Engines ... *cont'd*

The first engine finished its acceptance testing in late January 1961. Orenda was able to utilize most of the Canadian companies that had manufactured accessories and parts for the Orenda and Iroquois programs, giving the J79 a high Canadian content.
Production of the J79 continued until the mid1960s; 478 engines were delivered. Some of these engines are still in service with the Turkish Air Force and some in Germany, 35 years after the first engine was delivered.

J85-CAN-15

The J85-CAN-15 was manufactured under licence from General Electric to service the R.C.A.F.'s CF5 strike surveillance produced by Canadair under Licence to Northrop. In production in 1967, this afterburning engine developed approximately 4,000 lb thrust with the same physical dimensions as the J85-CAN-40 (except for the afterburner) which produces about 2,900 lb thrust.

The axial-flow turbojet engine, about 18" in diameter, 45" long, with a 58" afterburning tailpipe had a very high performance-to-weight ratio. It swallowed air at a rate of some 1.25 tons per minute and burned 6 gallons of fuel per minute to produce 2,900 lb. of continuous thrust at the jet nozzle.

When maximum power was required, extra fuel burned in the tailpipe, increasing fuel consumption to 20 gallons per minute and thrust to 4300 lb. To get that thrust, the engine performed at 16500 rpm. .

On May 4, 1968, the first Canadair built CF-5 supersonic tactical fighter, powered by two J85CAN-15 engines flew at Edwards Air Force Base, California. The plane flew for 61 minutes and went supersonic twice. The engines each delivered 4300 lb. sea level static thrust.

A total of 609 J85-CAN-15s were built until May 1974, when the program was discontinued. Orenda still provides repair and overhaul services for the engines still in use.

J85-CAN-40

Orenda manufactured the General Electric J85CAN-40 for the Canadair CL-41 Tutor trainer aircraft, under contract to the Canadian Government. The RCAF accepted the first engine officially in September 1963. By October 1965, overhaul, spare parts manufacture and 1965, Orenda had produced a further 230 J85-CAN-40s.

The J85-CAN-40 is perhaps best known today as the engine that powers the Tutors used by the Canadian Air Force in the aerial displays of the Snowbirds.

Orenda still provides repair and overhaul, spare parts manufacture and engineering product support services for this engine.

END OF PART THREE

Part Four of A.V. Roe Canada will continue with "New plant changes Malton's landscape forever".

Members Matter

This is the member's third issue of Pre-Flight for the year 2012. This issue had been held back in order to bring you update information on the Canadian Air and Space Museum's situation.

I have received permission to reproduce Chairman Ian McDougall's message for those who do not have a computer. This message was published on the CASMuseum's website.

NOTE—The AHFC's Annual General Meeting for 2011-2012 will be held in September this year.

Chairman's Message - March 30, 2012

The Canadian Air & Space Museum is pleased to confirm discussions with the Greater Toronto Airports Authority (GTAA) regarding the potential opening of a revitalized Museum in an outstanding new location which will allow for vastly improved access for residents and visitors to the Greater Toronto Area.

The Greater Toronto Airport Authority, along with several airport based private businesses including Flight Solutions and Services, Partner Jet, UYJ Air & MxAerospace are together providing interim storage of the Museum's important artifacts and archival material while potential development opportunities within the Greater Toronto Airport Authority's site are explored.

No binding commitments have been made at this time. However the Museum Trustees and the GTAA are evaluating opportunities to preserve and present Toronto's aviation past which includes watershed achievements at both the Malton and Downsview airports. All the parties share a belief that Toronto's many aviation and space contributions to Canada's rich history should be presented in innovative and exciting ways for the enjoyment and educational benefit of future generations.

Ian A. McDougall, Chairman

PART 3

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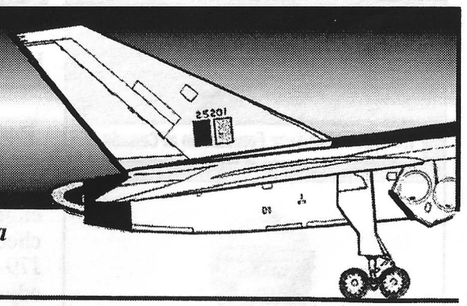
Pre-Flight



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The Orenda Years

(Part Three)

Sir Thomas Sopwith Laboratory

The Sir Thomas Sopwith Laboratory, near the new Orenda plant, was a research facility where scientists and technicians conducted experimental work that would advance the aircraft industry in Canada. For example, the various labs conducted:

(a) Metallurgical research, including experimental work on new metals, high temperature creep, fatigue, corrosion, surface finishes and heat treatment.

(b) Mechanical research, which studied the behaviour of all the mechanical components of engines under extremes of temperature and pressure. Test rigs were set up for bearings, seals, gears, starting equipment, anti-icing systems, lubrication pumps and overspeed tests.

(c) Fuel system research, which studied the behaviour of engine fuel and control systems.

(d) Vibration research, examining vibration and balance problems arising during engine development, especially compressor and turbine blading.

(e) Instrument research, focusing on the development of special instrumentation for other labs, engine test houses and test aircraft. Special probes for aerodynamic and mechanical investigations were maintained, repaired and calibrated. Special techniques were developed for which no commercially available instrumentation existed.

Founded 1989

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Famous Names, *cont'd*

F404 Test Cell

After many months of preparation, the new test cell for the GE F404 engine was completed in early August 1985. The first F404 engine check was run at 3:30 on August 6. The test cell was formerly used for J79 engines. To meet the requirements of the F404, the test cell and adjoining control room were totally rebuilt, representing a major capital outlay by the company. The F404 required an entirely different installation from that of the J79.

The new engine was suspended from a massive overhead structure with all supply and instrumentation lines connected from above. The control console embodied the latest advances in technology. Engine test running was largely under computer control, with much less manual input from the operator. Temperature, pressure and other readings from the engine fed out on an automatic printer. A remote-controlled TV camera provided close-up views of the side of the engine not visible from the observation windows.

Industrial gas turbine around the world

Early in 1959, the Engineering and Sales Departments began to study the possibility of entering the industrial turbine business, using the design of the Orenda engine as a base. It became apparent from conversations with potential customers in the petroleum and natural gas industries that heavy frame type industrial turbines were preferred to the aero derivative type. However, the aero derivatives could be acceptable to the electrical utilities for peak load generation.

The major difference in operation between a jet gas turbine and an industrial gas turbine is the way the hot exhaust gas is used. Like its aircraft-powering "cousin," the industrial gas turbine is used to generate power; however, the power is on or below ground.

OT-2

A conceptual design of a heavy frame turbine, using the aerodynamics of the Orenda 11 and 14, complete with a single-stage, free power turbine was produced in 1960. This turbine, called the OT-2, is approximately 18 feet long, 9 feet wide and weighs 25 tons. The 28-foot-long base on which the engine is mounted adds another 17 tons and includes provision for mounting a compressor or electric generator and accessories.

The OT-2 Series of industrial gas turbines had three versions: The OT-F-270 (Simple Cycle, 8250 hp); OT-F-2708 (Regenerative Cycle, 7800 hp); and the OT-F2100 (Simple Cycle, 13,800 hp)

OT-3

The OT-3 consisted of the power turbine of the OT-2 driven by the exhaust gases of an Orenda jet engine modified for burning diesel fuel or natural gas instead of jet aircraft fuel. At the time, both machines were rated at about 7400 hp, up rated since then by increasing firing temperature and speed.

Turbines ... *cont'd.*

OT-5

The OT-5 is a heavy frame single shaft engine, using about one-quarter scale aerodynamics from the Orenda 11 and producing 1650 hp. The first industrial engine installed was an OT-5 driving an electrical generator, one of 18 installed in Pinetree Radar Stations in Western Canada. Installations are still in use for emergency electrical generation, gas compressor and refrigeration compressor drives. In 1961, Orenda took its first order for industrial gas turbine engines. In the following ten years, Orenda built and sold 125 engines, representing 680,000 hp. The National Research Council in Ottawa took delivery of the first OT-3 power turbine in Spring 1962, for use as a wind tunnel fan drive. The turbine was driven by the exhaust gas from a remotely mounted Orenda jet engine.

Some of Orenda's early industrial gas turbine customers included: the Royal Canadian Air Force, the U.S. Army,. TransCanada Pipelines, Northern Illinois Gas, Great Lakes Gas Transmission Co. , Alberta Gas Trunk Lines, Creole Petroleum (Venezuela), Productos-de-Vidrio, S.A. (Venezuela), Olin Chemical Co. (Kentucky), Ontario Hydro, British Gas, and Louisiana Power and Light Company.

The first OT-F-2708, was delivered to TransCanada Pipeline in 1963 for installation at Orient Bay near Fort William (now Thunder Bay). Five more OT-F-270s were delivered to TCPL, two OT-F-270Rs to Alberta Gas Trunk Lines, and six OT-F-270Rs to Great Lakes Gas Transmission Co. in Michigan. The latter represented the first mainline compressor station order from the United States.

The engines powered a 36" diameter pipeline for natural gas, extending from the Manitoba border to Ontario through the U.S. Reflecting customer requirements for engines with larger horsepower, and to broaden the product line, the OT-F-2 design was modified to add 2 stages to the existing 10-stage compressor and to add a second power turbine stage. These changes up rated the engine to 10,650 hp with only a slight increase in size. The five TransCanada Pipeline OT-F270s were converted to the new configuration, called OT-F-2100, and a further three were delivered to Alberta Gas Trunk Lines. By September 1969, total running time on all the OT-F-2708 and OT-F21200 engines had neared the 300,000 hour mark with one OT-F-2708 up to 40,000 hours. In 1969 Orenda was selected as the supplier of gas turbine generating sets for Disney World, near Orlando, Florida. The equipment, delivered in May 1970, consisted of two OT-F-3 packaged generating sets, each set rated at 5500 kw. The sets generated directly a portion of the electrical load at Disney World and the exhaust gases were utilized in waste heat water heaters to supply hot water for air conditioning and heating loads. One of Orenda's leading customers for industrial gas turbine engines has been Ontario Hydro. The auxiliary equipment at Hydro's very large thermal generating stations-pumps for boilers, fans for furnace blowers, etc. required large quantities of power.

The gas turbine engine met the need for standby power for these auxiliaries. Orenda supplied 19 OT-F-3 Generating Sets, which were installed at Lakeview, R.L. Hearn, Nanticoke, Lambton and Clark Keith thermal stations, and the Pickering nuclear-powered station. Another major customer has been the worldwide Esso-Standard Oil organization. As of November 1969, they had a total of 13 OT-C-S industrial gas turbine units in service or on order. Five of those units were purchased by Imperial Oil for installation in Canada. The other eight, all OT-F-3 units, were installed in Venezuela by Creole Petroleum Corporation for driving oil or water pumps.

Around March 1, 1970, the 53 Orenda OT -5 Series Industrial Turbines in service passed the one million hour mark for total running time. This is the equivalent of 114 years of continuous running for one engine. The million hours is spread over the 53 engines, under many different kinds of service and in different climates. In Fall 1970, the sale of an OT-F-390 gas turbine compressor package to Alberta Gas Trunk Line was announced. This improved version of the OT-F-370 looked the same as the 370 and had identical dimensions and common systems.

However, it produced 20 percent more power and had an improved heat rate. It was rated at 9,280 hp, achieved with modest modifications to the hot end components. Production of the industrial gas turbine ceased in the late 1970s. However, units are still in operation worldwide: Britain, Dubai, Canada, the U.S., Mexico, Venezuela, New Zealand, China. To date in 1996, over 9,000,000 operating hours have been accumulated by Orenda's industrial gas turbines.

Engines under licence

J79-OEL-7

After the cancellation of the Arrow and the Iroquois, Canadian design and development of military aircraft and engines came to an end. The Lockheed F-104 fighter aircraft was chosen as the successor to the Sabre by mid-1959 and Orenda was contracted to build the General Electric J79-OEL-7 engines for those planes. The drawings and specifications arrived from GE in late October 1959.