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INSIDE THIS ISSUE

PILATUS PC-21

FAST JET TRAINING IN THE SHAPE OF A TURBOPROP

CDR recently sent Aviation Editor, ***Joetey Attariwala****, to Stans, Switzerland, to visit Pilatus Aircraft. We wanted to learn about the Pilatus PC-21, an advanced single engine turboprop training aircraft that is changing the way air forces train the next generation of military pilots. And for Canada, the PC-21 could be an ideal fit for the FAcT (Future Aircrew Training) project and potentially for F-FLIT (Future Fighter Lead-In Training), as well. Here is our firsthand report from Switzerland.*

PC-21 with Swiss Air Force F-18

Pilatus, which is nestled in the Nidwalden valley, was founded in 1939 and is the only Swiss company developing, manufacturing and marketing aircraft to customers around the world. The privately held company is a global leader in the manufacture and sale of single-engine turboprop aircraft from the legendary Pilatus PC-6 Porter, to the bestselling PC-12 turboprop.

Most recently, the PC-21 has been branded as the ultimate military training system and from a jet perspective, Pilatus has developed the impressive PC-24, the world's first ever business jet whose intrinsic design allows it to be used on short, unprepared runways as and when necessary. The company is licensed to maintain and perform upgrades on a variety of aircraft, and is certified to ISO 14001 in recognition of its environmental efforts.

Although a continent away, there is much that connects Pilatus to Canada. Levaero Aviation Group located in Thunder Bay, Ontario, is the exclusive distributor for the Pilatus PC-12 and PC-24 aircraft in Canada. From an operator perspective, the highest profile user in Canada is the RCMP which operates a fleet of sixteen Pilatus PC-12 aircraft, including the special mission PC-12 NG Spectre.

POWERED BY PRATT & WHITNEY CANADA ENGINES

The RCMP fleet along with all other PC-12 and PC-21 aircraft are powered by variants of the legendary PT6A turboprop engine which happens to be manufactured by Pratt & Whitney Canada. Pilatus aircraft also utilize avionics from Canada's CMC Electronics and the company has also worked with Montreal-based, CAE in the past.

Interestingly, Pilatus flew a PC-21 all the way from Switzerland to CFB Moose Jaw to take part in the 2019 Saskatchewan Airshow. The flight across the Atlantic and Canada was done in a series of hops and was aided by the PC-21's ability to carry underwing external fuel tanks - each of which have a capacity of 250 litres. This increases ferry range. It was the PC-21's first appearance on Canadian soil, and from all accounts was a real crowd pleaser.

Pilatus has a long history of developing military training aircraft, notably the PC-7, PC-7 MkII and the PC-9 M, 900 of which have been built to date. Those fleets have provided Pilatus with valuable insights into military flight training and the skills that air force pilots require. That knowledge base, coupled with the use of cutting-edge technology, formed the foundation from which Pilatus developed the next generation of military training aircraft - the PC-21 - which, unlike its predecessors, is a comprehensive integrated training system.

Air forces are seeking new ways of managing and maintaining fleets as defence budgets come under increasing pressure, but the PC-21 provides operators a highly efficient training solution with its ability to cover everything from Basic Training, Advanced Training, Tactical Training to a portion of an Operational Training Unit syllabus. All that, enables pilots to convert to operational aircraft types much later than what would normally be the case.

JET–LIKE CHARACTERISTICS

The ability to do this lies in the PC-21's impressive jet-like flying characteristics along with modern technologies which are suited for the novice pilot as much as it is for advanced pilots preparing for front line platforms. This capability provides Air Forces with substantial cost savings across the training continuum as it negates the need for multiple types of training aircraft, and that, in turn, delivers enormous life-cycle efficiencies when it comes to maintenance and support costs.

The PC-21 is a stepped tandem-seat trainer that delivers a modern and comfortable training environment. Tandem seating enables a student to sit in-front and an instructor behind - this configuration immediately immerses students in an environment that is representative of operational fighter platforms. The aircraft is equipped with a pressurized cockpit, air-conditioning, an anti-G system and on-board oxygen generation.

The PC-21 is mated to the class-leading 1,600 shaft horsepower Pratt & Whitney Canada PT6A-68B engine, which is coupled to a Hartzell five-blade graphite scimitar propeller. This engine pushes the speed and climb rate of the PC-21 into a zone that was, heretofore, exclusively jet territory. It provides sustained low-level speeds in excess of 320 knots, and a maximum speed of 370 knots - which is greater than any other turboprop trainer - and that means the PC-21 has a much larger usable flight envelope. Being a turboprop also means the PC-21 requires much less fuel than a comparable jet

A turboprop with jet-like characteristics

trainer, which is another cost saving feature, particularly when the entire life cycle of a fleet is taken into consideration.

The PC-21's high wing loading, bridges the aerodynamic performance gap between traditional turboprop trainers and front-line aircraft. Hydraulically-assisted ailerons and spoilers enable fighter-like performance, with the PC-21 capable of -4G to +8G, and a roll-rate in excess of 200 degrees per second. A digital power management system and automatic yaw compensation make the PC-21 easy to fly in the circuit, while still providing the performance required for advanced and FLIT training. Endurance of the PC-21 is rated at 3 hours, or 5 hours with external fuel tanks. The PC-21 has minimal scheduled maintenance intervals, with no aircraft depot level tasks required.

ADVANCED COCKPIT

Reto Obrist is a factory test pilot and flight instructor for Pilatus, and he's a former F/A-18 pilot. During our visit he told me, "Part of what makes the PC-21 such an impressive trainer is the advanced cockpit which has displays and systems presented in a way that mirrors what pilots will find in the latest generation of fighter jets."


CDR's Attariwala gets to fly the PC-21 over the Swiss Alps **Photo:** Joetey Attariwala

He told CDR, "This includes multi-function displays, HUD [Heads-Up Display], and HOTAS [Hands-On Throttle and Stick] functionality. The PC-21 also has a new integrated mission computer which consists of Pilatus' proprietary embedded simulation technology which allows pilots the ability to conduct realistic training in air-to-air and air-to-ground tactics and procedures - it's basically a flying simulator. The aircraft also has a Night Vision compatible cockpit and a formation lighting system which is also night vision compatible."

Pilatus test pilot, Reto Obrist, says the PC-21 features a highly advanced cockpit
Photo: Joetey Attariwala

ment, including computer-based training, part-task trainers, full flight simulators, and a mission planning and debrief system.

The PC-21's Mission Planning System (MPS) allows pilots to plan all aspects of a sortie using mission computers that load information to a Pilot Memory Module (PMM) which can then be transferred to the simulator or to the actual aircraft to load pre-flight information. After a sortie or mission is flown, the recorded information on the PMM can be downloaded into the Mission Debriefing System (MDS) for post-flight training analysis.

TRAINING AT A FRACTION OF THE COST

The PC-21's Mission System has open architecture which allows Pilatus to emulate cockpit functionalities of the HUD, HOTAS moding, navigation and radar of a number of fast-jet types. This demonstrates a qualitative training advantage at a fraction of the cost of training mission system operation on current FLIT or front-line aircraft.

The Ground-based Training System (GBTS), in combination with the benign handling qualities of the aircraft and the ability to de-clutter the mission system, means that the aircraft can be used for ab-initio students, eliminating the need for an elementary or

A French Air Force PC-21 with a Rafale fighter jet

The capabilities of the PC-21 integrated training system make it ideally suited to air forces that need an aircraft to satisfy a very wide training envelope. The PC-21's integrated training system comprises the aircraft and a full suite of ground-based training equipment, including computer-based training, part-task trainers, full flight simulators, and a mission planning and debrief system.

basic flying training fleet. When coupled with the Pilatus proprietary mission system that emulates the functionality of fast jets, air forces, in many cases, have eliminated the need for expensive FLIT aircraft. Four major air forces are using the PC-21 in exactly this manner with pilots graduating directly from the PC-21 into operational jets.

My visit to Pilatus also provided me with the opportunity to fly in the PC-21. Prior to saddling up, I had to be fitted for an anti-G suit since the PC-21 is fitted with Martin Baker Mk16 zero/zero ejection seats. Helping me through this process was Guido Frey, Pilatus' Subject Matter Expert for Aircrew Life Support and Survival. Frey took great care to ensure I was fitted for safety and comfort as my flight would take me high over the Swiss Alps, an unforgiving environment if ejection was required.

The pilot for my familiarization flight was Reto Obrist, who patiently guided me through the entire experience. My initial impression of the PC-21 is one of Swiss-crafted perfection. The aircraft is sleek and streamlined and that forecast the impressive performance envelope which I was to soon witness first-hand. The fuselage is dominated by a large bird-strike resistant canopy that provides exceptional visibility for both occupants. The rest of the fuselage has cowlings for easy access to the engine compartment, and a brilliantly designed avionics bay with large service panels located just behind the rear-seat.

I FLY THE PC–21

One of the service panels for the avionics bay is on the belly of the aircraft, so when opened, a maintenance technician can literally stand in a way that he or she is inside the aircraft and looking directly at Line-Replaceable Units (LRUs). This facilitates ease of maintenance, along with troubleshooting support characteristics like Built-In Test (BIT) for major systems and a Health and Usage Monitoring System (HUMS). Such is the ease of supporting the PC-21 that operators regularly demonstrate that a single technician can turn the aircraft around in an impressive 12 minutes.

Stepping up and into the PC-21 requires no ground support equipment. The canopy conveniently opens sideways and allows for ease of access into the seats. An advantage to this type of opening means the ejection seats can be safely removed or installed without the need to remove the canopy, thereby saving time and money.

Sitting in the PC-21 cockpit immediately reminded me of a front line military jet cockpit (I've flown in an F-18). Each seat in the cockpit faces a large Primary Flight

Continued on Pg. 126

Continued from Pg. 85

Display (PFD) and two large Multi-Function Displays (MFD) - these displays can be configured to suit the breadth of military flying training requirements. New pilots can begin training solely with the PFD so they aren't overloaded with information, after which MFDs can be energized to build a larger tactical picture as training progresses.

With that said, operator experience has shown that all screens are used from the outset since student pilots today are also digitally savvy and have little problem assimilating the information presented to them, especially since they would have many hours in simulators before flying the actual aircraft.

Obrist also spoke about the altitudes the PC-21 can operate at, "We can fly quite high which allows us to train above typical cloud layers. That's something that helps us a lot with the weather here in Switzerland - it means we're able to fly more, so I'm sure that would be important in Canada as well. Our flight will be at flight level 130 and higher. Flying higher also means we burn less fuel and we emit less noise."

FLIGHT MANAGEMENT FROM CMC ELECTRONICS

For our flight, startup was very quick and also required no ground support equipment. After a short taxi we launched into a partly overcast sky and quickly climbed above the cloud layer where we spent much of our time. I was seated in the back seat which has a HUD repeater so I could see exactly what Obrist saw from his HUD and he took the opportunity to point out that the PC-21's HUD and Flight Management System is supplied by CMC Electronics in Canada.

As one would expect, the PC-21 has flight controls which are fully balanced and harmonized between both seats. Obrist put the aircraft through its paces as we pulled Gs and he demonstrated the fighter-like roll rate of the PC-21 - which is double the roll-rate of other turboprop trainers, and something that this reporter will never forget! Obrist then slowed the PC-21 until it stalled, from which he recovered in mere seconds.

I had the opportunity to take the controls of the PC-21 and "responsive" is perhaps the best word to describe what it's like to fly this aircraft! The slightest movement of the control stick elicits an immediate reaction, and that speaks to the impressive agility of the aircraft. Once Obrist took back the controls, he demonstrated an IFR approach on autopilot, and finally a GPS (RNAV - aRea NAVigation) approach to landing at Stans.

Obrist was also eager to showcase the embedded training modes within the PC-21 that are robust and conveniently negate the need for a dedicated weapons range. In air-to-air (A/A) simulation mode the PC-21 can locate, track and engage computer-generated targets that appear on a synthetic radar display projected on a MFD. This tactical picture can be shared across multiple PC-21s via datalink, which further enhances advanced tactical training. The same can be said of the PC-21's synthetic air-to-ground (A/G) mode. In this case, PC-21s flying over a known area use a map of the actual terrain such that the aircraft position is harmonized perfectly with the ground which is essential to avoid negative training. The PC-21's embedded simulation capability allows student pilots to "fight" the aircraft and employ simulated weapons and countermeasures in safety and with repeatability until tactics and procedures become second nature. The aircraft also incorporates a real-time and post flight debrief scoring system for simulated A/A and A/G weapons.

MAJOR AIR FORCES SELECT THE PC–21

Pilatus has over 30 military customers across its portfolio of aircraft. To date the company has sold 235 PC-21s to ten air forces including Switzerland, France, Australia, Singapore, United Arab Emirates, Singapore, Qatar, Jordan and the United Kingdom (QinetiQ, Empire Test Pilot School). The newest customer is the Spanish Air Force, which ordered 24 aircraft in January 2020. All of these customers leverage Pilatus' Integrated Logistics Support System which is customizable to each operator.

In 2008 the Swiss Air Force inducted the PC-21 for pilot training at the Emmen military air base. The Pilatus PC-7 is used in the selection of candidates for the pilot academy and also for basic training after which pilots go on to complete their entire training qualification on the PC-21, with pilots in the fighter-stream transferring directly to the F/A-18 Hornet.

But, one of the notable operators of the PC-21 is the United Kingdom's world renowned Empire Test Pilots' School (ETPS), which uses its PC-21s, with their modified flight instruments, to train test pilots and flight test engineers for customers from the United Kingdom and elsewhere.

"Pilatus is pleased to be part of the program of modernization at QinetiQ Test Aircrew Training," said Markus Bucher, CEO of Pilatus. "Our PC-21 will provide a training platform for the next generation of test pilots worldwide. That a global leader in the test flight sector decides to replace ageing Hawks and Alpha Jets with the PC-21 is a tribute to our product's performance and flexibility."

Also operating the PC-21 is the Royal Australian Air Force, a Five Eyes partner. Their AIR 5428 project was aimed at harmonizing Australian Defence Force flight training across all three services - Army, Navy and Air Force. Pilatus delivered a total of 49 PC-21s and supplied significant elements of ground based training equipment and in-service support capability for this project.

BEATING OUT INTERNATIONAL COMPETITORS

As noted above, the Spanish Air Force now becomes the third European air force to opt for the PC-21 which will replace the Casa C-101 jet trainer. Comprising an integrated training system, the order includes simulators developed and produced by Pilatus, spare parts and logistics support. Oscar Schwenk, Chairman of Pilatus, told CDR about the competitive contract award, "As a small Swiss aircraft manufacturer, I'm delighted at our repeated success in winning over large, international competitors. This result is proof that, with our PC-21, we can deliver the very best training system in the world."

Operators around the world have recognized that the Pilatus PC-21 delivers considerable cost efficiencies when compared to equivalent jet trainers, all without compromising on capability. As we've attempted to detail here, the PC-21 deserves the accolades it receives as the ultimate military training system for the future, particularly as it shortens the training process by minimizing unnecessary transitions.

All that in addition to PC-21 customers being able to reduce the cost of training a military pilot by as much as 50 percent. It's a compelling story and a solution that may well fit Canada's requirement for FAcT and quite possibly for the F-FLIT program as well. ■

***Joetey Attariwala** is CDR's Senior Staff Writer and Aviation Editor*