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December 23, 2022

PATRIOT Air and Missile Defense System for Ukraine

The PATRIOT air and missile defense (AMD) system is an integral component of U.S. air and missile defense. The system and its interceptors are both expensive and limited in supply. On December 21, 2022, the Department of Defense (DOD) announced that the United States would provide a PATRIOT battery to Ukraine as part of a larger $1.85 billion security assistance package. The provision of PATRIOT units now, and whether or not the United States may transfer additional PATRIOT units to Ukraine in the future, present issues that Congress will face in both its legislative and oversight roles.

What Is the PATRIOT System?

PATRIOT (**Figure 1**) is an acronym for "**P**hased **A**rray **T**racking **R**adar to **I**ntercept on **T**arget."

Figure 1. PATRIOT Launcher Stations

Source: Bloomberg, "US Finalizing Arms Upgrade to Ukraine With Patriot Missiles," December 13, 2022.

The U.S. Army Aviation and Missile Life Cycle Management Command (AMCOM) notes:

> The PATRIOT is the U.S. Army's most advanced air defense system. Capable of defeating both high performance aircraft and tactical ballistic missiles, it is the only operational [U.S.] air defense system that can shoot down attacking missiles. A PATRIOT battery (the basic firing unit) consists of about 90 soldiers, but three soldiers in the engagement control station are the only personnel required to operate the battery in combat.

Raytheon Technologies manufactures PATRIOT radar and ground systems, and Lockheed Martin manufactures the interceptor missiles.

DOD's December 21, 2022, Ukraine Security Assistance Announcement

DOD's December 21, 2022, announcement appears to represent a change in the Biden Administration's position on the supply of PATRIOT units to Ukraine. Since Russia's February 2022 invasion, the Ukraine government repeatedly has asked the United States to supply PATRIOT systems. The United States to date has provided other, less capable AMD systems. According to a DOD news article, "Ukraine Getting Patriot Battery, Other Defense Weapons," the United States will transfer a PATRIOT battery under the provisions of Presidential Drawdown Authority (PDA), meaning PATRIOT battery systems, equipment, and associated interceptors could be taken from existing units/stocks within the Army (22 U.S.C.§2318(a)(1)). DOD further noted:

> PATRIOT is one of the world's most advanced air defense systems, and it will give Ukraine a critical long-range capability to defend its airspace. It is capable of intercepting cruise missiles, ballistic missiles and aircraft ... Our goal is to help Ukraine strengthen a layered integrated approach to air defense. PATRIOT will complement a range of medium and short-range air defense capabilities [Stinger and National Advanced Surface-to-Air Missile System (NASAMS)] that we have provided and the allies have provided in prior donation packages ... PATRIOT is a sophisticated air defense system so training will be required and will take some time.

How PATRIOT Functions

PATRIOT battery components and how they function are summarized in a NATO Fact Sheet on Patriot Deployment:

> A PATRIOT battery has six major components: a power plant [two vehicle-mounted 150 kilo watt (KW) generators], radar set, engagement control station, launcher stations, antenna mast group, and interceptor missiles (PAC-2s and PAC-3s).
>
> - The Radar Set provides detection and tracking of targets as well as fire control. The phased array radar helps guide interceptors to their targets and is resistant to jamming.
>
> - The Engagement Control Station calculates trajectories for interceptors and controls the launching sequence. It communicates with the launcher stations and other PATRIOT batteries. It is the only manned station in a PATRIOT fire unit.
>
> - The Launcher Stations transport and protect the interceptor missiles and provide the platform for the

physical launch of the missile. Each launcher station can accommodate four PAC-2 missiles or 16 PAC-3 missiles.

- The Antenna Mast Group is the main communications backbone for the PATRIOT unit.

- The Interceptor Missiles: **PAC-2** is a proximity-fusing missile, which explodes near an incoming missile, **PAC-3** has been specifically designed to intercept and destroy missiles by impacting them directly with kinetic energy- known as "hit to kill."

- Once the interceptor missile is launched, the phased array radar tracks it. As the interceptor approaches the target, its active seeker will steer it to the target. A PAC-2 interceptor will detonate near the threat missile whereas a PAC-3 will seek to impact the threat ballistic missile warhead.

PATRIOT Ranges and Coverage

Official PATRIOT ranges and coverages are not available. Reportedly, the PATRIOT's phase-arrayed radar system has a range in excess of 150 kilometers (km) and the capacity to track up to 100 targets, providing missile guidance data for up to nine missiles. The flight ceiling for PATRIOT interceptors is about 20 km and PATRIOT can provide area coverage and defense for about 15 to 20 km for incoming ballistic missiles.

Other Nations with PATRIOT Systems

The U.S. Army notes 16 other nations have PATRIOT systems, including a number of NATO members—Germany, Greece, Netherlands, Spain, Sweden, Poland, and Romania—and other non-NATO nations, such as Japan, Republic of Korea, Israel, Kuwait, Qatar, Saudi Arabia, United Arab Emirates, Taiwan, and Bahrain (sale approved by U.S. State Department in May 2019).

PATRIOT System Costs

Official PATRIOT system cost figures are not publicly available. According to a December 16, 2022, Center for Strategic and International Studies (CSIS) article, "Patriot to Ukraine: What Does it Mean?," a newly produced PATRIOT battery costs about $1.1 billion, including about $400 million for the system and about $690 million for the missiles. CSIS further suggests future U.S. PATRIOT battalions (U.S. PATRIOT battalions consist of four PATRIOT batteries) could cost up to $1.27 billion dollars apiece without missiles. PATRIOT interceptors are estimated to cost about $4 million per missile.

U.S. Army PATRIOT Units and Readiness Considerations

Because the PATRIOT battery and associated interceptors being sent to Ukraine could be taken from existing Army units and stockpiles, an understanding of PATRIOT in the basic force structure and related readiness issues could prove useful to policymakers. According to the Army, there are 15 PATRIOT battalions, all of which are in the Active Component. CSIS further notes:

> PATRIOT is a low-density, high-demand asset to the U.S. air defense efforts and has one of the highest operational tempos of the joint force. Every battalion, battery, and firing unit is therefore a valuable commodity. The Ukraine war has further heightened this tempo, with additional U.S. units deployed in Eastern Europe. How sending a PATRIOT battery to Ukraine will affect operations depends on where the equipment comes from. If it is withdrawn from other operational forces, such as U.S. Central Command or U.S. Indo-Pacific Command, that transferring the system to Ukraine may create opportunity costs and potential risks in those theaters. If they are withdrawn from the U.S. homeland, that could impede training or modernization cycles. Out of the 15 Patriot battalions currently available, one is usually being modernized as part of a relatively slow, 15-or-so-year modernization cycle.

PATRIOT Training Considerations

The provision of a PATRIOT battery to Ukraine also requires training for both operators and maintenance personnel. According to CSIS:

> Training courses for Patriot operators and maintainers normally take many months. The PATRIOT system repairer course, for example, takes 53 weeks. Others are not quite so lengthy. The fire control operator course is 20 weeks. The launch system operator course is 13 weeks. Ukraine could save time by sending trained air defenders—for example, troops trained on the S-300 system, which Ukraine has operated for many years. Nevertheless, there is a lot of learning to do before Ukraine will have a functioning PATRIOT system on the ground.

Considerations for Congress

Oversight questions Congress could consider include the following:

- What are the readiness implications for the Army and Combatant Commands associated with providing a PATRIOT battery to Ukraine using Presidential Drawdown Authority (PDA)?
- Will NATO allies provide PATRIOT systems and/or interceptors to Ukraine in response to the Administration's December 21, 2022, announcement?
- If additional PATRIOT systems and/or interceptors are provided to Ukraine, will DOD's security cooperation authorities be used in lieu of PDA?
- With the high cost of PATRIOT interceptors, will restrictions be imposed on what types of hostile systems can be engaged by PATRIOT?
- What are DOD's and NATO's plans to train and qualify additional Ukrainian PATRIOT crews and support personnel?

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IF12297

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