibility when available;
5) air temperature;
6) dew point temperature, inclusion determined on the basis of a regional air navigation agreement;
7) altimeter setting(s);
8) any available information on significant meteorological phenomena in the approach area; and
9) trend-type landing forecast, when available.

Note.— The meteorological information listed above is identical to that required in ATIS broadcasts for arriving aircraft as specified in Annex 11, 4.3.7 j) to r), and is to be extracted from local meteorological routine and special reports, in accordance with Chapter 11, 11.4.3.2.2 to 11.4.3.2.3.

b) current runway surface conditions, in case of precipitants or other temporary hazards;

c) changes in the operational status of visual and non-visual aids essential for approach and landing.

6.6.2 In applying the provisions in 6.7.3.1.1, it should be recognized that information published by NOTAM or disseminated by other means may not have been received by the aircraft prior to departure or during en-route flight.
6.6.3 If it becomes necessary or operationally desirable that an arriving aircraft follow an instrument approach procedure or use a runway other than that initially stated, the flight crew shall be advised without delay.
6.6.5 During final approach, the following information shall be transmitted without delay:
a) the sudden occurrence of hazards (e.g. unauthorized traffic on the runway);
b) significant variations in the current surface wind, expressed in terms of minimum and maximum values;
c) significant changes in runway surface conditions;
d) changes in the operational status of required visual or non-visual aids;
e) changes in observed RVR value(s), in accordance with the reported scale in use, or changes in the visibility representative of the direction of approach and landing.

7.2 Selection of Runway-In-Use

7.2.1 The term "runway-in-use" shall be used to indicate the runway or runways that, at a particular time, are considered by the aerodrome control tower to be the most suitable for use by the types of aircraft expected to land or take-off at the aerodrome.
Note.— Separate or multiple runways may be designated runway-in-use for arriving aircraft and departing aircraft.
7.2.2 Normally, an aircraft will land and take off into wind unless safety, the runway configuration, meteorological conditions and available instrument approach procedures or air traffic conditions determine that a different direction is preferable. In selecting the runway-in-use, however, the unit providing aerodrome control service shall take into consideration, besides surface wind speed and direction, other relevant factors such as the aerodrome traffic circuits, the length of runways, and the approach and landing aids available.
7.2.3 A runway for take-off or landing, appropriate to the operation, may be nominated for noise abatement purposes, the objective being to utilize whenever possible those runways that permit aeroplanes to avoid noise-sensitive areas during the initial departure and final approach phases of flight.
7.2.4 Runways should not be selected for noise abatement purposes for landing operations unless they are equipped with suitable glide path guidance, e.g. ILS, or a visual approach slope indicator system for operations in visual meteorological conditions.
7.2.5 A pilot-in-command, prompted by safety concerns, can refuse a runway offered for noise-preferential reasons.
7.2.6 Noise abatement shall not be a determining factor in runway nomination under the following circumstances:
a) if the runway surface conditions are adversely affected (e.g. by snow, slush, ice, water, mud, rubber, oil or other substances);
b) for landing in conditions:
1) when the ceiling is lower than 150 m (500 ft) above aerodrome elevation, or the visibility is less than 1 900 m; or

2) when the approach requires use to be made of vertical minima greater than 100 m (300 ft) above aerodrome elevation and:
a) the ceiling is lower than 240 m (800 ft) above aerodrome elevation; or
b) the visibility is less than 3 000 m;
c) for take-off when the visibility is less than 1 900 m;
d) when wind shear has been reported or forecast or when thunderstorms are expected to affect the approach or departure; and
e) when the crosswind component, including gusts, exceeds 28 km/h (15 kt), or the tailwind component, including gusts, exceeds 9 km/h (5 kt).

9.1.3.7 TRANSMISSION OF INFORMATION TO SUPERSONIC AIRCRAFT

The following information shall be available at appropriate ACCs or flight information centres for aerodromes determined on the basis of regional air navigation agreements and shall be transmitted on request to supersonic aircraft prior to commencement of deceleration/descent from supersonic cruise:
a) current meteorological reports and forecasts, except that where communications difficulties are encountered under conditions of poor propagation, the elements transmitted may be limited to:
i) mean surface wind, direction and speed (including gusts);
ii) visibility or runway visual range;
iii) amount and height of base of low clouds;
iv) other significant information;
v) if appropriate, information regarding expected changes;
b) operationally significant information on the status of facilities relating to the runway-in-use, including the precision approach category in the event that the lowest approach category promulgated for the runway is not available;
c) Sufficient information on the runway surface conditions to permit assessment of the runway braking action.

	A	B	C	D	E	F	G	H	I	J
1	Question	Australia	Singapore	Malaysia	Thailand	Philipines	Qatar	Hong kong	Myanmar	India
2	Does the ATS/AIS Authority notify breaking action as GOOD/MEDIUM/POOR for wet, or contaminated runway (due to water or slush more than 3 mm deep, or loose snow more than 20 mm deep, or compacted snow or ice, including wet ice) ?	YES	YES	YES	YES	YES	YES	NO	YES	NO
3	Does the ATS/AIS Authority permit landing/departure on runway when the breaking action has been notified as POOR?	YES	No	YES	YES	YES	YES	YES	No	NO
4	Does the ATS/AIS Authority conveys Pilot Report on breaking action to subsequent arriving/departing flights?	YES	YES	YES	YES	YES	YES	YES	YES	YES

	A	B	C	D	E	F	G	H	I	J
5	Copy of NOTAM – whereby – the information – **Runway surface may be slippery when wet** – has been promulgated.	There is no published information for Sydney	Such NOTAM will only be promulgated if the friction value falls to 0.34 or less	NO	There is no notam containing the informatio n" runway surface may be slippery when wet" has been issued	N/A	None	N/A	A1713/11 1111220910/1112231 200 EST RWY RWY 03/21 LIABLE TO BE SLIPPERY WHEN WET. THE VALUE OF COEFFICIENT OF FRICTION IS BLW THE NOTIFIED VALUE OF 0.5 FOR RWY 03/21 IN SECTION AS BLW :- RWY03 BTN 200M AND 400M RWY21 100M FROM THRESHOLD	N/A
6	Sample text of ATIS Broadcast, if the information on runway friction level is passed to flight crew/airlines through ATIS broadcast.	N/A	No ATIS broadcast, once braking action is deemed to be MEDIUM or worse, ATC will inform all aircrafts through the RTF.	NOT Boardcasted	there is no ATIS broadcast containing the informatio n on runway friction level	N/A	N/A	N/A	NO	TO BE PROVIDED BY AAI
7	Copy of Snow Plan as per AIP AD 1.2.2	NONE	N/A	The airport lies in the tropic	N/A	N/A	N/A	N/A	N/A	N/A

	A	B	C	D	E	F	G	H	I	J
8	Sample SNOWTAM issued by ATS/AIS Authority	NONE	N/A	The airport lies in the tropic	N/A	N/A	N/A	N/A	N/A	N/A
9	In case of water patches on runway, depth of water patches is also measured? For example less than 3 mm or greater than 3 mm.	Friction levels are determined by CFME only – no additional testing of water depth undertaken (all runways are grooved).	N/A	NO	The airport operator has not got the device to measure the depth of water patches on runway		NO	N/A		NO
10	What is the minimum depth of standing water or flowing water is reported? For example less than 3 mm or greater than 3 mm.	N/A	N/A	N/A	The airport operator has not got the device to measure the depth of water patches on runway	none	NO	N/A		NOT REPORTED

	A	B	C	D	E	F	G	H	I	J
11	Does the ATS/AIS Authority report runway surface condition as DAMP, WET , WATER PATCHES, FLOODED (refer Annex 14, Volume 1, Aerodrome Design, & Operations, Chapter 2, paragraph 2.9.4 – or Water Patches are not notified and instead runway is flooded is reported).	YES	YES, ATS will broadcast the runway surface condition on the ATIS as WET or DAMP only. Water patches or flooded is not reported.	YES	YES	YES	YES- wet only	YES	YES	REPORTED ON DATIS/RT
12	Does the ATS/AIS Authority notify the three friction levels, in accordance with ICAO Doc 9137 Part 2 Chapter 3, paragraph 3.2.11, as follows:					NO	YES			YES
13	Does the Airport Authority determine friction level accordance with ICAO Doc 9137 Part 2 Chapter 3, paragraph 3.2.13, as follows:					NO	YES			YES

	A	B	C	D	E	F	G	H	I	J
14	How the friction coefficient is reported in the NOTAM. Please specify	NOT reported	Friction Coefficient is not reported in the NOTAM.	The airport Authority conducts friction tests once in a week.if coefficient falls below the mantenance level, it is reported by hand to AIS for notam action.	NO	N/A		friction coefficient not reported	No Friction coefficient is reported	Will be reported if falls below 0.34
15	Does the Airport Authority report the mean depth of contaminant over each third segment of the runway to ATS/AIS for notification, in accordance with ICAO Doc 9137 Part 2 Chapter 4, paragraph 4.2.9.	NOT reported	NO	YES	NO	NO	YES	NO	YES	NO
16	Does ATS/AIS Authority notify friction coefficient for each third of the runway.	NO	NO	YES, if it falls below maintenance level	NO	NO	YES	YES	YES	NO

	A	B	C	D	E	F	G	H	I	J
17	What is the periodicity of runway friction measurement to assess the friction level of busiest runway?	Runway 16R/34L – monthly Runway 16L/34R – 3 monthly Runway 07-25 – 6 monthly	Friction test is carried out once per week on both sides of the runway, but requires 1 month for the completion of report. (ie. 1st week - 3m left/right of centreline, 2nd week - 6m left/right centreline etc)	Once a week	weekly		monthly	Once every ten days		Bimonthly
18	Type of friction measuring devices used: tick one									

	A	B	C	D	E	F	G	H	I	J
19	How frequently the rubber deposit is removed. refer Annex 5	Depends on the results of CFME testing but could be up to 3 times p/a for the busiest runways to annually for the least busy.	Removal of rubber deposit is carried out once a month on each runway during the monthly scheduled 6 hours closure of runway for maintenanc e at night between 1700 to 2300UTC.	Once every three months or when required	approxima tely once per 2 days for each runway		At least every six months	Atleast twice a year	Rubber deposit removal will be carried out once a year.	RWY 29- Thrice a week RWY 28- Twice a week RWY 27 - Once a week
20	How much time it takes to transmit the friction value from Runway Friction Assessment team to the ATC/AIS.	N/A	Immediate	Three hours	There is no procedure to transmit the runway friction assesment result to ATC or AIS		immediate	less than one minute	ONE HOUR	Within 0100 hrs

	A	B	C	D	E	F	G	H	I	J
21	What means are employed to send the information on friction value to ATC/AIS. Telephone/FAX/email/ Radio telephony/electronically straight from runway/ if any others - please specify	N/A	Telephone, Radio Telephony (For immediate info to ATC) Fax, Email (For follow up action by the respective authority and disseminatio n to other units)	By Hand			Radio	radio telephony from the assessment team	Telephone/radio telephone	Radio telephony
22	Please provide copy of SNOWTAM in which Item 'T' contains extent of contaminants/deposits relative to the total area of runway in %.		N/A	The airport lies in tropics		N/A	N/A	N/A	N/A	N/A
23	Does the ATS/AIS Authority follow ICAO NOTAM Codes to notify such contaminants as mentioned at Sl No. 25 above.	YES	YES	yes, if such type of notams need to be sent out	There is no notam to notify the runway contanima nts has been issued		N/A	N/A	YES	YES

	A	B	C	D	E	F	G	H	I	J
24	Any other information on Runway condition reporting methods that may be shared to Develop a set of Best Industry Practices.	Visual pavement inspectionsT exture depth testing	NIL	None			N/A	NIL	NO	N/A
25	Remarks: please provide a few examples of each type of NOTAM issued on Runway Surface Condition Reporting.		NIL				N/A	No notams issued		

EASA-RUFAB: - European Aviation Safety Agency-- Runway Friction Characteristics Measurement and Aircraft Braking, Volume 4 – Operational Friction

4.3 Reporting Formats Including the ICAO SNOWTAM

4.3.1 SNOWTAM

4.3.1.1 Discussion

There are advantages in unifying the format in which winter runway conditions are provided to carriers and pilots by AIS NOTAM. SNOWTAM, NOTAMJ (Canada), and other NOTAM formats referring to transient winter runway conditions have varying degrees of detail. CAAs' differing interpretation of condition reporting requirements have resulted in varying instructions to airport and AISs regarding content and structure of airport reports and NOTAMS. The fundamental differences are in the level of detail to be reported and in the requirement to report conditions either by runway third or for the entire runway with locational exceptions reported in detail. A unified interpretation of air carriers' and pilots' need for information would be required to completely harmonize the reporting format and provide a practical output. The following steps are recommended:

(a) Such a harmonizing process should have, as its first step, a definitive declaration of the runway information required by carriers and pilots to assess aircraft performance. Once the required information is defined the reporting formats used in various jurisdictions can be tailored to address them.

(b) One methodology for achieving such a harmonization goal would include the following steps:

(i) Define the reportable contaminant parameters such as type, depth, location, etc.;

(ii) Mandate the reporting of location of conditions by runway third or for entire runway with exceptions or to allow for either;

(iii) Choose to provide for reporting of runway friction (mandatory or advised) or not;

(iv) Review the international SNOWTAM protocol to confirm or amend the required runway condition data elements and accuracy;

(v) Provide a sample runway condition reporting format, including all required data elements, for airport use or interpretation;

(vi) Require all airports to report conditions to AISs using as a minimum, the sample runway condition reporting format;

(vii) Provide detailed guidance to airports on minimum runway condition report requirements, structure, interpretation, preparation and frequency; and

(viii) Provide detailed guidance to AISs on transposing airport runway condition reports to SNOWTAM.

4.3.1.2 Potential Changes to the Current SNOWTAM Format

The current ICAO SNOWTAM reporting requirements (Figure 2.1, in Section 2) do not fully respond to those as stated by carriers and pilots to date, nor are they consistent with definitions and requirements stated elsewhere in ICAO for determination of aircraft performance or with direction to airports for reporting of conditions.

As part of the response to many of the project requirements, this report recommends that aircraft manufactures and aircraft operators should state their requirements for runway condition information. For the SNOWTAM format to be fully in tune with these requirements, the preceding step must be completed. In the absence of fully definitive requirements information from aircraft manufacturers and based upon current knowledge the following changes are recommended to SNOWTAM submittal instructions to airports:

(a) Change wording of items 'D' and 'E' from 'CLEARED' to 'MAINTAINED' to better reflect status.

(b) Within item 'E', provide format for defining runway centerline off-set (if any).

(c) Within item 'E', change off-set direction indicator from L/R to magnetic heading to reduce potential for confusion.

(d) Subdivide item 'F' to provide the following information:

(i) Deposits over each third of maintained width of runway; and

(ii) Deposits over un-maintained width, subdivide runway sides by magnetic heading if significantly different conditions exist on each.

(e) Substitute current list of conditions in item 'F' with agreed definitions as listed elsewhere in ICAO Annex 14.

(f) Harmonize friction/braking action values in item 'H' with outcome from ICAO Friction Task Force findings, if different.

(g) Substitute designation magnetic headings in place of 'L', 'R', and 'LR' for location of snow banks in item 'J'.

(h) Provide means to describe longitudinal location of snowbanks in relation to thresholds or other geographic locators in item J.

(i) Updated guidance should be provided on reporting layered contaminants.

(j) Updated guidance should be provided on completion of each section.

(k) Updated guidance should be provided on distinguishing between the type of information to be entered into items 'N', 'P' and 'R' and that entered into item 'T'.

An example graphical depiction of a practical information collection form to be completed by RIs at the end of an inspection together with suitable direction on interpretation would be of value to airports as guidance in amending their surveying and reporting protocols.