Status Report: EHPOD & EDPOD Projects

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The Project on the Development of the Electronic Warfare Pod (EHPOD) System for F-16 Aircraft is being executed with indigenous facilities under the coordination of TÜBİTAK. The Critical Design Stage of the Project has been completed and the integration activities are in progress. Capable of using both 'coherent' and 'non-coherent' techniques due to its DRFM technology is optimized as the self-protection pod of the F-16 Aircraft, the EHPOD System is able to provide users with "considerably more" effective radiated power (ERP) from both the AN/ALQ-211(V)9 and EL/L-8225 external EW Self-Defense Pods in the inventory of Turkish Air Forces Command (TurAF/HvKK) and internal EW Self-Defense Systems.

The Project on the Development of the Electronic Warfare Pod (EHPOD) System for the F-16 Aircraft was launched by the Ministry of National Defense (MoND) within the scope of the demands of the TurAF. The Project is being executed through indigenous facilities under the coordination of TUBITAK in line with the signed contract. The Project was planned to be realized through10 stages each of which lasts 6 months and activities were launched as of December 1, 2014. According to news published in the press in December 2014, the EHPOD's cost per aircraft was projected as nearly US$ 2 million and the cost of the development and prototype production was estimated at the level of TRY 135 million.

Within the scope of the Project, three EHPODs will be manufactured as serial production prototypes. During attack, defense and joint operations of F-16 Aircraft, the EHPOD will enable self-protection against air defense elements. It is designed as an external pod and it will be integrated to the aircraft and operate in coordination with the KTAS/CMDS with receiver (RWR) and jammer (ECM) features. It is being developed as a system capable of functioning unaided in all flight profiles of the F-16 Platform.

The RWR gives warning as it detects threat radars in the environment, generates data on the direction and the identity of the radar while the ECM system launches Electronic Warfare (EW) to the threat detected by the RWR. The EHPOD will conduct its tasks by utilizing the data on the identified threat, EW technique and system parameters in its task data file. The interface between the EHPOD and the pilot will be achieved with the Pilot Imaging and Control Unit developed as part of the Project.

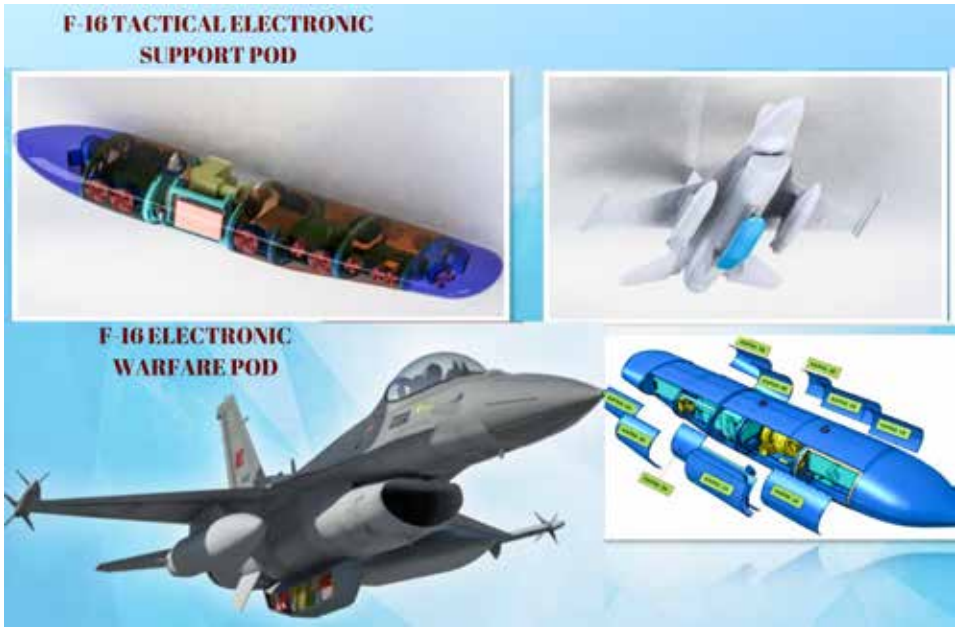
The EHPOD Project is being funded by the TÜBİTAK Support Program for the Research and Development Projects of the Public Institutions. TUBITAK BILGEM ILTAREN is the Project Manager; TUBITAK BILGEM BTE, TUBITAK UZAY and Havelsan EHSIM are the Project Coordinators. Environmental conditions verification and external load certification tests of the EHPOD are being carried out by TUBITAK SAGE. Joint activities are being conducted with the 1st Air Supply and Maintenance Factory Directorate (former 1st Air Supply and Maintenance Center Command) under the TurAF for the identification of the interface with the F-16 aircraft and the integration.

In TUBITAK's recently published 2019 Annual Report, the following information was shared on the latest status of the Project: "The Unit Tests and Critical Design Stage of the Electronic Warfare and Electronic Support Pods have been completed. These are the very first indigenous and national Electronic Warfare Pods.

They are being developed for the F-16 Aircraft platform and integration activities are also being carried out as part of the Project."

We had the opportunity to get in contact with a TUBITAK official at a fair held in 2018 and we were informed that the Critical Design Phase and the initial tests in the laboratory environment had been completed. We were also told that the activities regarding the integration phase had been launched in the second half of 2018. On that very date, the integration activities over the F-16C were planned to be conducted in 2018 and the test flights with the F-16C were intended to be launched in 2019. In light of the information provided in the Annual Report, it may be considered that the first EHPOD flight test to be executed over the F-16, that was previously expected to take place in 2019, could only be conducted after the completion of the integration activities in 2020 or in the beginning of 2021.

The indigenous EHPOD System is being developed as a self-protection (Self-Defense) pod. Self-protection pods are capable of fulfilling operational requirements different than Escort Jamming or Stand-Off Jamming (SOJ) systems, therefore their system requirements are different. Utilization of a pod optimized specifically for one, in the other, is generally not preferred. The indigenous EHPOD is a system optimized as the self-protection pod for the F-16 Aircraft. The F-16 Aircraft is an aircraft with a wide range of flight profiles



and maneuver capability, therefore the design and development of a pod that can be operational in all flight profiles requires the optimization of numerous system functions in an interrelated manner. Another parameter that affects the success in the development of such pods is analyzing all threat spectrums well and carrying out the design and production of the system functions in a way to be effective against all potential threats. All such issues require a very strict development life-cycle where the EW system criteria are identified by the relevant Force in line with specific operational requirements, hardware and software designs that are optimized in accordance with such requirements. Threats are analyzed in a comprehensive and detailed manner and where verification and validation are realized through the execution of large-scale field tests. Moreover, the development of indigenous algorithms is absolutely essential for the performance and security of the system and this entails a deep scientific background and field experience.

The Indigenous EHPOD is a new generation electronic jamming system that is capable of smart jamming through its internal DRFM (Digital RF Memory). This system is designed in a way to feature listening, sense of direction, jamming, deception and noise capabilities. With its broad band, narrow and wide band RWR sub-system, high precision sense of direction, high effective radiated power (ERP), DRFM based broad beam jamming and deception capability optimized for the criteria it is designed upon, multiple simultaneous engagement capability, high-performance heating/cooling system (Environmental Conditioning System [ECS]) enabling the system to operate in all flight profiles, advanced jamming techniques effective against all threat spectrums in line with the operational requirements and reprogramming feature through the Task Data File developed with indigenous design, it is a system ranked among the top category of the EW Pods that exist in the inventories of developed countries.

According to the information shared in the 2016 Havelsan EHSIM Annual Report published in February 2017, the EW Suite Manager concept was developed for EHPOD's integration into the F-16C Aircraft and upon its preliminary design, the system was revealed as a result of the activities performed with the 1st Air Supply Factory Directorate. According to the report, as of December 2016 the hardware and software development activities were being carried out. The report also stated that the Radar EW Simulator (RASSIM) developed as part of the Project would enable the application of threats, that the EHPOD might encounter in the battlefield, into the antenna inputs at laboratory. The threat signals with phase simulation to be generated in 4 different channels by RASSIM in line with

Both EHPOD and EDPOD were displayed at TÜBİTAK BİLGEM booth at IDEF' 19

the generated scenarios will be applied to the EHPOD to test operational performance of the system.

Within the scope of the Project which was planned to be completed in 2019 (though this schedule could not be achieved) TUBITAK UZAY is responsible for the structural design of the pod, cooling system design, aerodynamic design, power distribution unit design and design of the case. Additionally, the structural design of the EHPOD to be utilized in the F-16C combat aircraft that will fly at supersonic speeds, was made in line with military standards by TUBITAK UZAY. The outer shell geometry of the 4-meter long EHPOD was designed as similar as possible to the external centerline fuel tank of 300 gallons (1.150 liters) of the F-16 Aircraft. Aluminum alloys and composite materials (for a light weight and resilient product) are utilized in the production of the pods. The turbo compressor, exchanger, pump, accumulator, pipe system and unions/ fittings are part of the 100% indigenously designed cooling system which guarantees the system's performance under all F-16 flight conditions.

Liquid cooling technology is used in the active heat control system of the EHPOD. The EHPOD with liquid and air cooling and natural heating during the flight receives the air as RAM Air through the air inlet near the front of the hull and spreads it within the pod through the turbo compressor. A RAM Air Turbine (RAT) was not required in the EHPODs as the F-16C Aircraft is able to supply the power required for the system. As a result of the adequate energy efficiency and the existing power supply in the aircraft, there is no need for a RAT type cooling technology.

According to the information we obtained, instead of using Active Electronically Scanned Phased Arrayed (AESA) antenna technology, a broad beamed multiple 'horn' antenna group was utilized in the EHPOD System which is to be integrated and certified for the F-16C type aircraft. The main objective behind the design of this structure is ultimately achieving efficiency in jamming. This form of antenna acquires broad beam capability that could best tolerate direction faults likely to occur in all the maneuvers of the F-16C Aircraft. In conclusion, since the EW Pod is a self-protection EW Pod instead of an Escort Jamming pod, and as the primary purpose consists of the self-defense of the carrier F-16 Aircraft, the multiple 'horn' antenna group design is preferred as the most optimum and cost-effective solution.

In order to fulfill the high ERP requirement, RAT is used in the AN/ALQ-99 series Tactical Jamming System (TJS) and the EL/L-8251 Escort Jamming Pod. Aerodynamic problems occur at supersonic speeds when the RAT is used in the front part of the pod (as seen in the EA-18G Growler and the AN/ALQ-99 TJS), in addition, no antennas can be placed at the fore part of the pod. Instead of a RAT, a High Impact RAM Air Turbine (HIRAT) is being used in the New Generation Jamming (NGJ) Pod that is being developed for the EA-18G Growler Aircraft. According to open sources, while the RAT within the AN/ALQ-99 Pod has a power capacity of 27kW, the HIRAT generator in the NGJ Pod with AESA antenna technology and Gallium Nitrate (GaN) based semiconductor chips (in this way it could be placed in the centerline instead of the nose part) is capable of generating power over 140kW. It is also stated that it will have 360-degree coverage capability as it will feature an antenna in the fore part in contrast to the ALQ-99. There are two CW transmitters in every ALQ-99 Pod and the ERP value of each of these transmitters could reach over 100kW depending on the frequency band. The ERP value for the NGJ Pod is targeted as 1MW. The EA-18G Growler will be able to perform while at supersonic speeds with the help of the NGJ Pod, however, according to open sources, the jamming task can be performed usually at Mach 0.95 that is the speed where the system reaches its highest efficiency.

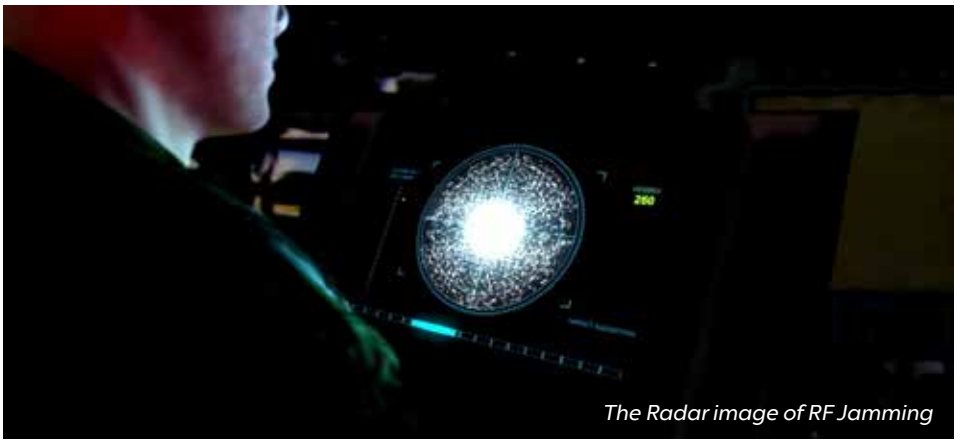
According to the information we obtained, the EHPOD System is capable of providing its users 'considerably more' effective radiated power than both the external EW Self-Defense Pods such as the AN/ALQ-211(V)9 and the EL/I-8225 in the inventory of the TurAF and internal EW Self-Defense Systems.

The EHPOD with a high-capacity DRFM capability is able to apply modern coherent and non-coherent jamming techniques to more than one threat radar. On account of such capacities, the EHPOD is also capable of eliminating the effectiveness of threat radars both in search and track modes.

Modern EW Pods utilize both 'coherent' and 'non-coherent' techniques against threat radars. The technique of phase coherent jamming is claimed to be the top-level jamming technique in technological terms.

Here, the pulse of the threat radar is acquired through utilizing a DRFM and it is recorded and the ET/deception technique is applied and transmitted back to the radar. In this way the radar is convinced that its own pulse returned if it is technologically smart radar. However, if you apply ET over a smart radar without a DRFM, then you say to the radar that you're not jammming it with the artificial pulse transmitted, and in this case when this radar receives the transmitted pulse, it is able to detect that it doesn't belong to it and thus leaves it aside (the 'jamming stop' capability). Therefore, it is not affected by electronic jamming. This capability is called ECCM.

The EW Pod is a strategic product with critical value. Therefore, it has to be developed through indigenous facilities. Because of a few lines of code discreetly installed in the pod by a foreign manufacturer, an imported EHPOD may not be utilized effectively if Turkey goes to a war in the future with the same country that the pod is imported from or with a country that is an ally of this country. Since EW Pod or radars have a sensor (receiver) and as these receivers are designed in a way to receive a certain series of pulses (certain frequency bands), they could easily switch to failure mode due to special software/code previously embedded in the EW Pod or the radar by the manufacturer company. For instance, the system could be triggered to signal a 'temperature warning' through transmitting a series of pulses. Even if the temperature is 25 degrees, because of the pulse transmitted, it can be perceived as 90 degrees and the system may shut itself down due to the Built-In Test function. Therefore, the indigenous EW Pod and air defense radar systems as well as the software and algorithms used in these systems are essential. For instance, due to the EW techniques used during war, Ukraine is not capable of utilizing many of its systems based on Russian technology against the Russian Army or on the separatist powers supported by Russia.



The Radar image of RF Jamming

Internal and Pod type EW Self-Defense Systems are designed in a way to receive a radar pattern; you can instruct what to do when the pattern is received. The system receives the wave of the threat radar, selects the deception/jamming technique and launches the jamming/deception process. By analyzing the pulse transmitted through the radar, the system detects that it is a SA-8 System then identifies it and the EW is launched with the technique compliant with the SA-8 in the Task Data File over it. If no technique is available in the Task Data File, then the System applies the noise technique.

On the other hand, TUBITAK BILGEM has been developing a Tactical Electronic Support Pod (EDPOD) also for the F-16 Aircraft in addition to the EHPOD. The EDPOD features an outer Shell similar to the external fuel tank of 300 gallons at the centerline of F-16 Aircrafts as well. Unveiled at TUBITAK's booth at IDEF '19, the EDPOD System will contribute to the Electronic Order of Battle (EOB) by detecting and identifying threat radars and utilizing their geographical position data. Actually, Electronic Warfare starts way before facing the enemy's aircraft and/or their missiles. Initially, the information and data on the surface, underwater, air and land platforms and the spectral bands/ frequencies of the radars and sensors over them and on the weapon systems they carry (potential threats) should be collected via the EDT/ ELINT Systems and this data should be installed to the EW Data Bank during peace time and a reliable and high-resolution 'Electronic Order of Battle' that will contain all potential threats [surface, underwater, air and land-based] in the area of operation should be prepared. Because the reaction is launched upon the formation of the EOB and on account of the EOB previously prepared, the friendly components' control over the zone will be facilitated. The tactical EDPOD System is capable of detecting threat radars via the Wide-Band and Narrow-Band Receivers over it. After identification, the arrival direction, frequency, pulse width, pulse amplitude, pulse repetition frequency, antenna scanning and inter-pulse modulation parameters are generated. Through the utilization of the arrival direction of the radars, their geographical positions are calculated. The EHPOD System records the contact parameters, location info, Pulse Descriptor Word (PDW) values and raw Intermediate Frequency data of the threat radars for post-operation analysis. It transmits the threat data it acquires to the other EHPODs in the operation field and to the Ground Support System via the Link-16 datalink network. The EDPOD System enables the analysis of the recordings it makes through the software on the Ground Support System. As a result of these analyses, the EHPOD and EDPOD Systems will contribute to the update of the National Joint EW Data Bank ■