FAA

NextGen Portfolio Management & Technology Development Directorate (ANG-C)

Overarching Remote Tower System Research
Operational Visual Requirements

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Document Revision History

Version	Date	Author	Sections Changed	Description of Change
0.1	05/03/19	ANG-C5	All	Initial document for ANG-C5 review
0.2	05/10/19	ANG-C5	All	Second draft
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Acronyms

Acronym	Definition
AIM	Aeronautical Information Manual
ANG	Office of NextGen
AOV	Air Traffic Safety Oversight Service
ATCT	Airport Traffic Control Tower
ATO	Air Traffic Organization
CFR	Code of Federal Regulations
FAA	Federal Aviation Administration
FAAO	Federal Aviation Administration Order
FCT	Federal Contract Tower
JO	Joint Order
MEL	Minimum Equipment List
NATCA	National Air Traffic Controllers Association
OTW	Out-the-Window
OVR	Operational Visual Requirement
PCG	Pilot/Controller Glossary
RT	Remote Tower
SRMD	Safety Risk Management Document
VMC	Visual Meteorological Conditions

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1 Purpose

The Remote Tower (RT) System Operational Visual Requirements (OVRs) described in this document identify the visual informational needs of controllers at Airport Traffic Control Towers (ATCTs) providing operational air traffic services. These RT System OVRs will be utilized to inform the Federal Aviation Administration (FAA) Air Traffic Organization (ATO) in developing and evaluating system performance standards as part of the type certification process for RT systems.

2 Scope

The RT System OVRs is a living document that will continue to be updated, improved, and validated. The focus of the RT System OVRs (Version 1.0) is on the visual information needs of controllers in an ATCT in Class D airspace. The implementation of RT systems replaces the standard out-the-window (OTW) 3D view of a brick-and-mortar tower with a 2D view of the same environment. Since the implementation of RT systems replaces the OTW display with an RT system display, the RT System OVRs are scoped to the visual component of the controllers' information needs. The following assumptions were made for the RT System OVRs (V1.0) with future updates potentially addressing these assumptions:

- Visual Meteorological Conditions (VMC)
- RT system operated without additional surveillance information provided (e.g., RADAR)
- ATCT equipped with Federal Contract Tower (FCT) Minimum Equipment List (MEL) in place (FAAO JO 7210.78, *FAA Contract Tower (FCT) New Start and Replacement Tower Process*)
- Manual weather observations are excluded but will be taken in accordance with FAA JO 7210.77, *Non-Federal Weather Observation Program*

3 Process

Initial draft OVRs were developed using a variety of different information sources including, but not limited to, RT system site-specific evaluations and results, RT system site-specific safety risk management documents (SRMDs), FAA Orders, Title 14 of the Code of Federal Regulations Part 91, and FAA research findings (e.g., FAA ATCT Job Analysis, operational evaluations, etc.). Five workshops (from December 2018 – April 2019) with FAA subject matter experts from ATO, Air Traffic Safety Oversight Service (AOV), Office of NextGen (ANG), and National Air Traffic Controllers Association (NATCA) were conducted. At the workshops, subject matter experts were presented with the RT System OVRs and feedback was elicited to update the OVRs. Each individual OVR was discussed and reviewed by the workshops' attendees and was classified in one or more of each of the following categories:

- Display source (see section 4.2)
- Visual component (see section 4.1)
- FAA JO 7110.65 paragraph reference
- Separation information, if applicable (see section 4.4)
- ATCT Service

4 Result

The RT System OVRs (V1.0) identified 91 operational requirement statements and can be viewed as a summary in Table 1 and in detail in the accompanying file.

4.1 Visual Information Component

Each of the RT System OVRs describes controllers' visual information need(s) as defined below:

- **Detect**: Refers to the user's ability to notice the presence of a particular object (Ellis & Liston, 2011)
- **Recognize**: Refers to the user's ability to categorize the object into a general class (e.g., high-wing or low-wing aircraft) (Ellis & Liston, 2011)
- **Identify**: Refers to the user's ability to determine the specific type of object (Ellis & Liston, 2011)
- **Verify**: Refers to the user's ability to corroborate visual information with known external information (e.g., pilot report)
- **Observe**: Refers to the user's ability to discern an object's state and any changes in an object's state in the context of the environment. An object's state includes altitude, orientation, speed, attitude, position, and/or condition.

4.2 Primary/Secondary Display

The RT System OVRs must be met by the controller utilizing either a primary display or a primary display in conjunction with a secondary display. Primary and secondary displays are defined as follows:

- **Primary Display**: Continuous 360-degree view of the airfield and surrounding airspace.
- **Secondary Display**: Enhanced view(s) of the airfield and/or surrounding airspace. Secondary displays are not displayed on the primary display and must be utilized in addition to a primary display.

4.3 Category Aircraft

Some OVRs refer to specific categories of aircraft.

4.3.1 Same Runway Separation

For the purpose of the operational requirement statements document, same runway separation aircraft categories are defined in FAAO JO 7360.1, Aircraft Type Designators, and FAAO JO 7110.65, Section 3-9-6, Same Runway Separation, as follows:

- Category 1: Small single-engine propeller driven aircraft weighing 12,500 lbs. or less, and all helicopters.
- Category 2: Small twin-engine propeller driven aircraft weighing 12,500lbs or less.
- Category 3: All other aircraft.

4.3.2 Runway Usage Planning

The workgroup provided examples of aircraft size as related to the requirements for observation of aircraft on final approach. When referencing sizes of aircraft for the purposes of these requirements (V030 – V041), the following example aircraft are to be referenced:

- Category 1: Cessna 172
- Category 2/Category 3 Small: Piper Cheyenne, Cessna Citation
- Category 3 (excluding Category 3 Small): Boeing 737, Gulfstream 5

4.4 Separation Information

If applicable, the OVR was linked to the visual information needed to provide separation in one of the following categories:

- Standard Runway Separation
- Reduced Same Runway Separation
- Intersecting Runway / Intersecting Flight Path Separation
- IFR Separation
- Wake Turbulence Separation

4.5 Airport Traffic Pattern

The standard traffic pattern applies to all OVRs that reference the traffic pattern or portion of the traffic pattern. Per FAA-H-8083-3B, Airplane Flying Handbook, Chapter 7:

> *"Airport traffic patterns are developed to ensure that air traffic is flown into and out of an airport safely. Each airport traffic pattern is established based on the local conditions, including the direction and placement of the pattern, the altitude at which it is to be flown, and the procedures for entering and exiting the pattern. It is imperative that pilots are taught correct traffic pattern procedures and exercise constant vigilance in the vicinity of airports when entering and exiting the traffic pattern. Information regarding the procedures for a specific airport can be found in the Chart Supplements. Additional information on airport operations and traffic patterns can be found in the Aeronautical Information Manual (AIM)."*

4.6 Site-Specific Areas

Site-specific areas refer to any area on the airport surface that may need additional and/or specific requirements for the controller to complete visual tasks (e.g., hotspots, blind spots).

4.7 Other Definitions

- **Active Runway Surface Area**: "Any runway or runways currently being used for takeoff or landing." (7110.65 PCG)
- **Area of Jurisdiction**: An ATCT's airspace or area of responsibility.
- **Movement Area**: "The runways, taxiways, and other areas of an airport/heliport which are utilized for taxiing/hover taxiing, air taxiing, takeoff, and landing of aircraft exclusive of loading ramps and parking areas." (7110.65 PCG) Runway OVRs supersede movement area OVRs.
- **Physical Landmarks**: A material object on the airport surface or vicinity nearby. Physical landmarks may not be substituted with virtual overlays within the RT System.
- **Relative Altitude**: Altitude of one object in reference to another object.
- **Relative Position**: The location of one object in reference to another object.
- **Relative Speed**: Refers to slowing down, speeding up, and relative speed to other objects.

5 Remote Tower System Operational Visual Requirements (Version 1.0)

Table 1: RT System OVR (Version 1.0)

ID	Operational Visual Requirement	Primary Display	Secondary Display	7110.65 Link
V001	The remote tower system must permit the controller to visually recognize an aircraft on the runway.	X		3-1-3.; 3-1-7.; 3-9-4.; 3-9-5.; 3-9-6.; 3-9-10.; 3-10-3.; 3-10-6.; 3-10-9.; 3-10-10.;
V002	The remote tower system must permit the controller to visually identify an aircraft on the runway.		X	3-9-6.; 3-10-3.
V003	The remote tower system must permit the controller to visually recognize an aircraft on the runway safety area.	X		3-1-3.; 3-1-7.; 3-10-9.;
V004	The remote tower system must permit the controller to visually identify an aircraft on the runway safety area.		X	3-9-5.; 3-9-6.; 3-10-3.; 3-10-9.;
V005	The remote tower system must permit the controller to visually recognize an aircraft on the movement area.	X		3-1-3.; 3-1-6.: 3-1-7.; 3-7-1.; 3-7-2.; 3-9-5.; 3-10-9.;
V006	The remote tower system must permit the controller to visually identify an aircraft on the movement area.		X	3-1-6.: 3-1-7.;
V007	The remote tower system must permit the controller to visually recognize an aircraft operating within any site-specific area.	X		3-1-3.; 3-1-7.;
V008	The remote tower system must permit the controller to visually identify an aircraft operating within any site-specific area.		X	3-1-6.: 3-1-7.;
V009	The remote tower system must permit the controller to visually observe an aircraft's direction of movement on the runway.	X		3-1-3.; 3-9-5.; 3-10-6.; 3-10-9.; 3-10-10.;
V010	The remote tower system must permit the controller to visually observe an aircraft's direction of movement on the runway safety area.	X		3-1-3.; 3-9-5.; 3-10-9.;
V011	The remote tower system must permit the controller to visually observe an aircraft's direction of movement on the movement area.	X		3-1-3.; 3-9-5.; 3-10-6.; 3-10-9.;
V012	The remote tower system must permit the controller to visually observe an aircraft's direction of movement on any site-specific area.	X		3-1-3.; 3-1-7.;

ID	Operational Visual Requirement	Primary Display	Secondary Display	7110.65 Link
V013	The remote tower system must permit the controller to visually observe an aircraft's relative speed on the runway.	X		3-1-3.; 3-9-5.; 3-10--6.; 3-10-9.;
V014	The remote tower system must permit the controller to visually observe an aircraft's relative speed on the runway safety area.	X		3-1-3.; 3-9-5.; 3-10-6.; 3-10-9.;
V015	The remote tower system must permit the controller to visually observe an aircraft's relative speed on the movement area.	X		3-1-3.; 3-9-5.; 3-10-6.; 3-10-9.;
V016	The remote tower system must permit the controller to visually observe an aircraft's relative speed on any site-specific area.	X		3-1-3.; 3-1-7.;
V017	The remote tower system must permit the controller to visually observe the aircraft's spatial relationship with other aircraft on the runway.	X		3-1-3.;
V018	The remote tower system must permit the controller to visually observe completed aircraft's landing roll.	X		3-1-3.; 3-10-6.; 3-10-9.;
V019	The remote tower system must permit the controller to visually verify the aircraft's spatial relationship with the runway holding position markings.	X		3-1-3.; 3-9-5.; 3-9-10.; 3-10-3.; 3-10-9.;
V020	The remote tower system must permit the controller to visually observe the aircraft's spatial relationship with the runway holding position markings.		X	3-1-3.; 3-9-5.; 3-9-10.; 3-10-3.; 3-10-9.;
V021	The remote tower system must permit the controller to visually observe the aircraft's spatial relationship with the landing threshold.	X		3-8-1.; 3-10-3.; 3-10-6.;
V022	The remote tower system must permit the controller to visually observe the aircraft's spatial relationship with the departure end of the runway.	X		3-8-1.; 3-9-6.; 3-9-9.; 3-10-3.;

ID	Operational Visual Requirement	Primary Display	Secondary Display	7110.65 Link
V023	The remote tower system must permit the controller to visually observe when a departure aircraft is airborne.	X		3-9-6.; 3-10-3.;
V024	The remote tower system must permit the controller to visually verify the start of an aircraft's takeoff roll.	X		3-1-3.; 3-9-5.;
V025	The remote tower system must permit the controller to visually observe the start of an aircraft's takeoff roll.		X	3-1-3.; 3-9-5.;
V026	The remote tower system must permit the controller to visually observe an aircraft's initial departure turn over the runway.	X		3-8-1.; 3-9-6; 3-9-8.; 3-9-9.;
V027	The remote tower system must permit the controller to visually verify that the runway is free of all known objects the size of a deer or larger.		X	3-1-3.; 3-1-5.; 3-9-6.; 3-10-3.;
V028	The remote tower system must permit the controller to visually observe the location of an aircraft on the runway in reference to intersections.	X		3-1-3.; 3-9-7; 3-9-8; 3-9-10.; 3-10-4.; 3-10-9.;
V029	The remote tower system must permit the controller to visually observe the location of an aircraft on the runway in reference to suitable landmarks.	X		3-1-3.; 3-9-5.; 3-9-6; 3-10-3.; 3-10-6.;
V030	The Remote Tower System must permit the controller to visually verify if a known aircraft is Category 1 at 1 nautical mile from the landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.; 3-10-11.;
V031	The remote tower system must permit the controller to visually observe a Category 1 aircraft's direction of flight at 1 nautical mile from the landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V032	The remote tower system must permit the controller to visually observe a Category 1 aircraft's relative speed at 1 nautical mile from the landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V033	The remote tower system must permit the controller to visually observe a Category 1 aircraft's relative altitude at 1 nautical mile from the landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V034	The remote tower system must permit the controller to visually verify if a known aircraft is Category 2 at 1.5 nautical miles from the landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V035	The remote tower system must permit the controller to visually observe a Category 2/Category 3 Small aircraft's direction of flight at 1.5 nautical miles from the landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;

ID	Operational Visual Requirement	Primary Display	Secondary Display	7110.65 Link
V036	The remote tower system must permit the controller to visually observe a Category 2/Category 3 Small aircraft's relative speed at 1.5 nautical miles from the landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V037	The remote tower system must permit the controller to visually observe a Category 2/Category 3 Small aircraft's relative altitude at 1.5 nautical miles from the landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V038	The remote tower system must permit the controller to visually verify if known a aircraft is Category 3/Large at 2 nautical miles from landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V039	The remote tower system must permit the controller to visually observe a Category 3 (excluding Category 3 Small) aircraft's direction of flight at 2 nautical miles from landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V040	The remote tower system must permit the controller to visually observe a Category 3 (excluding Category 3 Small) aircraft's relative speed at 2 nautical miles from landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V041	The remote tower system must permit the controller to visually observe a Category 3 (excluding Category 3 Small) aircraft's relative altitude at 2 nautical miles from landing threshold.	X		3-8-1.; 3-9-6; 3-10-6.;
V042	The remote tower system must permit the controller to visually observe a departing aircraft passing through any intersecting flight path.	X		3-9-7.; 3-9-9.; 3-10-4.;
V043	The remote tower system must permit the controller to visually observe a departing aircraft passing through any runway intersection.	X		3-9-7.; 3-9-8.; 3-10-4.;
V044	The remote tower system must permit the controller to visually observe an arriving aircraft passing through the projected intersecting flight path of another aircraft.	X		3-9-8.; 3-10-4.;
V045	The remote tower system must permit the controller to visually observe an arriving aircraft will hold short of any runway intersection.	X		3-1-3.; 3-9-7.; 3-9-8.; 3-10-4.;
V046	The remote tower system must permit the controller to visually observe the spatial relationship between taxiing or hover-taxi helicopters and other aircraft.	X		3-7-3.; 3-10-9.; 3-11-1.;
V047	The remote tower system must permit the controller to visually detect aircraft at a minimum of 3 nautical miles laterally and at a minimum of 1,500 feet above the top of the area of jurisdiction from active runway surface area.	X		3-8-1.; 2-1-21.;

ID	Operational Visual Requirement	Primary Display	Secondary Display	7110.65 Link
V048	The remote tower system must permit the controller to visually observe an aircraft in reference to suitable physical landmarks for 3,000 feet same runway separation in accordance with JO 7110.65 3-9-6 and 3-10-3.	X		3-9-6.;
V049	The remote tower system must permit the controller to visually observe an aircraft in reference to suitable physical landmarks for 4,500 feet same runway separation in accordance with JO 7110.65 3-9-6 and 3-10-3.	X		3-9-6.;
V050	The remote tower system must permit the controller to visually observe an aircraft in reference to suitable physical landmarks for 6,000 feet same runway separation in accordance with JO 7110.65 3-9-6 and 3-10-3.	X		3-9-6.;
V051	The remote tower system must permit the controller to visually verify an aircraft abort takeoff.	X		3-1-3.;
V052	The remote tower system must permit the controller to visually observe an aircraft abort takeoff.		X	3-1-3.;
V053	The remote tower system must permit the controller to visually observe an aircraft execute a go-around.	X		3-8-1.; 3-10-2.;
V054	The remote tower system must permit the controller to visually observe with reference to suitable surface markings a helicopter is a minimum of 200 feet from a simultaneous departing helicopter.	X		3-11-5.;
V055	The remote tower system must permit the controller to visually observe with reference to suitable surface markings a helicopter is a minimum of 200 feet from a simultaneous landing helicopter.	X		3-11-5.;
V056	The remote tower system must permit the controller to visually recognize a vehicle on the runway.	X		3-1-3.; 3-1-5.; 3-1-6.; 3-9-5.; 3-10-10.;
V057	The remote tower system must permit the controller to visually recognize a vehicle on the runway safety area.	X		3-1-3.; 3-1-7.; 3-7-5.; 3-7-6.; 3-10-9.;
V058	The remote tower system must permit the controller to visually recognize a vehicle on the movement area.	X		3-1-6.; 3-3-3.; 3-7-1.; 3-7-2.; 3-10-9.;
V059	The remote tower system must permit the controller to visually recognize a vehicle on any site-specific areas.	X		3-1-6.; 3-3-3.; 3-7-1.; 3-7-2.; 3-10-9.;
V060	The remote tower system must permit the controller to visually detect a pedestrian on the runway.		X	3-1-3.; 3-1-5.; 3-1-6.; 3-3-3.; 3-10-10.;

ID	Operational Visual Requirement	Primary Display	Secondary Display	7110.65 Link
V061	The remote tower system must permit the controller to visually detect a pedestrian on the runway safety area.		X	3-1-3.; 3-1-5.; 3-1-6.; 3-3-3.;
V062	The remote tower system must permit the controller to visually detect a pedestrian on the movement area.		X	3-1-5.; 3-1-6.; 3-3-3.;
V063	The remote tower system must permit the controller to visually observe a vehicle's direction of movement when operating on the movement area.	X		3-1-3.;
V064	The remote tower system must permit the controller to visually observe a vehicle's relative speed on the movement area.	X		3-1-3.;
V065	The remote tower system must permit the controller to visually observe an aircraft's spatial relationship with other aircraft on the movement area.	X		3-7-1.; 3-7-2.;
V066	The remote tower system must permit the controller to visually observe an aircraft's spatial relationship with a known object on the airport surface.	X		3-1-3.;3-3-3.;
V067	The remote tower system must permit the controller to visually observe an aircraft on the upwind leg of a standard traffic pattern.	X		3-8-1.; 3-10-6.; 3-10-11.;
V068	The remote tower system must permit the controller to visually observe an aircraft turning from upwind leg to crosswind leg of a standard traffic pattern.	X		3-8-1.; 3-10-6.; 3-10-11.;
V069	The remote tower system must permit the controller to visually observe an aircraft on the crosswind leg of a standard traffic pattern.	X		3-8-1.; 3-10-6.; 3-10-11.;
V070	The remote tower system must permit the controller to visually observe an aircraft turning from crosswind leg to downwind leg of a standard traffic pattern.	X		3-8-1.; 3-10-6.; 3-10-11.;
V071	The remote tower system must permit the controller to visually observe an aircraft on the downwind leg of a standard traffic pattern.	X		3-8-1.; 3-10-6.; 3-10-11.;
V072	The remote tower system must permit the controller to visually observe an aircraft turning from downwind leg to base leg of a standard traffic pattern.	X		3-8-1.; 3-10-6.; 3-10-11.;
V073	The remote tower system must permit the controller to visually observe an aircraft on the base leg of a standard traffic pattern.	X		3-8-1.; 3-10-6.; 3-10-11.;
V074	The remote tower system must permit the controller to visually observe an aircraft turning from base leg to final approach of a standard traffic pattern.	X		3-8-1.; 3-10-6.; 3-10-11.;

ID	Operational Visual Requirement	Primary Display	Secondary Display	7110.65 Link
V075	The remote tower system must permit the controller to visually observe an aircraft on final of a standard traffic pattern.	X		3-8-1.; 3-10-6.; 3-10-11.;
V076	The remote tower system must permit the controller to visually verify an aircraft's relative position to landmarks at a minimum of 3 nautical miles from active runway surface area.	X		3-8-1.;
V077	The remote tower system must permit the controller to visually observe an aircraft's spatial relationship with other aircraft at a minimum of 3 nautical miles laterally and at a minimum of 1,500 feet above the top of the area of jurisdiction from active runway surface area.	X		2-1-6.; 3-8-1.; 2-1-21.; 7-2-1.; 7-5-3.; 7-5-5.;
V078	The remote tower system must permit the controller to visually verify the status of the runway edge lights.		X	3-4-10.;
V079	The remote tower system must permit the controller to visually verify the status of the taxiway lights.		X	3-4-16.;
V080	The remote tower system must permit the controller to visually detect construction work on the movement area.	X		3-1-5.; 3-1-6.; 3-3-3.;
V081	The remote tower system must permit the controller to visually detect construction work immediately adjacent to the movement area.		X	3-1-5.; 3-1-6.; 3-3-3.;
V082	The remote tower system must permit the controller to visually observe site-specific airport conditions impacting operations.		X	3-3-1.; 3-3-3.;
V083	The remote tower system must permit the controller to visually observe spatial relationships between aircraft and site-specific obstructions.		X	3-3-1.; 3-3-3.;
V084	The remote tower system must permit the controller to visually observe fixed-wing aircraft rock wings in response to a light gun signal between sunrise and sunset.		X	3-2-3.;
V085	The remote tower system must permit the controller to visually observe fixed-wing aircraft move ailerons or rudders while on the ground in response to a light gun signal between sunrise and sunset.		X	3-2-3.;
V086	The remote tower system must permit the controller to visually observe fixed-wing aircraft flash navigation or landing lights in response to a light gun signal between sunset and sunrise.		X	3-2-3.;
V087	The remote tower system must permit the controller to visually observe a helicopter flash the landing light in response to a light gun signal between sunrise and sunset.		X	3-2-3.;

ID	Operational Visual Requirement	Primary Display	Secondary Display	7110.65 Link
V088	The remote tower system must permit the controller to visually observe a helicopter rock the tip path plane in response to a light gun signal between sunrise and sunset.		X	3-2-3.;
V089	The remote tower system must permit the controller to visually observe a helicopter flash the landing light or search light in response to a light gun signal between sunset and sunrise.		X	3-2-3.;
V090	The remote tower system must permit the controller to visually recognize visibility landmarks for tower visibility observations in accordance with JO 7110.65 2-6-3.	X		2-6-3.;
V091	The remote tower system must permit the controller to visually observe an aircraft landing gear for a Category 1 aircraft at a minimum of 1/2 nautical mile from any active runway surface when requested.		X	3-1-10;