Additional Operations Details for MV-22s

Appendix A

1 **DEFINITIONS OF AIRFIELD OPERATIONS**

2 **Departure:** This involves an aircraft taking off to a local training area, Landing Zone (LZ), low-altitude
3 route, or as part of a training maneuver (e.g., touch-and-go). MV-22 take-offs are either vertical or after
4 a short-roll.

5 **Arrival:** This involves aircraft returning and landing from a local training area, LZ, low-altitude route, or
6 as part of a training maneuver. For the MV-22, the aircraft would need to transition from airplane mode
7 of flight to vertical take-off/landing (VTOL) mode in order to land. Such landings would occur on the
8 runway or at pads at the airfield. The following defines the basic types of arrivals.

9 *Non-Break Arrival:* When performing this operation, an aircraft lines up on the runway centerline,
10 descends gradually, converts to VTOL mode, lands, and then taxis off the runway. This operation
11 can involve vertical landings or roll-on landings, if the aircraft is in conversion mode.

12 *Overhead Break Arrival:* This operation consists of an expeditious arrival using Visual Flight Rules
13 (VFR). An aircraft rapidly approaches the runway at approximately 500 feet above the altitude of
14 the landing pattern. Approximately halfway down the runway, the aircraft performs a 180 degree
15 turn to enter the landing pattern. Once established in the pattern, the aircraft converts to VTOL
16 mode, lowers landing gear, and performs a 180-degree descending turn to execute a vertical landing
17 on the runway. Roll-on landings in conversion mode can be used.

18 *Instrument Arrival:* In this operation, air traffic controllers direct the MV-22 to a landing using
19 Instrument Flight Rules (IFR) only (i.e., in non-visual means). During the approach, the aircraft
20 transitions to conversion mode, lowers the landing gear, then continues to transition to VTOL mode
21 prior to executing a vertical landing. Roll-on landings can be made in conversion mode.

22 **Closed Patterns:** The MV-22 would conduct touch-and-goes, ground-controlled approaches, and other
23 patterns in the airfield environment.

24 *Touch-and-Go*: An aircraft lands and takes off on a runway without a full stop. After landing, the
25 pilot executes another take-off with minimal delay without taxiing clear of the runway. The
26 touch-and-go is counted as two operations because the landing counts as one operation and the
27 take-off represents another.

28 *Ground-Controlled Approach:* In this training event, air traffic controllers guide aircraft to a landing
29 to practice arrivals under adverse conditions. This event may involve a precision or non-precision
30 approach.

1 # DESCRIPTION OF A TYPICAL LANDING ZONE SORTIE

2 **Departure from MCAS Futenma:** On a daily basis, MV-22s would depart MCAS Futenma via vertical or
3 short-roll take-off as described for the airfield. The aircraft would then transition to airplane mode for
4 the flight to an LZ or multiple LZs.

5 **Flight to LZ:** In airplane mode, the MV-22 would normally fly like a turboprop (rotors and engines
6 [nacelles] forward) aircraft at altitudes between 500 and 10,000 feet above ground level (AGL) and at a
7 speed of 240 nautical miles (nm) per hour (knots). Throughout many years of training on Okinawa,
8 pilots of the CH-46Es identified and used informal transit routes within airspace over Department of
9 Defense (DoD) training areas to access the LZs; the MV-22s would continue to follow these informal
10 tracks to the extent feasible given their greater speed and different handling characteristics. It is
11 possible that more than one MV-22 would fly together for this training, and the aircraft would fly in
12 formation. A formation typically involves a lead aircraft and one or more other aircraft in formation at a
13 30-degree angle behind the forward aircraft. Separation between aircraft is typically 25 feet vertically
14 and 2,500 feet horizontally.

15 **Approaching the LZ:** Training for the MV-22 in and around the LZs would differ somewhat from that of
16 the CH-46Es. Upon approaching the LZ, the MV-22 would begin a descent to a normal landing pattern
17 altitude. When the aircraft arrives at approximately 3 miles from the LZ, the aircrew will reduce speed
18 and transition from airplane to conversion mode moving the nacelles toward the vertical. Thus, the
19 aircraft will generally arrive at a point 1.2 nm from the LZ at 300 feet AGL and 120 knots. Based on the
20 *MV-22 Training and Readiness Manual*, five types of tactical approaches would be used by the MV-22s:
21 straight-in tactical (29 percent); 90 degree offset (29 percent); 180 degree offset (14 percent); hasty (14
22 percent); and conversion (14 percent).

23 **Hovering/Landing:** After arriving at a point 1.2 nm from the zone, the aircraft will continue to
24 decelerate, complete its transition to VTOL mode, and execute a vertical landing at the LZ. Normal
25 parameters call for the aircraft to arrive at a point 0.2 nm from the zone at 150 feet AGL and 50 knots,
26 and then fly over the intended point of landing with zero forward airspeed at an altitude of 20 feet or
27 less. During this hovering/landing phase, the aircraft will generally have its nacelles in a near vertical
28 position and will fly profiles similar to a helicopter. Descent to the ground takes an average of 6 to 10
29 seconds. At suitable LZs and under appropriate conditions, a formation of MV-22s may land in
30 sequence. In VTOL mode, landings onto and take-offs from uneven terrain are possible.

31 **Take-off:** An MV-22 take-off from an LZ would be made in the VTOL mode, usually into the wind. As
32 power is added, the aircraft rises straight up through the first 20 feet, then the pilot transitions to
33 forward flight by tilting the nacelles forward, causing the aircraft to accelerate forward as it climbs. If
34 the pilot plans to stay in conversion mode, the nacelles would be set at approximately 75 degrees (15
35 degrees forward from vertical) for acceleration to establish and maintain 80 knots when leveling off at
36 300 feet AGL. If the pilot plans to transition to airplane mode, the nacelle movement continues to 0
37 degrees until the nacelles are parallel to the ground. At this point, the MV-22 would accelerate to 170
38 to 220 knots and climb to a cruising altitude that can vary from 1,300 feet AGL (if the pilot will be staying

1   in a training pattern for further landings) or to higher than 10,000 feet AGL (if the pilot wishes to travel
2   longer distances to another training area or base).

3   **Patterns and Repeated Landings at LZ:** For training, the MV-22 may conduct more than one Confined
4   Area Landing (CAL) at a given LZ during a sortie, or may use many LZs. The Marine Corps estimates that
5   every sortie would involve about 7 CALs at one or more LZ. Patterns can be conducted either in airplane
6   or VTOL configurations. When in the airplane configuration, the sizes of the patterns more closely
7   resemble those by other types of fixed-wing turboprop aircraft which do not typically operate at tactical
8   LZs. These patterns are longer and faster than those the current CH-46E employs, with the MV-22 flying
9   200 to 220 knots and up to 6 nm from the LZ. As described previously, the pattern work would involve a
10   vertical take-off with a transition into the conversion mode followed by the airplane mode. The MV-22
11   would proceed away from the LZ at about 500 feet AGL and 200 knots. When separated sufficiently
12   (around 5 nm) from the LZ, the MV-22 would turn back toward the LZ, descend to 300 feet AGL and
13   accelerate to 220 knots. This maneuver offers pilots training using a more tactical approach to an LZ. As
14   the aircraft approaches the LZ, the pilot would gradually adjust the nacelle angle back up toward
15   vertical, converting the aircraft's flight profile to that more like a helicopter. Deceleration would result
16   in the aircraft arriving back over its intended point of landing on the LZ at zero airspeed, so that it can
17   land vertically.

18   **Exiting the LZ:** Using the take-off and transition procedures described above, the MV-22 would exit the
19   LZ. On any given sortie, an MV-22 may transit to another LZ, return to base, or continue with different
20   operations elsewhere.