1. Introduction

As currently planned, the F-35 Joint Strike Fighter is the largest aircraft acquisition program in Department of Defense (DoD) history. According to the December 2011 F-35 Selected Acquisition Report, the total acquisition cost to procure 2,457 F-35 aircraft across the U.S. Air Force (USAF), Navy, and Marine Corps is $331 billion, with total operating and support (O&S) costs of $617 billion to operate the aircraft through 2065, with both costs computed using a base year of 2012 (DoD, 2011). Moreover, the F-35 cost-per-flying-hour estimate has increased by more than 80 percent (in constant dollars) over the interval 2002 to 2010. To ensure that the affordability of the F-35 program is not threatened by continuing O&S cost growth, the USAF is examining alternative strategies to reduce those costs.

One approach to reducing O&S costs is to reduce the number of F-35 home-station operating locations, which is in turn related to the number of F-35 squadrons and the number of Primary Aerospace Vehicle Authorized (PAA) per squadron. The USAF Program of Record for the F-35A calls for procurement of 1,763 F-35A Conventional Takeoff and Landing-variant aircraft (DoD, 2011). In 2012, the commander of Air Combat Command (ACC/CC) approved a beddown plan to determine how to allocate the 960 combat-coded PAA across fighter squadrons and operating locations. For the purposes of this report, "beddown" refers to the number and sizes of F-35 squadrons, and their distribution across the Active Component (AC), both within the continental United States (CONUS) and outside (OCONUS), the Air Force Reserve Command (AFRC), and the Air National Guard (ANG), without regard to the specific locations at which these squadrons are permanently based.[15] According to the ACC/CC plan, there are to be 44 squadrons, with the aircraft allocated into squadrons of 24 PAA in the AC and AFRC, and squadrons of 18 PAA in the ANG. These 44 total squadrons would be distributed among 31 operating locations. The remaining 803 noncombat-coded aircraft would be assigned to other missions, such as training or testing (369 total aircraft), or would fill requirements for backup aircraft inventory or attrition reserve (434 total aircraft).

At the request of the Vice Chief of Staff of the Air Force, RAND Project AIR FORCE (PAF) assessed whether O&S savings could be achieved (1) by reconfiguring the

[15] We recognize that this use of the term "beddown" is inconsistent with AFI 10-503 (2010), which states, "Beddown is considered the execution of a basing action." We use the term "beddown" here in a different manner, and avoid the use of the term "basing", to emphasize that this analysis is not focused on specific locations for permanently stationed F-35 units.

960 combat-coded PAA into larger squadrons (i.e., increasing the PAA per squadron),[16] (2) by adjusting the mix of PAA across the AC and Reserve Component (RC), and (3) by adjusting the percentage of the AC PAA assigned to home-station locations in CONUS.

Within this analysis, we limited our focus to combat-coded aircraft. We excluded backup inventory and attrition reserve aircraft from the analysis because these aircraft do not generate significant O&S costs, relative to combat-coded, test, and training PAA. We did not include training and test PAA in this analysis because these aircraft were already relatively concentrated in the ACC/CC beddown, suggesting that relatively small efficiencies could be gained through further consolidation.

Specifically, this research addressed how a change along these three dimensions would affect the Air Force in the following ways:

- Ability to support both surge and steady-state contingency operations
- Ability to absorb the necessary number of F-35 pilots
- Requirements for maintenance manpower and support equipment (SE)
- Requirements for new infrastructure across the set of existing F-16 and A-10 bases
- Ability to develop future senior leaders out of the pool of fighter pilots.

A key tenet of this analysis is that it was not intended to make specific recommendations about the utility of any specific site as a potential F-35 beddown location. Instead, this analysis will focus on issues that are generally not site-specific.[17]

This analysis addresses aspects of many issues that are within the purview of other USAF analyses and decision processes, namely the Force Composition Analysis performed by the Directorate of Strategic Planning, Office of the Deputy Chief of Staff for Strategic Plans and Programs, Headquarters USAF (AF/A8X) and the Strategic Basing Process performed by the Office of the Assistant Secretary of the Air Force for Installations, Environment, and Logistics (SAF/IE) and the Office of the Deputy Chief of Staff for Strategic Plans and Programs, Headquarters USAF (AF/A8). The analysis presented in this report is not intended to be duplicative, nor is it an attempt to validate the findings of these other efforts. Rather, the findings of this analysis should be useful to inform those (and other) efforts that are examining similar issues related to the USAF F-35 beddown.

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[16] For USAF fighter aircraft, no current squadron has more than 24 PAA. However, fighter squadron sizes have varied over time based on the facilities and aircraft numbers available, and they tend to peak during wartime and decrease during postwar drawdown periods. The analysis presented in this report will examine the potential for squadron sizes larger than 24 PAA to generate increased cost-effectiveness.

[17] The infrastructure requirements analysis is an exception to this rule, but the findings presented in this section will not be focused at the level of individual locations.

Current F-35 Beddown Plan

In 2012, ACC/CC approved a beddown plan to identify the allocation of the 960 combat-coded PAA across fighter squadrons and operating locations. This plan identifies the following sets of F-35 operating locations for combat-coded aircraft:

- AC, within CONUS: three squadrons of 24 PAA at each of three locations; two squadrons of 24 PAA at one location; one squadron of 24 PAA at one location (for a total of five locations, 12 squadrons, and 288 PAA)
- AC, OCONUS: two squadrons of 24 PAA at each of six locations (for a total of six locations, 12 squadrons, and 288 PAA)
- AFRC: one squadron of 24 PAA at each of four locations (for a total of four locations, four squadrons, and 96 PAA)
- ANG: one squadron of 18 PAA at each of 16 locations (for a total of 16 locations, 16 squadrons, and 288 PAA)

The sum totals across all combat-coded F-35s are 31 locations, 44 squadrons, and 960 PAA.

F-35 Beddown Alternatives

Within this analysis, we will consider a set of 28 F-35 beddown alternatives. These alternatives vary across three dimensions. First, we considered three values for the percentage of total combat-coded F-35 PAA in the AC: 45 percent, 60 percent and 75 percent. Second, this analysis considered three values for the number of PAA per squadron in the AC: 24 PAA, 30 PAA and 36 PAA. Based upon consultation with the National Guard Bureau (NGB) and Headquarters AFRC, it was determined that within any beddown alternative, AFRC squadrons would always be assumed to have the same number of PAA per squadron as AC squadrons. However, only two values would be considered for the number of PAA per ANG squadron: 18 PAA and 24 PAA. Third, we considered two values for the percentage of AC PAA that would be based at CONUS home-station locations: 50 percent and 67 percent.[18] In keeping with the ACC/CC-approved plan's allocation across the RC, all beddowns that were considered place significantly more PAA in the ANG than in the AFRC. Table 1.1 presents the full set of

[18] The values presented here for "Percentage of Total PAA in AC" and "Percentage of Total AC PAA in CONUS" are approximate, as it is not always possible to apportion the PAA in squadrons of the identified size and also obtain the exact percentages specified in the AC and AC CONUS.

alternative F-35 beddowns considered in this analysis, and introduces the naming convention that will be used throughout the remainder of this report.[19]

Observe that the ACC/CC-approved beddown corresponds to beddown alternative 2A. Throughout this report, we will examine the impact of these 28 beddown alternatives on each of the five analytic focus areas (contingency requirements, pilot absorption, logistics requirements, infrastructure requirements and leadership development), with respect to the performance of the ACC/CC-approved beddown.

More detail regarding how this number of squadrons was arranged into multisquadron wings for the AC is presented in Table 1.2. We will assume that each AFRC and ANG squadron is located at a unique base.[20] We assume that each AC Wing, as presented in Table 1.2, corresponds to one base. For example, beddown 1A corresponds to 7 AFRC bases; 20 ANG bases; three AC CONUS bases, with three squadrons of 24 PAA at each base; and four AC OCONUS bases, one base with three squadrons of 24 PAA, and two squadrons of 24 PAA at each of the other three AC OCONUS bases.[21]

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[19] Note that, under this structure, there are two beddown alternatives (3G and 3H) that are not included in this analysis. We exclude them due to the difficulty of allocating 25 percent of the total combat-coded PAA to the RC with AFRC squadrons of 30 PAA and ANG squadrons of 24 PAA. The only option for which the arithmetic works has a total of 120 PAA in AFRC and 120 PAA in ANG, which is inconsistent with all other beddowns, for which ANG has many more PAA than does AFRC.

[20] This assumption is consistent with the current beddown of combat-coded AFRC and ANG fighter/attack squadrons. It is possible that multiple RC squadrons could be assigned to a single wing; however this analysis did not consider such alternatives.

[21] There are significant cost implications associated with changing the number of USAF bases at which fighter/attack aircraft are permanently stationed. Issues related to the closure or repurposing of existing USAF bases were beyond the scope of this analysis.

Table 1.1. F-35 Beddown Alternatives

Percentage of Total PAA in AC	Squadron Size (PAA)	Percentage of Total AC PAA in CONUS	Beddown Alternative	AC Squadrons		RC Squadrons		Total Squadrons
				CONUS	OCONUS	AFRC	ANG	
45	18 (ANG), 24 (AC/AFRC)	50	1A	9	9	7	20	45
		67	1B	12	6	7	20	45
	24 (ANG), 24 (AC/AFRC)	50	1C	9	9	6	16	40
		67	1D	12	6	6	16	40
	18 (ANG), 30 (AC/AFRC)	50	1E	8	7	5	20	40
		67	1F	10	5	5	20	40
	24 (ANG), 30 (AC/AFRC)	50	1G	8	7	5	15	35
		67	1H	10	5	5	15	35
	24 (ANG), 36 (AC/AFRC)	50	1I	6	6	4	16	32
		67	1J	8	4	4	16	32
60	18 (ANG), 24 (AC/AFRC)	50	2A	12	12	4	16	44
		67	2B	16	8	4	16	44
	24 (ANG), 24 (AC/AFRC)	50	2C	12	12	4	12	40
		67	2D	16	8	4	12	40
	18 (ANG), 30 (AC/AFRC)	50	2E	10	9	4	15	38
		67	2F	13	6	4	15	38
	24 (ANG), 30 (AC/AFRC)	50	2G	10	9	5	10	34
		67	2H	13	6	5	10	34
	24 (ANG), 36 (AC/AFRC)	50	2I	8	8	4	10	30
		67	2J	11	5	4	10	30

Percentage of Total PAA in AC	Squadron Size (PAA)	Percentage of Total AC PAA in CONUS	Beddown Alternative	AC Squadrons		RC Squadrons		Total Squadrons
				CONUS	OCONUS	AFRC	ANG	
75	18 (ANG), 24 (AC/AFRC)	50	3A	15	15	4	8	42
		67	3B	20	10	4	8	42
	24 (ANG), 24 (AC/AFRC)	50	3C	15	15	3	7	40
		67	3D	20	10	3	7	40
	18 (ANG), 30 (AC/AFRC)	50	3E	12	12	2	10	36
		67	3F	16	8	2	10	36
	24 (ANG), 30 (AC/AFRC)							
	24 (ANG), 36 (AC/AFRC)	50	3I	10	10	2	7	29
		67	3J	13	7	2	7	29

Table 1.2. Arrangement of AC Squadrons Into Multisquadron Wings, for Each Alternative Beddown

		Number of Wings with *N* Squadrons						
		AC CONUS				AC OCONUS		
Beddown Alternative	**AC Squadron Size (PAA)**	**1**	**2**	**3**	**4**	**1**	**2**	**3**
1A	24			3			3	1
1B				4		2	2	
1C				3			3	1
1D				4		2	2	
1E	30		1	2		1	3	
1F			2	2		3	1	
1G			1	2		1	3	
1H			2	2		3	1	
1I	36			2		2	2	
1J			1	2		4		
2A	24	1	1	3			6	
2B			2	4			4	
2C				4				4
2D			2	4			4	
2E	30		2	2			3	1
2F			2	3		2	2	
2G			2	2			3	1
2H			2	3		2	2	
2I	36		1	2			4	
2J			1	3		3	1	

		Number of Wings with *N* Squadrons						
		AC CONUS				AC OCONUS		
Beddown Alternative	AC Squadron Size (PAA)	1	2	3	4	1	2	3
3A	24			1	3			5
3B					5		2	2
3C				1	3			5
3D					5		2	2
3E	30			4				4
3F			2	4			4	
3I	36		2	2			2	2
3J			2	3		1	3	

An important aspect of this analysis is that it was directed to assume that all RC units and all AC units in CONUS would utilize associate unit arrangements. Thus, every beddown alternative will include both *Active Associate* units, in which an RC unit has principal responsibility for a weapon system and shares the equipment with an AC unit, and *Classic Associate* units, in which an AC unit retains principal responsibility for a weapon system and shares the equipment with an RC unit.

One of the principal motivations for the use of Active Associate units in the recent past has been to increase pilot absorption by assigning inexperienced AC pilots to Active Associate units and using the highly experienced RC pilot force to relieve some of the AC pilot training burden.[22] Active Associate units have also been viewed as a potential means for increasing access to RC force structure for deployments during steady-state periods, since the AC pilots and maintainers assigned to an Active Associate unit could be available for deployment more often than RC personnel.[23]

Guidance is required to identify whether Active Associate units for the F-35 are intended to achieve both, or only the former, of these objectives. This decision affects the force presentation concept, and thus deployment capability, as well as costs of these units. These issues will be discussed in more detail in later sections of this report.

Organization of This Report

The remainder of this report is organized into six chapters. Chapter Two presents our analysis of surge and steady-state contingency requirements for the F-35. Chapter Three describes our analysis of pilot absorption requirements and capabilities. Chapter Four contains our analysis of logistics resource requirements. Chapter Five presents our analysis of F-35 infrastructure requirements, in relation to the set of existing F-16 and A-10 bases. Chapter Six describes our analysis of impacts on leadership development. Finally, Chapter Seven contains our conclusions.

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[22] By similar logic, Active Associate units could also assist with the training of AC maintenance personnel (although this would force RC maintainers to spend less time on direct production tasks and more time supporting maintenance training, eliminating some of the efficiency advantage that has traditionally been enjoyed by RC maintenance manpower).

[23] The motivation for Classic Associate units is different. By assigning experienced RC pilots to the unit, the unit can reduce its total costs and increase its overall experience level. However, Classic Associate units do not significantly increase pilot absorption capabilities, and could actually reduce access to AC PAA during steady-state periods.