The NStar Chronicle

Project North Star Association of Canada March 2010

Merlin Musings

Fourteenth in a series

Ted Devey

Overhauling a Merlin 622 (4)

Completing assembly and installing the Power Pack on the North Star

In the thirteenth article of this series, I described some of the difficulties in completing the assembly of the Power Pack. Our time was taken up with connecting pipes and conduits, wirelocking fasteners in places of difficult access which was due to the structure of the engine support frame being in the way of arms hands and tools. These tasks were completed successfully by the Merlin Crew after developing much patience. In memory, I hark back to the caption under some of the "Out Our Way" cartoons of the 1930s and 40s, namely "Heroes Are Made, Not Born"

Home Again

The firewall on the engine nacelle was cleaned and prepared for receiving the Power Pack. On the 16th of February, the engine was returned in sparkling condition to its home where it had resided in the Great Canadian Outdoors for thirty-nine years. With cowlings off, #1 engine presents a contrast to #2 engine which is awaiting the same procedure as the Merlin Crew inflicted painstakingly on the former.

The final tasks to complete the re-installation of #1 were the connection of various pipes, hoses and electrical cables to the firewall and lockwiring them. The flexible coupling was the final connection from the engine to the auxiliary gearbox mounted on the firewall. Mounting the cowlings is the last of the assembly activities. The cowlings were refurbished to repair corroded areas, dzus fasteners were all replaced with new ones and the surfaces were polished.

Disconnected jottings

The following comprises a collection of thoughts, facts and opinions which would have been difficult to include in Merlin Musings without disrupting the smooth flow of language.

The difficult we do immediately, the impossible takes a wee bit longer.

The North Star Power Pack comprises the assembly of the engine, cooling radiators and other parts mounted forward of the nacelle firewall or bulkhead. It is often referred to as a "Quick Engine Change (QEC)" because an engine could be disconnected and removed from an aircraft and replaced with an overhauled engine in short order. Technicians could do a complete engine change within one to two hours depending on the skills and experience of the crew, facilities (and often the weather). RCAF North Star crews have had occasion to change an engine in the

Contents of this volume:

Aleutian Islands in wintertime on the Korean run.

North Star 17515 was flown to Rockcliffe in 1966. It was not corrosion-inhibited and it remained outdoors unprotected until 2005 when it was moved into the new storage hangar.

"Nacelle" is loosely defined as an enclosure for some sort of machinery or other things. The fuselage or wing is not included in the definition. Sometimes, the term is used to describe an enclosure for a piston or turbine engine. In the case of the North Star, the term "nacelle" refers to the enclosure aft of the engine firewall. The enclosure containing the engine and three radiators as an assembly is called a "power pack".

The difficult we did immediately, the impossible took some time longer.

Was the overhaul of this Merlin engine difficult for an inexperienced crew that knew little about what it was doing? Not really, because dismantling anything is a lead-pipe cinch. The overhaul consisted mostly of cleaning parts with solvents, elbow grease and glass beads propelled by compressed air. Seals and gaskets were replaced, as were broken piston rings. Re-assembly was complicated by forgetting how a unit came apart. The crew referred to drawings, pictures and text in manuals worded for trained mechanics with experience in overhaul.

Mike Irvin, the Museum project manager ordered replacement seals, gaskets, piston rings and specialised pieces from a supplier on the Island of Jersey in the English Channel which we incorporated in the overhaul. Mike is a tough task-master, and his sharp eye missed nothing. A two-way relationship between Mike and the Merlin crew was well lubricated by respect, tolerance and, above all, plenty of good humour. The whole project was a good deal of fun. After all, we are back at it again ready to take on three more Rolls-Royce Merlin 622 engines.

Pierre Drapeau is a retired Air Canada jet engine mechanic familiar with Rolls-Royce engines and procedures. Before we commenced work on the first engine, he commuted regularly from his home in Montreal and did research in the Museum library on this Merlin. He photocopied manuals and parts lists which we used as reference throughout the overhaul. Additionally, he spent many hours at home producing updated pages for the parts lists. He also worked on the engine during his visits to the Museum. Pierre's contribution to this project was very valuable to the crew.

The difficult we did almost immediately, the impossible took about three and one-half years!

PNSAC

Flying the North Atlantic

Captain Bill Tate

Route structure

During peak operations in the summer, there is a total of 1,200 flights (270,000 passengers per day) that operate daily in the North Atlantic Track System, with roughly half operating eastbound, and the other half operating westbound. Of these, 75% operate in the Organized Track System (O.T.S.) and the remaining 25% in a Random Track Structure (R.T.S.).

The tracks in the O.T.S. are determined twice per day by the controllers in Shanwick, an amalgamation of the Shannon and Prestwick Oceanic Control Areas (O.C.A.), and the Gander Oceanic Control Area. The area covered by Shanwick extends roughly from 61 North 10 West to 45 North 10 West to 61 North 30 West to 45 North 30 West. For Gander, it starts at 61 North 30 West and 45 North 30 West to 65 North 63 West to 45 North 51 West. These definitions are rough guides as there are overlapping areas of Air Traffic Control (A.T.C.)., for example Canadian Domestic Air Space starts with Edmonton Arctic Control in the North than Montreal A.R.T.C.C. or Center (Air Route Traffic Center) Gander Center and then Moncton Centre along with the respective O.C.A. airspace.

Tracks are selected on the basis of fuel efficiency, maximizing tail winds or minimizing headwinds. On average, five tracks are used for each twelve hour period, and they are usually separated by as little as one degree of longitude (60 nautical miles).

The first westbound track would be designated Track Alpha, the next would be Track Bravo, continuing in alphabetical order. For eastbound tracks, the first one would be designated Track Uniform, the next would be Track Victor and so on in alphabetical order. The separation of the track designators eliminates any confusion for the direction of traffic flow. If, for some reason, the O.T.S. does not offer the most economical routing, or if there is as a mechanical issue that would preclude the use of the O.T.S., the airline dispatcher can build a "Random Track".

Operating requirements

The airline crew and the aircraft have to be certified to operate in the O.T.S. For certification, the airline has to have a training program covering flight operations in the O.T.S., such as the Extended Twin Engine Operations (E.T.O.P.S.) program. The crew has to be flight checked to confirm that they are able to follow the established protocol in flying the O.T.S. Also, for certification, the aircraft has to have a Minimum Equipment List (M.E.L.) that will allow it to safely fly in the O.T.S. Some of the items on the A-330-300 have to be operational prior to entry into the E.T.O.P.S. airspace. These include:

1. Both main electrical power bases powered by separate sources, for example, two engine driven generators or a combination of the A.P.U. generator or engine driven generator

2. Three hydraulic systems pressurized and operating normally

3. Sufficient engine and wing anti-ice protection (Example: an engine out condition the pneumatic cross bleed has to be functional as per M.E.L.) to operate in existing or forecast conditions for E.T.O.P.S. portion or diversion

4. Sufficient cockpit displays to safely fly in the E.T.O.P.S. area and to conduct an approach and landing at an alternate

5. Sufficient communication capability for route of flight through the E.T.O.P.S. area and alternate

6. Sufficient auto-pilot capability to safely fly in the E.T.O.P.S. area and alternate

It should be noted that today's auto flight capability is not only used as a fatigue reduction tool for crew alertness but a highly accurate adjunct for cost efficiency.

If the aircraft has a maintenance issue, the M.E.L. is consulted to review capability to operate in the E.T.O.P.S. airspace. We operate under a 120 minute (848 n.m.), 138 minute (975 n.m. or 180 minute (1,290 n.m.) rule (maximum time and distance to an enroute alternate). Each limit is determined by aircraft mechanical status. For example, if there is no Auxiliary Power Unit (A.P.U.) for back-up electrics, we operate under the 120 (848 n.m.) rule. With no M.E.L. issues, we can use the full 180 minute rule.

If not, we have to operate outside the E.T.O.P.S. area, which adds considerable distance as it usually has us operating over Greenland and Iceland. This will result in greater costs due to increased fuel burn. It also causes missed connections for passengers inbound to destination and generally disrupts schedules.

Flight planning

Once the Flight Dispatcher has established the aircraft state according to the M.E.L., he will look at the most efficient route available for each flight which avoids areas of turbulence and severe weather.

Another important consideration for flight planning is the outside air temperature (O.A.T.). If the O.A.T. is minus 65 °C or colder, we cannot fly in this area for greater than 90 minutes due to fuel freeze limitations. With Jet A-1, a common type of jet fuel, the fuel freeze point is minus 47 °C. If we must fly in that area for longer than 90 minutes, there are two options available to prevent fuel freezing: Increase the cruise mach for an increase in skin friction to help warm up the fuel (average ram air temperature rise is roughly 24 °C at Mach .80) or descend into warmer air. The corrective fix above can make issues for A.T.C. due to separation that is based on altitude and fixed Mach numbers.

Once the flight plan is received by the crew, a check is made for gross error checks. For example, is the flight plan distance greater than the Great Circle Route. If it is not, then a segment of the flight plan is missing. This is confirmed by checking the flight plan distance versus the Great Circle distance. For example, the flight from Frankfurt to Montreal is 3227 nautical miles, but the Great Circle distance is 3163 nautical miles. In short the trip mileage will always exceed the Great Circle distance.

The flight plan is entered into the Flight Management Guidance System (F.M.G.C.S) on the aircraft as per the respective airline's Standard Operating Procedure (S.O.P.). Great care is taken in entering the ocean coordinates to prevent Gross Navigational Errors (G.N.E.). Tracks and distances are confirmed. For example, from a coast out point called Oystr to 55 North 050 West, we confirm the track is 091 ° for 187 n.m. This is done for each oceanic waypoint.

Entering the O.T.S.

When we are 90 minutes from the ocean entry way point, we send an Aircraft Communications and Reporting System (A.C.A.R.S.)/data link request for our oceanic clearance. The format has our routing, for example, CYUL/EDDF (Montreal/Frankfurt), our flight number (ACA874), entry point "Oystr" with an ETA, requested Flight Level (cruise altitude), requested Mach Number for cruise, along with the maximum Oceanic Crossing Altitude (O.C.A.) that we can accept.

After receipt of the oceanic clearance, but prior to entering the O.T.S., aircraft are given a fixed Mach to fly and a specific altitude to maintain. The O.T.S. most days has a floor of 29,000 feet (FL290) and a ceiling of 41,000 feet (FL410). This is also the altitude range for Reduced Vertical Separation Minima (R.V.S.M.).

The lateral separation in the O.T.S. is 60 nautical miles and the vertical separation is 1000 feet.

Before the aircraft is certified for entry into R.V.S.M. airspace, the aircraft has to be flown over a Height Monitoring Unit (H.M.U.), in order to confirm that the altimetry of the aircraft is within tolerances. Another requirement for entry is confirmation that both altimeters are within 200 feet of each other. (In most cases they are within fifty feet or less.) In large aircraft there is a third or standby altimeter to resolve any errors between the Captains' and First Officers' systems. Also, there has to be a serviceable automatic altitude keeping device and a serviceable altitude alerting device (aural and visual).

Aircraft operating in the O.T.S. must comply with Radio Navigation Performance -10 (R.N.P. 10), that is, position accuracy within 10 miles 99% of the time. This is achieved through an updating capability with a Global Positioning System (G.P.S.). The next standard will be R.N.P. 4, further reducing the separation minima in order to increase the efficiencies of the O.T.S. as well as cost reductions for the end users.

Prior to entry into oceanic airspace, after confirming weather requirements, we enter our diversion airports into our Flight Management Guidance System (F.M.G.S.) so as to have accurate time and fuel monitoring in the event of a diversion. A Reduced Vertical Separation Minima (R.V.S.M.)/altimeter check is done, confirming altimeters are within a maximum of 200 feet. In most cases, as previously stated they are usually within 50 feet.

En-route routine.

As we exit North American Airspace, Gander Oceanic, in consultation with Shanwick, confirms that our routing, speed and time do not conflict with other aircraft. If there is a conflict, there are several options including a different altitude, different speed, a Reach Time At (R.T.A.) for the outbound waypoint or a different routing. In the vast majority of times, the clearance received is as requested.

We do a Selective Calling (Selcal) check on our high frequency (HF) radio to preclude having to listen to HF radios all through the flight. The background noise sounds like listening to frying bacon. Each aircraft is assigned a distinctive four-letter identification code which, when keyed by the H.F. radio operator, sends a distinctive tone to aircraft via H.F. radio which in turn alerts the crew through an audible alert and flashing light on our audio control panel. We rely on H.F. communications to talk to Gander or Shanwick, which are our controlling agencies while in the O.T.S. Sometimes, depending on traffic or background noise, sun spot activity and solar storms that wreak havoc on H.F. communications, you might have to queue the operator for ten minutes before you can send a position report.

VHF radios are set up #1VHF on 121.5 (guard) and #2 VHF on 123.45 which is air-to-air common frequency.

The Controller Pilot Data Link Communication (C.P.D.L.C.) and Automatic Detection System (A.D.S.) are turned on prior to oceanic entry. With C.P.D.L.C., direct communications with A.T.C. are much easier than using H.F. radios. What A.D.S. does is automatically capture each waypoint passage through the aircraft F.M.G.S. and send the position report to the respective oceanic controller via satellite communications. With C.P.D.L.C., there is no longer the requirement to go on H.F. to make your request for an operational change. Think of C.P.D.L.C. like text messaging: You put your request in the "free text" side and send it directly to the Oceanic Controller via the satellite uplink without having to queue the radio operator.

After passing each waypoint, a very simple but thorough protocol is followed by the pilot flying (P.F.) and the pilot not flying (P.N.F.). Before the waypoint, a check of the triple mix Inertial Reference System (I.R.S.) against the waypoint for gross error , a check of next, and following waypoints, a check of track and distance to the next waypoint. While the P.F. does that check, the P.N.F. checks the information against the operational flight plan for accuracy.

After each waypoint passage, the P.F. confirms the next waypoint, track and distance on the Navigations Display (N.D.) screen which is located beside the Primary Flight Display (P.F.D.) in the cockpit. Crosschecks are carried out on altitude, Mach and aircraft systems. The P.N.F. logs the time of waypoint passage, altimeter, temp, wind comp and fuel readings.

A Strategic Lateral Offset Procedure (S.L.O.P.) is used through the F.M.G.S. A one or two mile offset to track is introduced and is used for traffic avoidance as well as mitigating the effects of wake turbulence.

Once established in the O.T.S., or random track, if there is a reason for diversion, there are several options. The easiest is to offset or parallel the track by 15 n.m., and once established, an expeditious descent is made to be below O.T.S. /R.V.S.M. airspace. Then diversion is accomplished in the conventional manner. The other is to turn 180 degrees while keeping in mind the need for the 15 n.m. requirement to parallel the track. To do this, a 90 degree turn to the right or left is initiated keeping in mind that once the 90 degree turn is completed, the cross track error is rapidly increasing as in cruise you can be doing up to 9 miles a minute. As this rate of change is very fast, one has to give consideration to starting the turn early in order to parallel by not exceeding the 15 nautical mile rule. As lateral distance is only sixty nautical miles between tracks, this will also prevent inadvertent intrusion on the adjacent track.

As a protocol, we enter a fix in the "Fix Information" in the F.M.G.S. which allows us to see the actual entry point for the E.T.O.P.S. area so that any equipment failure prior to that point precludes entry in the E.T.O.P.S. area. After that point, depending on the aircraft status and performance, a diversion might or might not be required. Although the process is detailed, it is intuitive and easy to follow.

In closing, a great sight to see is the heavy jet transports converging on the respective entry points and establishing themselves on the O.T.S.

PNSAC

WWII Monopoly

Commencing in 1941, an increasing number of British airmen found themselves as involuntary guests of the Third Reich, and the Crown was casting about for ways and means to facilitate their escape. Obviously, one of the most helpful aids to that end is a useful and accurate map, one showing not only where stuff was, but also showing the locations of 'safe houses' where a POW on-the-lam could go for food and water.

Paper maps had some real drawbacks; they made a lot of noise when you opened and folded them, they wore out rapidly, and if they got wet, they turned to mush.

Someone in MI-5 got the idea of printing maps on silk. It's durable, can be scrunched-up into tiny wads and unfolded as many times as needed. Plus it makes no noise whatsoever.

At that time, there was only one manufacturer in Great Britain that had perfected the technology of printing on silk, and that was John Waddington Ltd. When approached by the government, the firm was only too happy to do its bit for the war effort.

By pure coincidence, Waddington was also the UK Licensee for the popular American board game, Monopoly. As it happened, 'games and pastimes' was a category of item qualified for insertion into 'CARE packages', dispatched by the International Red Cross to prisoners of war.

Under the strictest of secrecy, in a securely guarded and inaccessible old workshop on the grounds of Waddington's, a group of sworn-to-secrecy employees began mass-producing escape maps, keyed to each region of Germany or Italy where Allied POW camps were located. When processed, these maps could be folded into tiny dots that could actually fit inside a Monopoly playing piece. As long as they were at it, the clever workmen at Waddington's also managed to add a playing token, containing a small magnetic compass; a two-part metal file that could easily be screwed together; and, useful amounts of genuine high-denomination German, Italian and French currency hidden within the piles of Monopoly money.

British and American aircrews were advised, before taking off on their first mission, how to identify a 'rigged' Monopoly set-by means of a tiny red dot, one cleverly rigged to look like an ordinary printing glitch, located in the corner of the 'Free Parking' square.

Of the estimated 35,000 Allied POWs who successfully escaped, an estimated one- third were aided in their flight by the rigged Monopoly sets. Everyone who did was sworn to secrecy indefinitely, since the British Government might have wanted to use this highly successful ruse in another future war. The story wasn't de-classified until 2007, when the surviving craftsmen from Waddington's, as well as the firm itself, were finally honoured in a public ceremony.

Note: Similar accounts may be found at `www.TruthOrFiction.com`

PNSAC

Miscellany

Thanks Triple K Transport Limited

Figure 1: Tim Timmins, President PNSAC, presenting Keith Sabiston, President of Triple K Transport Limited, with The Red Beaver

Photo Credit – Jim Riddoch

Tim Timmins, President PNSAC, recently presented Keith Sabiston, President of Triple K Transport Limited, with a Robert Bradford print, The Red Beaver, in appreciation for support received since the inception of Project North Star. Keith owns and operates a Beaver aircraft, similar to the one in the Bradford print.

Triple K Transport began operations in 1980 with one truck. Today it operates a large fleet of late model, satellite-equipped trucks from its base in Stittsville, providing services to the heavy haul transportation market. Keith built his business "....by offering superior services to customers, one load at a time". For more details visit `www.triplek.ca`.

North Star 17515 at Resolute Bay

Carl Jung was a radio operator with Transport Canada and took this picture of North Star 17515 at Resolute Bay in 1963 on a layover enroute to his duty station. During the 1960s, he served at weather observation stations located at Mould Bay, Alert and Isachsen. Submitted by Bill Stadnyk, Brandon, MA.

Figure 2: North Star 17515 at Resolute Bay

Photo Credit – Carl Jung Collection

Photographs

Photos in this section by Chris Payne.

Figure 3: Peter Houston

Figure 4: James prepping indshield frame

Figure 5: Ted Slack rebuilding engine panel

Figure 6: John Tasseron oversees No.1 installationk

Figure 7: Final cowling polish by P. Houston

Figure 8: Bill Tate at work outside the cockpit

Figure 9: Executive meeting

Newsletter distribution

The NStar Chronicle is delivered to members by e-mail or by regular post to members not having e-mail addresses.

Coming events

The next Members Meeting will be held in the Bush Theatre at the Canada Aviation Museum on Saturday, April 10th, commencing at 10:30 hrs. The Agenda will include reports, Q&A, followed by light refreshments.

Annual General Meetingl

The 7th PNSAC Annual General Meeting is scheduled for Saturday, June 1st, 2010 at the Canada Aviation Museum.

PNSAC executive

Austin J. S. Timmins
President
613-521-9459
ajstimmins@gmail.com

James Riddoch, P.Eng.
Vice President (Project Engineer)
613-596-5108
jriddoch@rogers.com

Roger Button, BA. MA. LLB.
Corporate Secretary
rbutton@hallray.ca

Richard Lodge CA.
Treasurer
rlodge@andrews.ca

Bruce Gemmill
Director, Membership
613-841-7248
dbgemmill@rogers.com

Ron Lemieux
Director at large
rlemieux@sympatico.ca

Garry Dupont
Director at large
gkdupont@magma.ca

Additions

Tom Miller
Research Officer
Chris Payne
Documentation Officer

Newsletter

Executive Editor: A.J.S. Timmins
Photographer: Chris Payne
Typesetter: Drew Hodge

PNSAC Newsletter[1] *email address:*
ajstim@gmail.com *– Attention: Editor*
Web site: www.projectnorthstar.ca

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