Ministry of Land, Infrastructure, Transport and Tourism
CIVIL AVIATION BUREAU 0F JAPAN

Runway Status Lights (RWSL) in Japan

July 2015

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What is Runway Status Lights (RWSL)

・Runway Status Lights (RWSL) is a system where a warning is generated by aeronautical ground lights, to an aircraft intending to take-off or an aircraft/vehicle intending to cross a runway whenever another aircraft/vehicle is occupying the runway.

・Features of a RWSL System
It is a system where Runway Entrance Lights (REL) or Take-off Hold Lights (THL) are illuminated or extinguished, automatically and independent of air traffic control instructions.

Its purpose is to prevent accidents resulting from runway incursions by providing a visual warning to the pilot.

Background on the Introduction of RWSL

- ✈ **Since September 2007, several runway incursions occurred at airports where there are converging points in ground movements**
- ✈ **Dec. 2007 - "Runway Incursion Prevention Review Committee" was formed to review preventive measures**
- ✈ **Mar. 2008 – Determined to proceed with considering the development of the RWSL as an additional visual support to the pilots**
- ✈ **With the cooperation of the U.S. FAA, commenced research activities of the RWSL which was under trial operations at Dallas Forth Worth and San Diego**
- ✈ **Since fiscal year 2009, development of the light fixtures for the implementation of RWSL progressed together with a phased trial operations**
- ✈ **It was determined that there were favorable results from the trial operations with a consequential decision to proceed with the full operation of the RWSL.**

Concept for Installing RWSL

> **RWSL (THL, REL) will be provided at a runway where aircraft routinely crosses the runway. (In other words, RWSL will not be installed on runways where are no aircraft crossing during normal operation.)**

> **REL will be provided on busy taxiways with heavy usage and connecting to the above-mentioned runways.**

> **As to the provision of THL, it will not be limited to full length departures but intersection departure will also be subject to the provision**

> ***However, intersection departure can be requested and accepted even if THL has not been provided.**
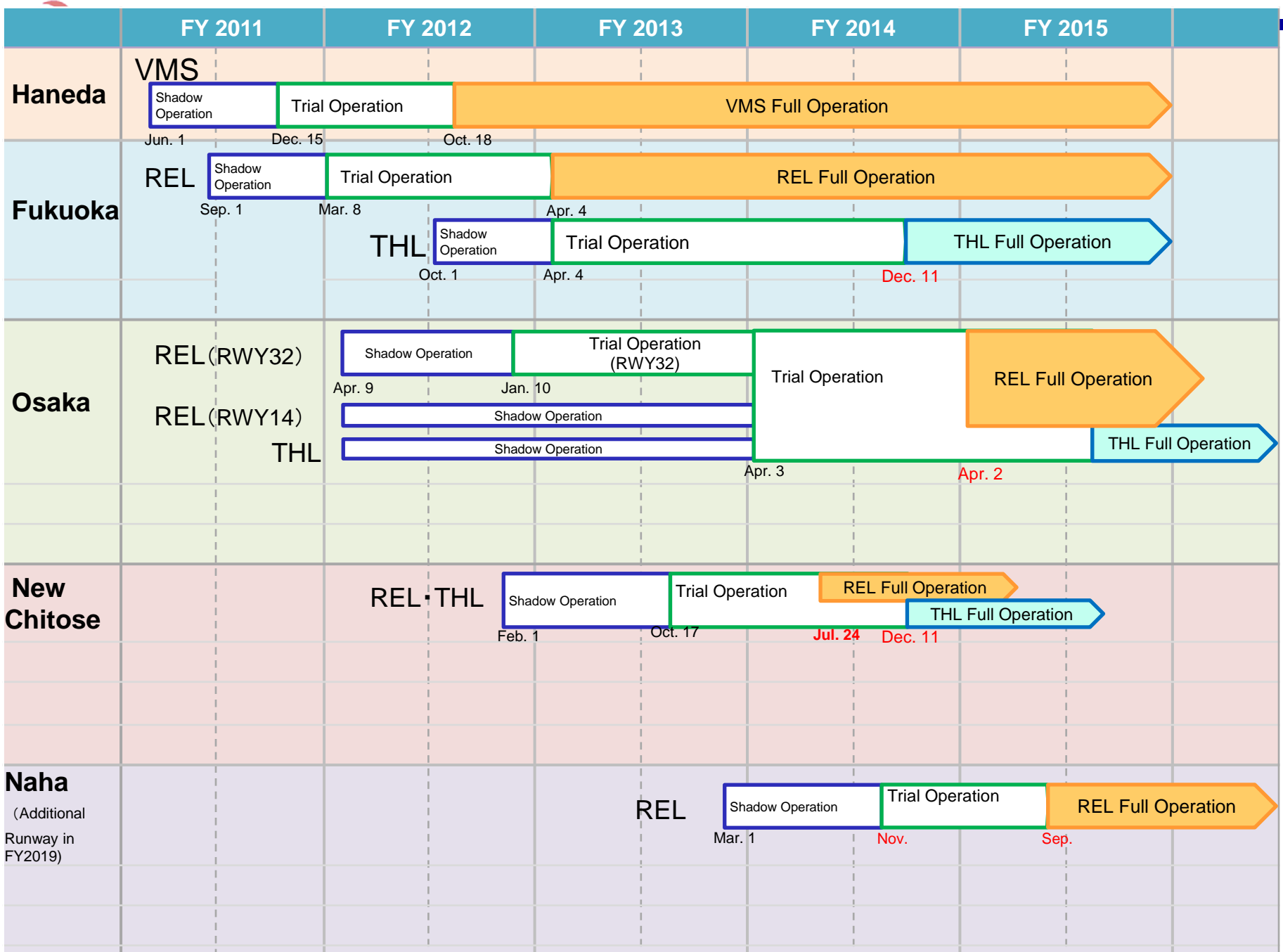
➜ Installations
- Apr. 2013   Fukuoka REL
- Dec. 2014   Fukuoka THL
- Jul. 2014   New Chitose REL
- Dec. 2014   New Chitose THL
- Apr. 2015   Osaka Int'l REL
- Oct. 2012   Tokyo Int'l (VMS)

➜ Trial Operations
- Osaka Int'l   THL
- Naha   REL

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015

Haneda
VMS
Shadow Operation — Jun. 1
Trial Operation — Dec. 15
VMS Full Operation — Oct. 18

Fukuoka
REL
Shadow Operation — Sep. 1
Trial Operation — Mar. 8
REL Full Operation — Apr. 4

THL
Shadow Operation — Oct. 1
Trial Operation — Apr. 4
THL Full Operation — Dec. 11

Osaka
REL（RWY32）
Shadow Operation — Apr. 9
Trial Operation (RWY32) — Jan. 10
Trial Operation
REL Full Operation

REL（RWY14）
Shadow Operation

THL
Shadow Operation — Apr. 3
THL Full Operation — Apr. 2

New Chitose
REL・THL
Shadow Operation — Feb. 1
Trial Operation — Oct. 17
REL Full Operation — Jul. 24
THL Full Operation — Dec. 11

Naha
（Additional Runway in FY2019)
REL
Shadow Operation — Mar. 1
Trial Operation — Nov.
REL Full Operation — Sep.

*VMS = Variable Message Sign   REL = Runway Entrance Lights   THL = Take-off Hold Lights*   5

# Overview: Basic Functions of RWSL

●Visual support for pilots

� Runway Entrance Lights (REL)：
Prevention of runway incursion

Runway Entrance Lights (REL) are installed at runway and taxiway intersections and flashes when an aircraft is moving or approaching the runway at the certain speed.
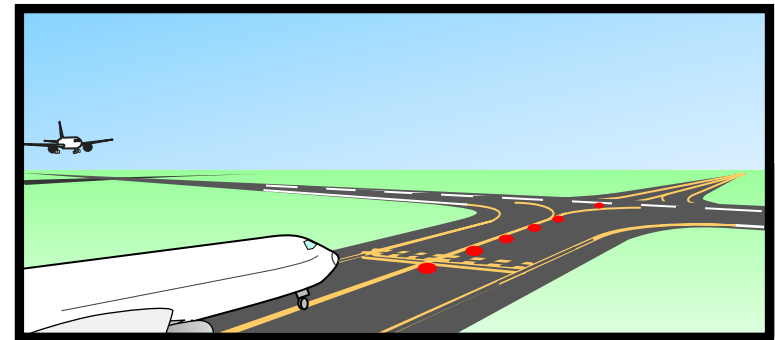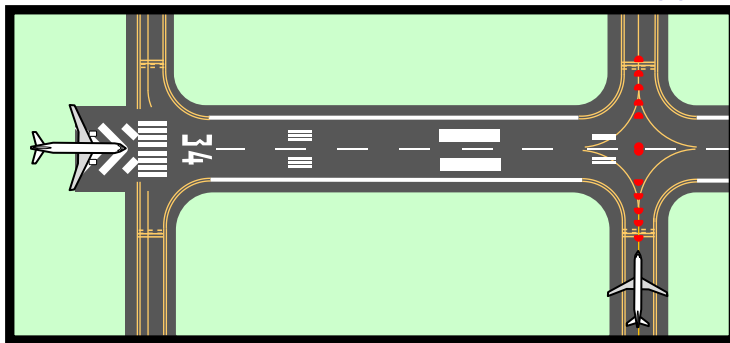
➤ Take-off Hold Lights (THL):
Prevention of an errant take-off

Take-off Hold Lights (THL) are installed in front of the take-off run at the starting position of the runway and flashes when the runway is occupied by other aircraft.
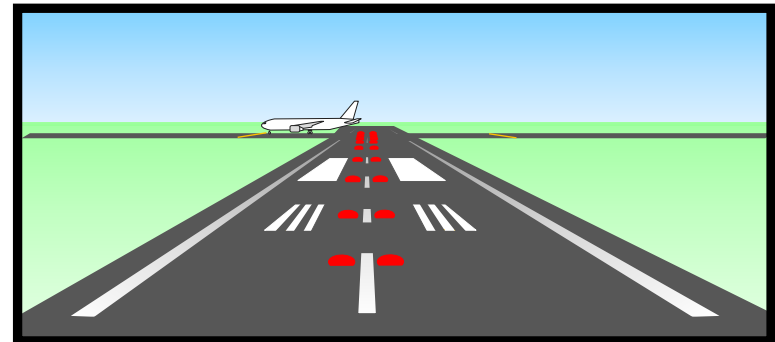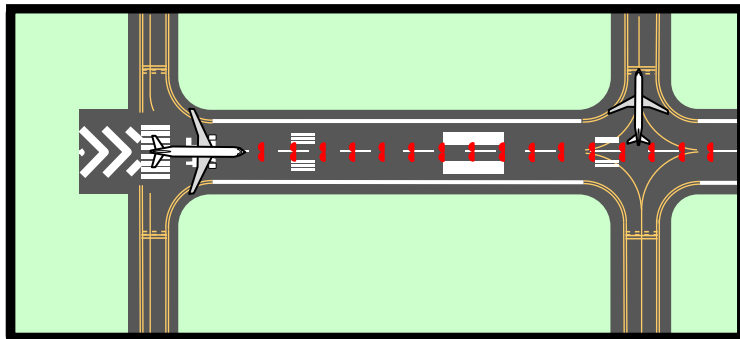
Overview : Examples of Runway Entrance Lights (REL) and Take-off Hold Lights (THL) (Animation)
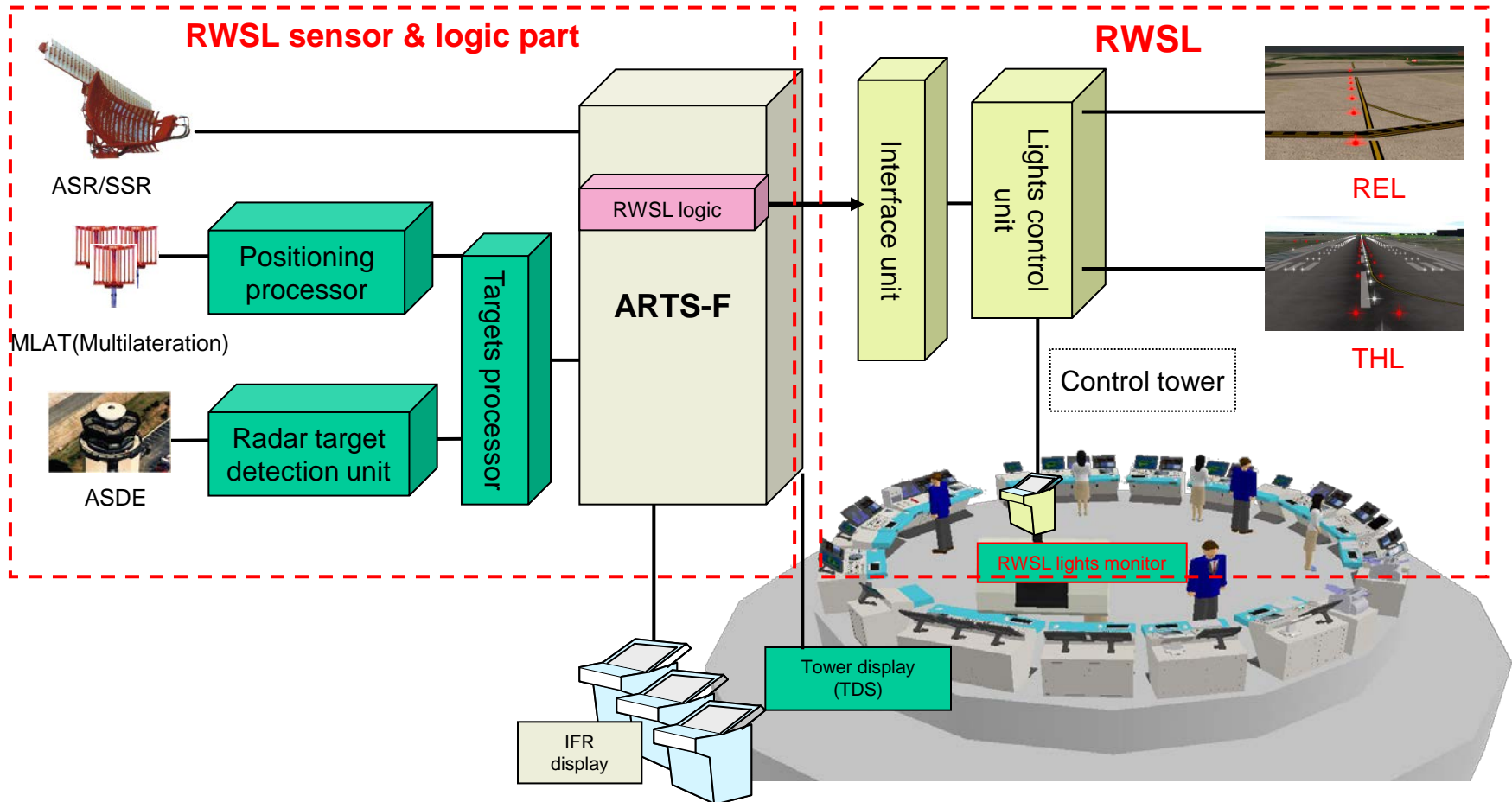

Example of REL and THL
(Osaka Int'l: Entering from C1 to take-off from A-RWY)

Example of VMS
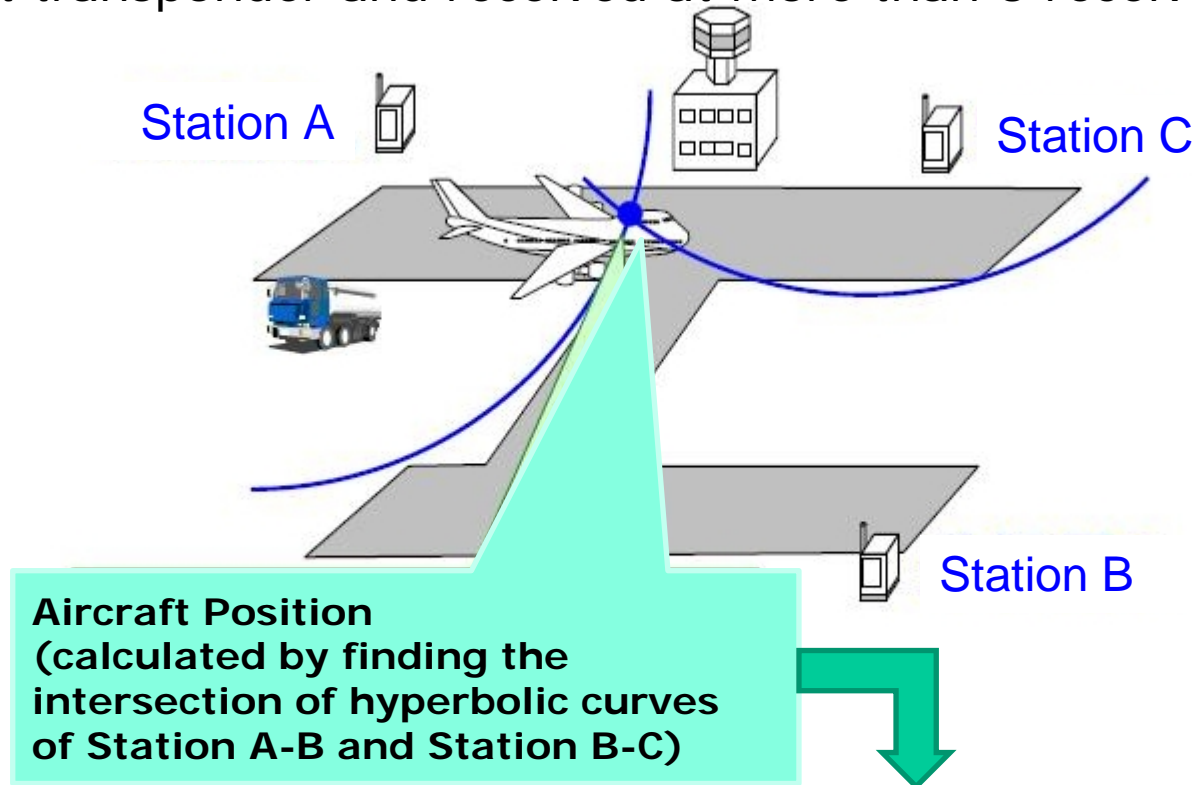（Haneda : Entering A2 to cross Runway A

Overview: Overall Structure of RWSL

Configuration of RWSL is shown below. Major sensor is MLAT and logic of turning on/off lights is executed in ARTS-F.

RWSL sensor & logic part

RWSL

ASR/SSR

MLAT(Multilateration)

ASDE

Positioning processor

Radar target detection unit

Targets processor

ARTS-F

RWSL logic

Interface unit

Lights control unit

REL

THL

Control tower

RWSL lights monitor

Tower display (TDS)

IFR display

Multilateration (MLAT)

Multilateration is a surveillance system which measures the aircraft position by the time difference of signals transmitted from the aircraft transponder and received at more than 3 receiving stations.

Station A

Station C

**Aircraft Position
(calculated by finding the
intersection of hyperbolic curves
of Station A-B and Station B-C)**

Station B

**MLAT system provides an improved dynamic surveillance capability
of aircraft on the airport surface. MLAT is also used for the RWSL.**
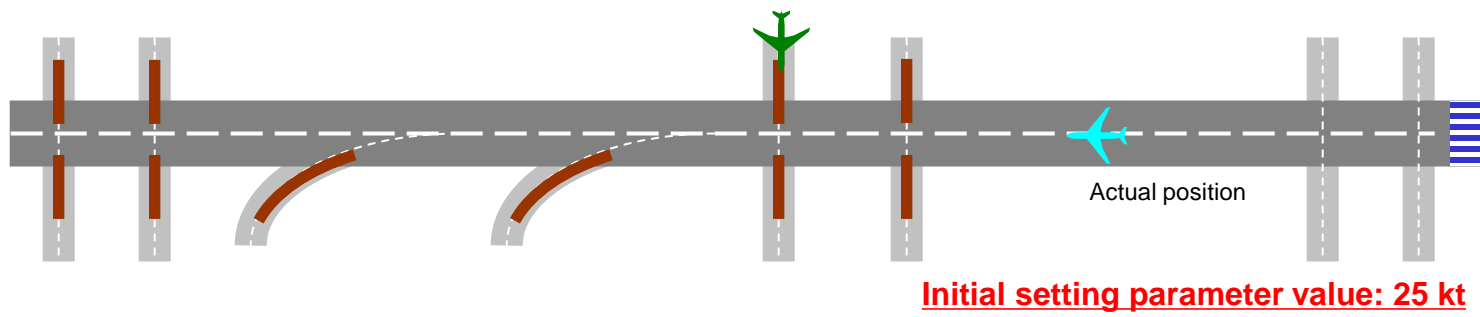
Basic Performance: Logic (ARTS-F) (1/4)

✈ REL (Runway Entrance Lights) (1/2)

- REL is installed at runway/taxiway intersections, turned on where there is an aircraft intending to take-off or approaching aircraft exists

- Condition for Turning on

    1. When approaching arrival aircraft comes close to fixed time (parameter) from runway end

Fixed time from RWY end
(Condition of turning on REL)

Initial setting parameter value: 48 seconds

Assumed 2 NM position at 150kt
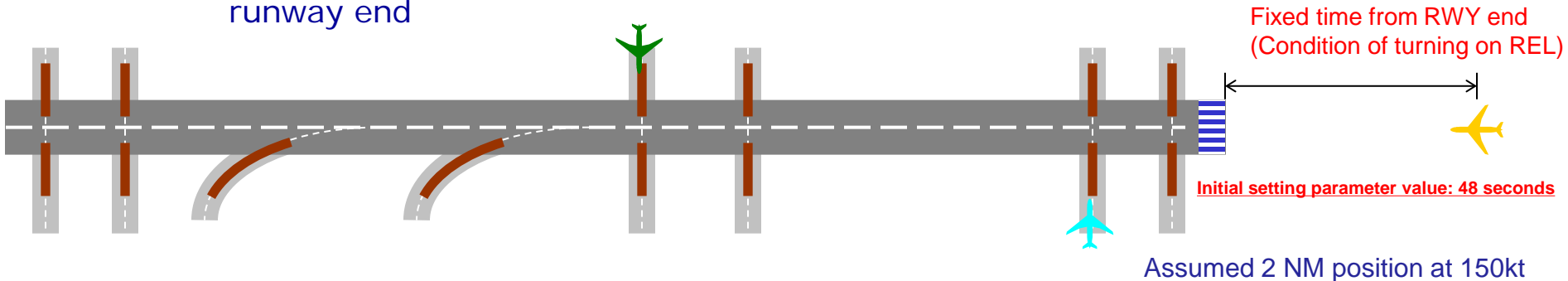
2. When departure aircraft's speed exceeds fixed value (parameter)

Actual position

Initial setting parameter value: 25 kt

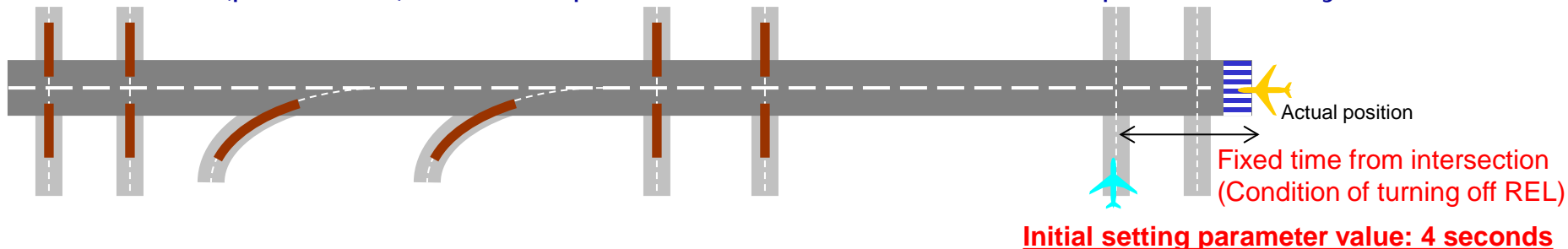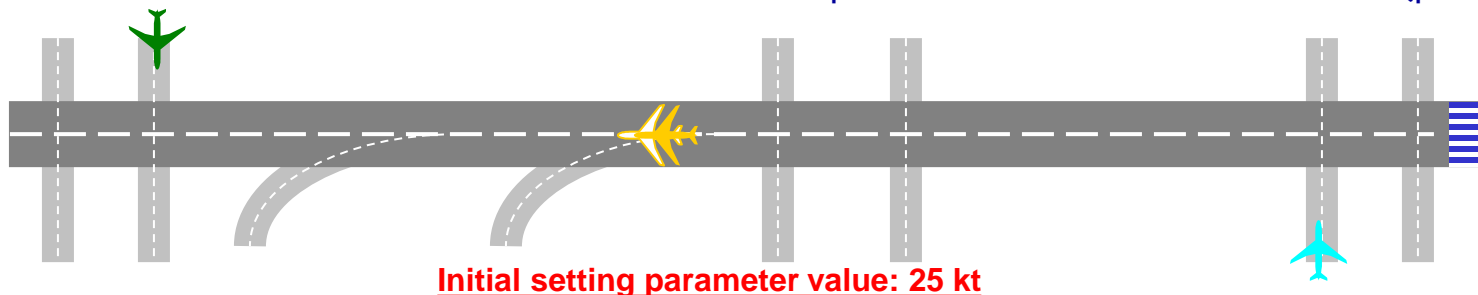# Basic Performance: Logic (ARTS-F) (2/4)

↗ REL (2/2)

- Condition for Turning off

1. Fixed time (parameter) before departure aircraft or arrival aircraft passes taxiway intersection

Actual position

Fixed time from intersection
(Condition of turning off REL)

Initial setting parameter value: 4 seconds

2. When landed arrival aircraft's speed is and under fixed value (parameter)

Initial setting parameter value: 25 kt

3. When altitude of take-off aircraft exceeds fixed value (parameter)

**Initial setting parameter value: 100ft**
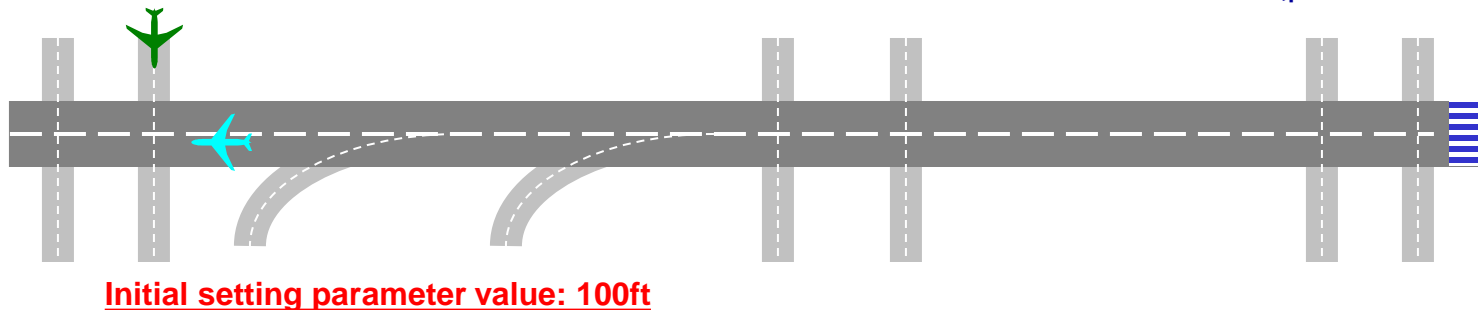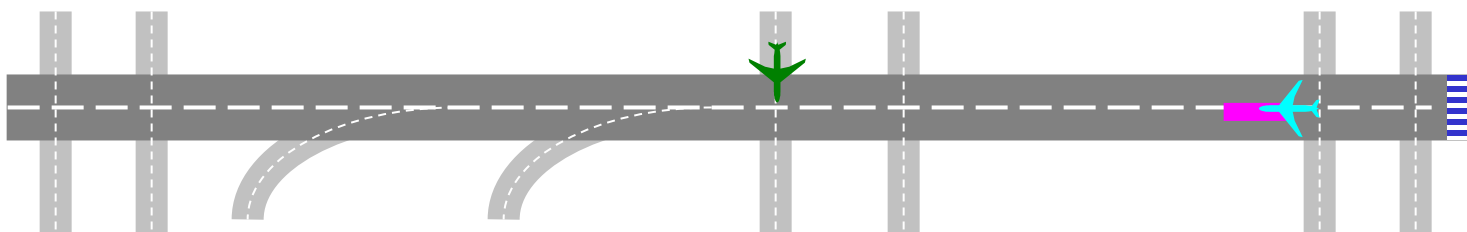
Basic Performance: Logic (ARTS-F) (3/4)

→ ## THL (Take-off Hold Lights)(1/2)

- THL is installed in front of take-off run starting position, turned on when another aircraft is occupying the runway in front of the aircraft taking off.
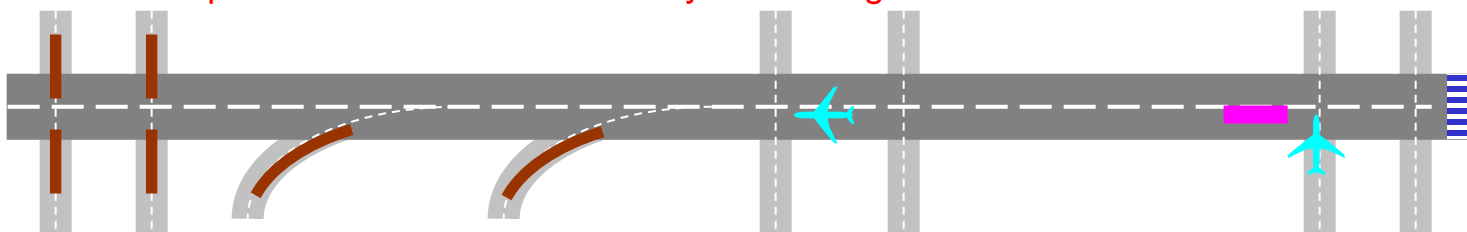- Condition for Turning On
  <u>When aircraft exists at take-off holding position</u> and other moving objects (aircraft or vehicle) exist on the runway
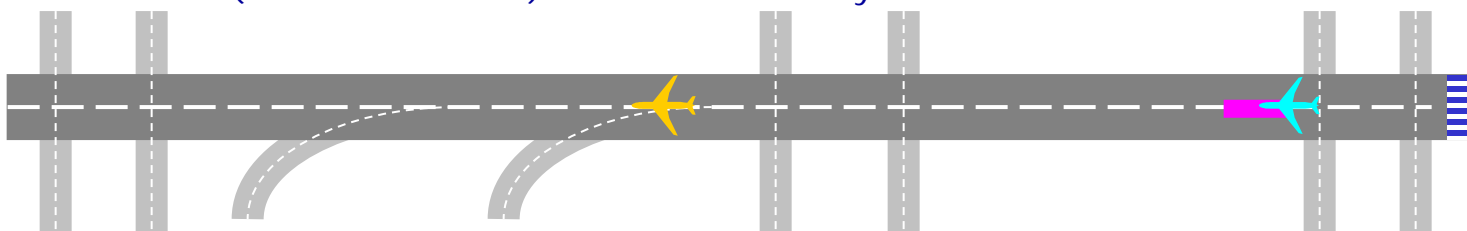
THL for subsequent departure aircraft is turned on by arrival aircraft

THL for departure aircraft is turned on by a crossing aircraft

Preceding departure aircraft is on the take-off roll and THL is turned on by subsequent departure aircraft entering the runway
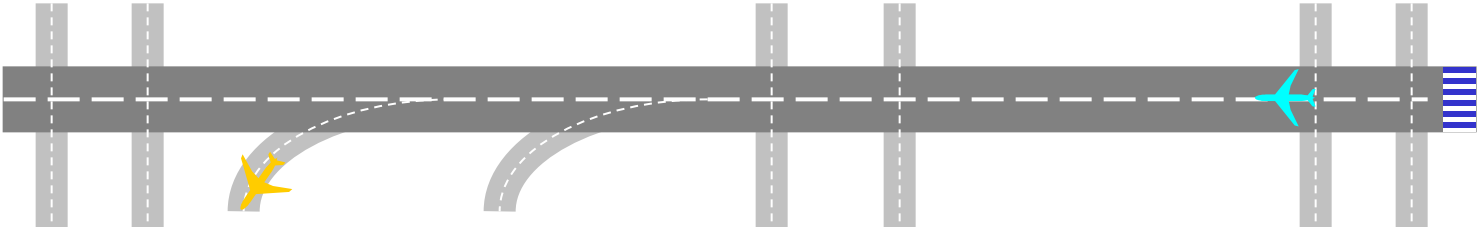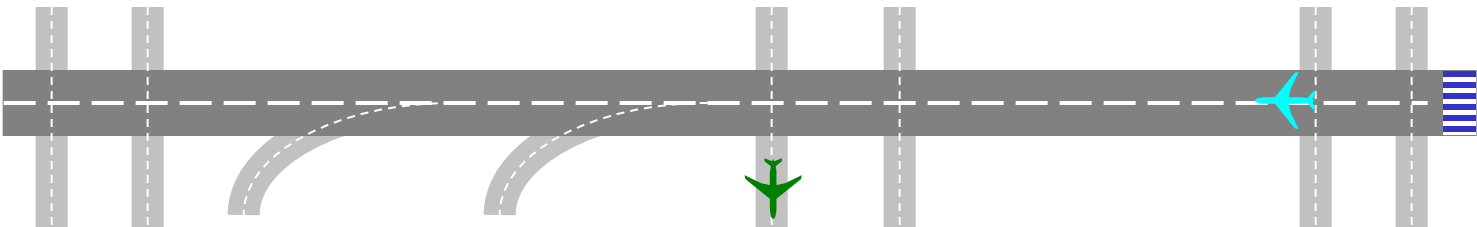
Basic Performance: Logic (ARTS-F) (4/4)

→ THL (2/2)
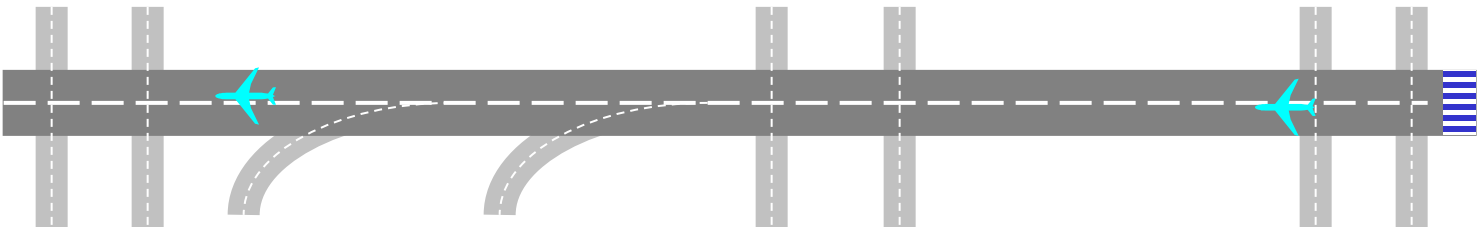- Condition for Turning Off
  When condition of turning on (previous slide) are resolved

THL for subsequent departure aircraft is turned off when system estimates that the arrival aircraft is leaving the runway

THL for departure aircraft is turned off when system estimates that an aircraft is finishing the crossing
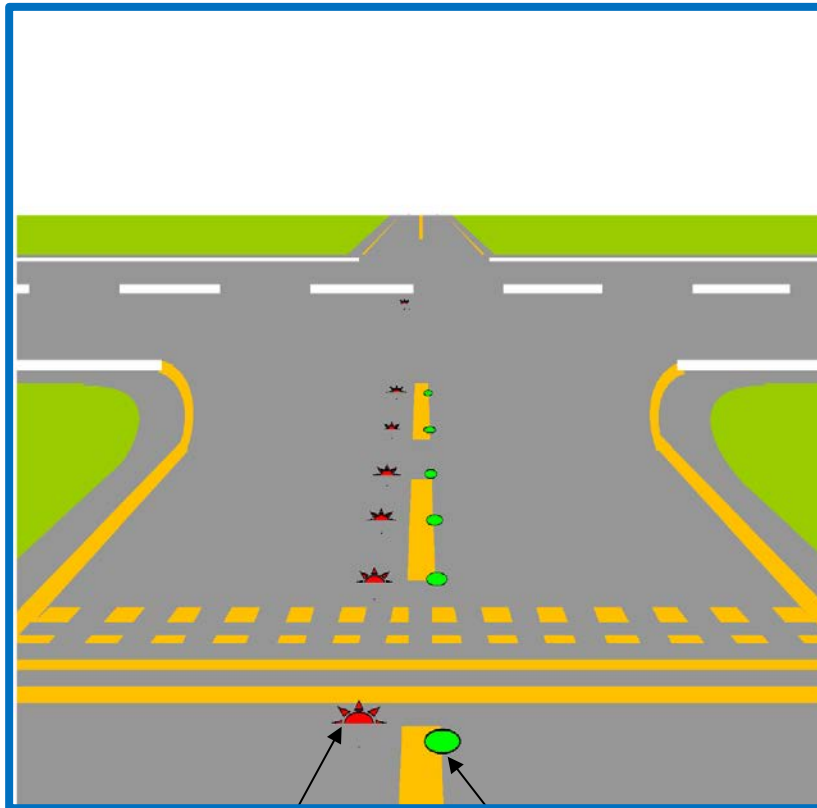
THL for subsequent departure aircraft is turned off when system detects the take-off of the preceding departure aircraft

Basic Performance: Lights (REL) (1/3)

(1) Installation image of REL

REL   Taxiway centerline lights

Runway Entrance Lights (REL)

・ REL is installed linearly from immediately before the runway holding position marking to runway center

  (REL is installed at almost equal intervals and under 15 m)

・ Lights' color is aviation red

・ Luminous intensity of lights is 200 cd (horizontal beam width: ±19.5°, vertical beam width: +1° - +10°, same as STBL (Stop Bar Lights))

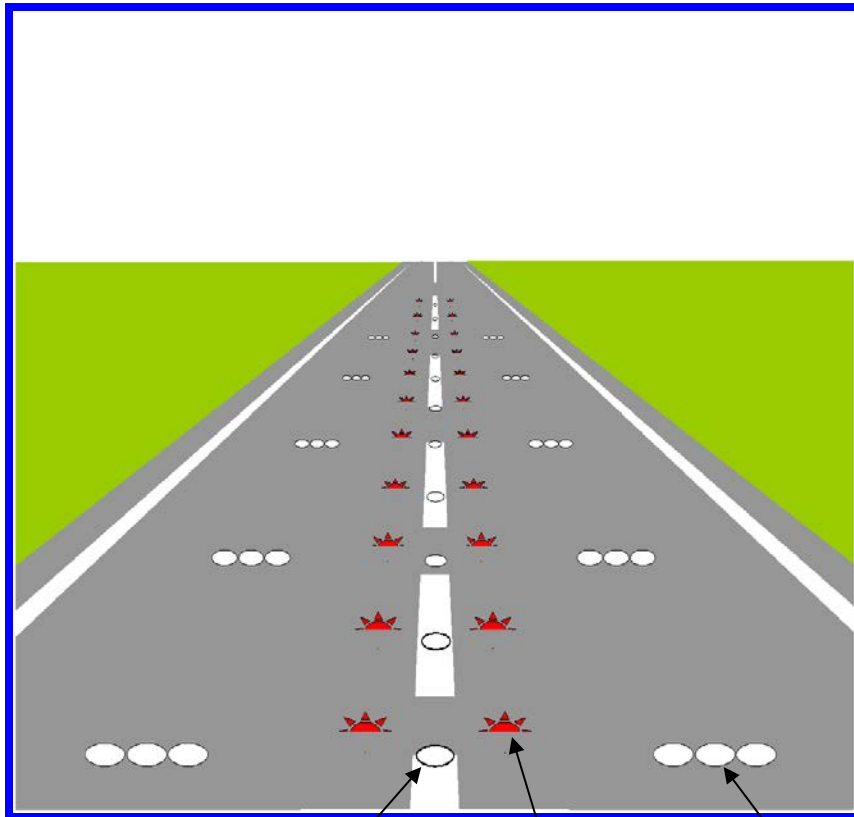・ As a system, quick response to turn on lights are required and lights installed are LED

REL at Osaka International (Itami, RJOO)

Basic Performance: Lights (THL) (2/3)

(2) Installation image of Take-off Hold Lights (THL)

Runway centerline lights   **THL**   Runway touchdown zone lights

Takeoff Hold Lights (THL)

- THL is installed both sides of runway center line and linearly parallel with direction of runway center line

  (THL is installed at almost equal intervals and under 30 m, 450 m per row)

- Lights' color is aviation red

- Luminous intensity of lights is 1500 cd (horizontal beam width: ±5°, vertical beam width: 0° - +9°, same as RCLL)

- As a system, quick response to turn on lights are required and lights installed are LED

THL at Fukuoka (RJFF)
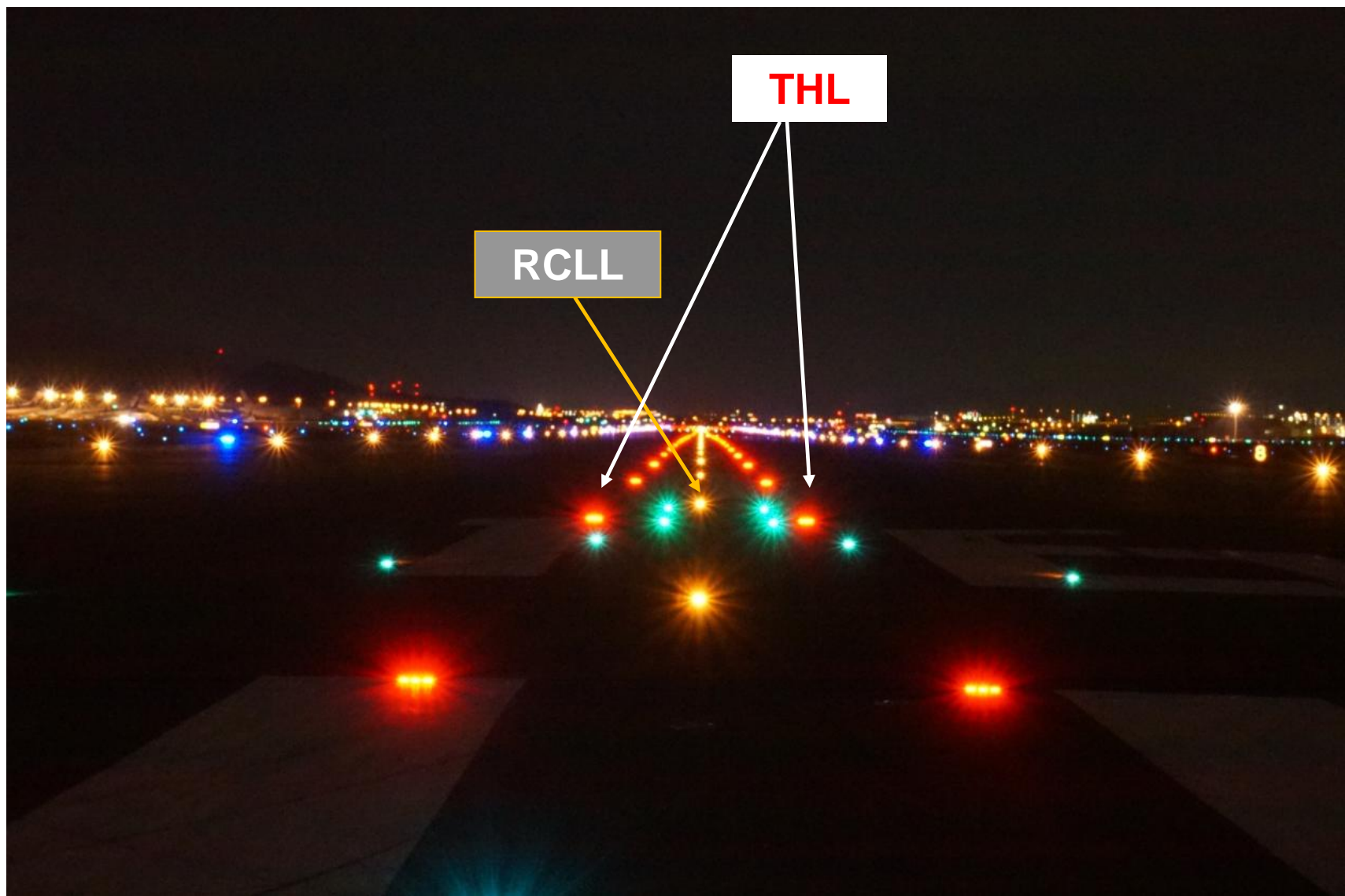
Basic Performance: Lights (VMS) (3/3)

(3) Installation image of Variable Message Signs (VMS)

Variable Message Sign (VMS)
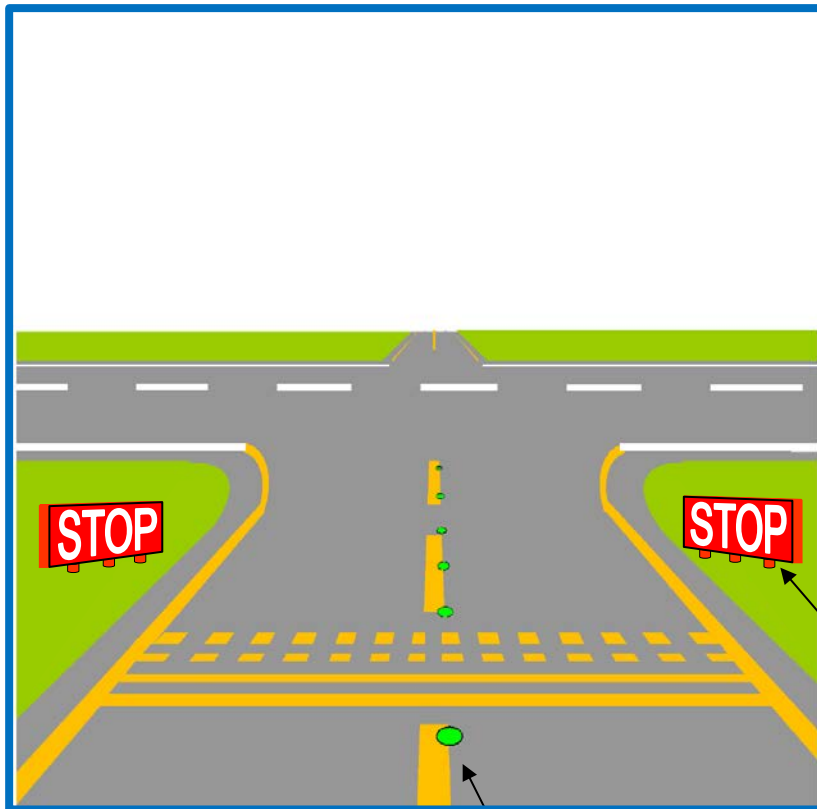
- VMS is installed at taxiway in the vicinity of holding position of the connecting taxiway and is turned on when other aircraft occupies the runway. "STOP" is displayed in white characters on red background, otherwise turned off

- VMS is installed only at HND as provisional measure until REL is installed

VMS

Taxiway centerline lights

VMS at Tokyo International (Haneda, RJTT)

Extinguished

Illuminated

RWSL Equipment

Runway Entrance Lights
φ203mm

Take-off Hold Lights
φ304mm

**Use of
LED Technology**

The response time for turning the lights on/off has been reduced with the use of LED Technology.

Light Control Unit (RWSL)
W 130×D 100×H 163
（Excludes cables,
protrusions）
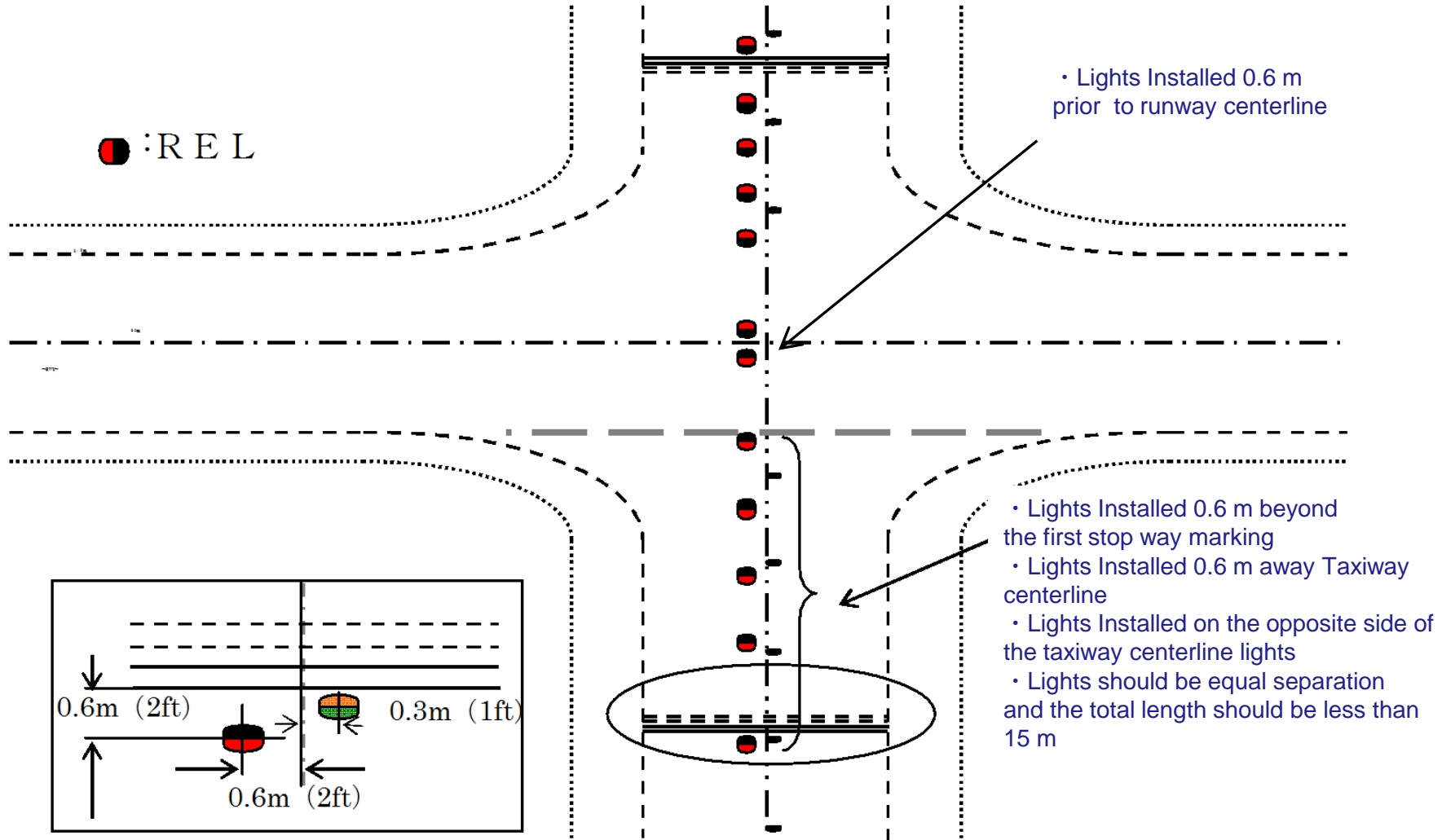
Photo : Courtesy of Toshiba Lighting and Technology Corporation

RWSL Equipment

Photo : Courtesy of Toshiba Lighting and Technology Corporation

Variable Message Sign(VMS）
A sign using LED Technology

Basic Performance: Configuration of REL lights (1/2)

● :REL

・Lights Installed 0.6 m prior to runway centerline

・Lights Installed 0.6 m beyond the first stop way marking
・Lights Installed 0.6 m away Taxiway centerline
・Lights Installed on the opposite side of the taxiway centerline lights
・Lights should be equal separation and the total length should be less than 15 m

0.6m（2ft）　　0.3m（1ft）

0.6m（2ft）

Basic Performance: Configuration of THL lights (2/2)

THL
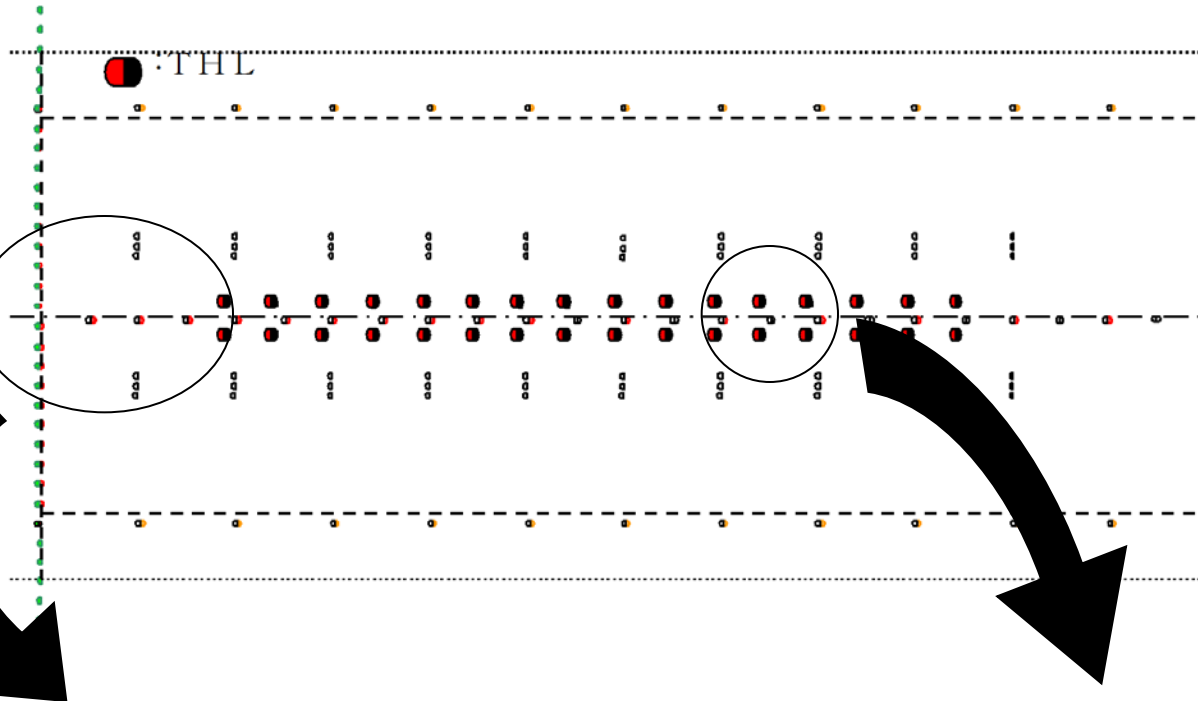
Lights should be installed in equal separation of less than 30 m for 16 fixtures (total length of 450 m)
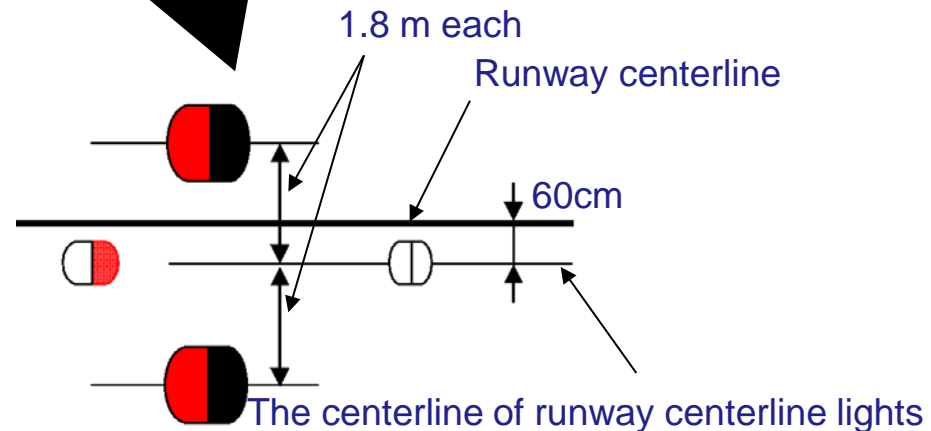
Separation due to cut-off

Basic line for lighting fixture
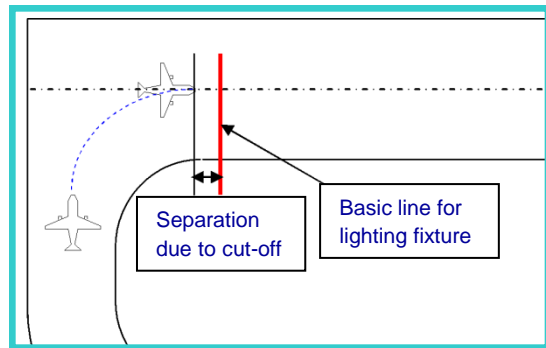
Detailed separation at runway threshold

1.8 m each

Runway centerline

60cm

The centerline of runway centerline lights

Detail of separation between lights

Operational Method: Basic Operational Procedure

➢ Operation of air traffic control will not change even if RWSL is introduced

➢ When RWSL is on, even if controller issues clearance, pilot will not enter into the runway or take off. Operator of vehicle will also not enter the runway.

➢ Even if RWSL is off and clearance from the controller is not issued, the pilot should not enter the runway or commence take-off. Operator of the vehicle also will not enter the runway.

➢ The controller issue the clearance but if RWSL is on, appropriate communication between the controller and pilot/operator of the vehicle must be made and any mismatch between the clearance and RWSL system must be solved (if the problem cannot be solved, RWSL should be turned off) then clearance to enter the runway or take off should be re-issued.

➢ If even one station of MLAT become out of service, RWSL should be turned off (even if MLAT can continue the operation as an support aids for the controller)

Operational Method: Basic Operational Rule（1/2）

Aircraft operators are made aware of the basic rules for the operation of the RWSL through the AIP.

Further, aircraft operators at airports where the installation of RWSL was planned have received a briefing on the RWSL prior to trial operations and the pilots have had a full understanding of the RWSL during the trial operations.

➢ Entry and crossing the runway

- Despite of a clearance from the controller to enter or cross the runway being issued and if REL on the taxiway in use is on, the pilot/operator of a vehicle should not enter the runway and report the status to the controller and confirm the contents of the clearance previously received

- If the controller receives a request for the above mentioned confirmation, the controller should cancel the previous clearance and re-verify the situation. If the controller considers that the entry and crossing of the runway is possible as previously issued, the controller turns off the RWSL and re-issues the clearance to enter and cross runway.

  (Maintain harmonization with the operation conducted by FAA and avoid risk of human error by pilot)

Operational Method: Basic Operational Rule (2/2)

✈ Take off

- Despite of receiving take off clearance and if THL on the runway is on, the pilot of the aircraft should not start take-off and is to contact the controller to confirm the contents of the previously issued clearance

- If the pilot requests confirmation of the said status, the controller will cancel the clearance and confirm the actual status. If the controller considers taking-off is possible as previously issued , the controller turns off the RWSL then re-issues the clearance for taking off to the aircraft

  (Maintain harmonization with the operation conducted by FAA and avoid risk of human error by pilot)

✈ Take-off Roll

- Should the pilot verify the illumination of the THL during the take-off roll and when the stopping is impractical for safety reasons, the pilot shall proceed according to their best judgment, with the understanding that the illuminated THL is an indication where the continuation of the take-off could affect the safety of the takeoff. Should this be the case, contact ATC at the earliest possible opportunity.

ATC Tower RWSL Monitor

RWSL Monitor

Display only indicates whether the RWSL lights are on or off. It does not have the capability to show malfunctions.

RWSL Kill (off) Switch

ATC controller can only turn the system off.

Reactivation of the system , change of intensity can not be conducted from the tower.

Lights Operation Console

Operating Panel

Example from Fukuoka

Thank you for your attention.