DIRIGERE: The History of Air Navigation Training in Canada

Air navigator training began in Canada in 1936 at RCAF Station Trenton.[1[1]] Very few navigators were trained prior to the Second World War, however the creation of the British Commonwealth Air Training Plan (BCATP) on 17 December 1939 had a dramatic impact on this situation. Specialist training expanded at a tremendous rate, resulting in the graduation of over thirty thousand Navigators from the BCATP,[2[2]] over twelve thousand of them Canadian.[3[3]] From that humble beginning, the navigator classification in Canada has grown tremendously, in terms of technology, aircraft, roles, and especially training.

The Canadian Forces Air Navigation School (CFANS) is the basic aircrew training facility for all Canadian navigators, as well as navigators from seven other NATO and non-NATO countries.[4[4]] CFANS has existed in its current form in Winnipeg since 1968, but air navigator training in Canada has been anything but constant. The wheel has been re-invented many times over the last 65 years, with name, location, syllabus, and aircraft changes. Navigator training in Canada has just taken a major leap forward with the introduction of a desktop-computer based simulator, called the Tactical Mission Trainer (TMT), which will allow navigator students to use the same computer software in the simulator that they will use in the aircraft. This has never been done

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[1[1]] *Canadian Forces Sentinel,* Volume 5, 1975, p. 14.

[2[2]] Larry Milberry and Hugh Halliday, *The Royal Canadian Air Force at War 1939-1945.* (Toronto: CANAV Books, 1990) p. 28. The figure taken from the table is 29,963 including Navigators, Navigator (bomber) and Navigator (wireless) students.

[3[3]] W.A.B. Douglas, *The Creation of a National Air Force: The Official History of the Royal Canadian Air Force Volume II.* (Toronto: University of Toronto Press, 1986) p. 293. These figures were taken from the official report to the Chief of the Air Staff at the end of the War. These figures are also available from Milberry and Halliday, p. 28. Douglas' figures are for RCAF graduates only; Milberry and Halliday's cover all BCATP graduates.

[4[4]] CFANS currently has students from Singapore, Korea, and New Zealand, and is expecting to train students from Germany, Norway, Denmark and the Netherlands by the end of 2001.

before in navigator training anywhere in the world, largely because aircraft and simulators have not been software-driven until very recently. This simulator will vastly improve navigator training, and will help students develop the skills needed to perform today's navigator role. The roles of the navigator have also changed significantly in the last 65 years. Navigation using a watch and a map has been replaced with advanced navigation computers like the Global Positioning System (GPS)[5[5]] and Inertial Navigation Systems (INS).[6[6]] GPS and INS have taken the guesswork out of navigating, and allowed the navigator to focus on mission and crew management.

The school in Trenton, Ontario where navigators were trained prior to the Second World War was called the Air Navigation and Seaplane School. The name of the school was changed to the Air Navigation and Reconnaissance School, and was changed again to No. 1 Air Navigation School (1 ANS) on 2 September 1940.[7[7]] The purpose of 1 ANS was to teach advanced navigation to air observers who had graduated from bombing and gunnery schools. The school had been originally intended to open at Rivers, Manitoba; however, construction delays there forced it to remain at Trenton. The school consisted of 227 military and 95 civilian personnel, and flew Avro Anson aircraft. The commanding officer of 1 ANS was Flight Lieutenant F.R. Miller. The completion of construction at Rivers allowed 1 ANS to move west in November 1940. By February of 1941, the staff had grown to 56 officers and 424 airmen. A

[5[5]] GPS is a navigation computer that uses the signals sent out by an American satellite constellation. The satellites send signals to aircraft GPS receivers, and the computer provides three-dimensional position information anywhere on the globe.

[6[6]] INS is a computer that can provide navigational information when initialized with a correct latitude and longitude. The system uses aircraft pitch, roll, and acceleration to calculate speed and direction to update the aircraft's position.

[7[7]] *Canadian Forces Sentinel,* Volume 5, 1975, p. 14.

month later, the first of the Commonwealth trainees arrived in Rivers from Australia and New Zealand.

The increase in bombing missions in Europe caused the demand for air observers to grow in 1941, and 2 ANS was formed at Pennfield Ridge, New Brunswick in July of that year. The two schools operated separately for a year before their amalgamation into the Central Navigation School (CNS). The decision to merge the schools was made for economic reasons, as well as the belief that meteorological conditions in Manitoba were preferable for celestial navigation training. No. 2 ANS moved to Rivers in May 1942, and 1 CNS was created under the command of Group Captain A. Lewis. In July of 1942, the staff at 1 CNS consisted of 103 officers, 1932 airmen, and 248 civilians, with an additional 90 officers and 595 airmen as students. They operated 118 Avro Ansons (Figure 1) and one Stinson HW-75 (Figure 2) aircraft.[8][8]

Figure 1 – Avro Anson

[8][8] Information taken from CFANS historical files.

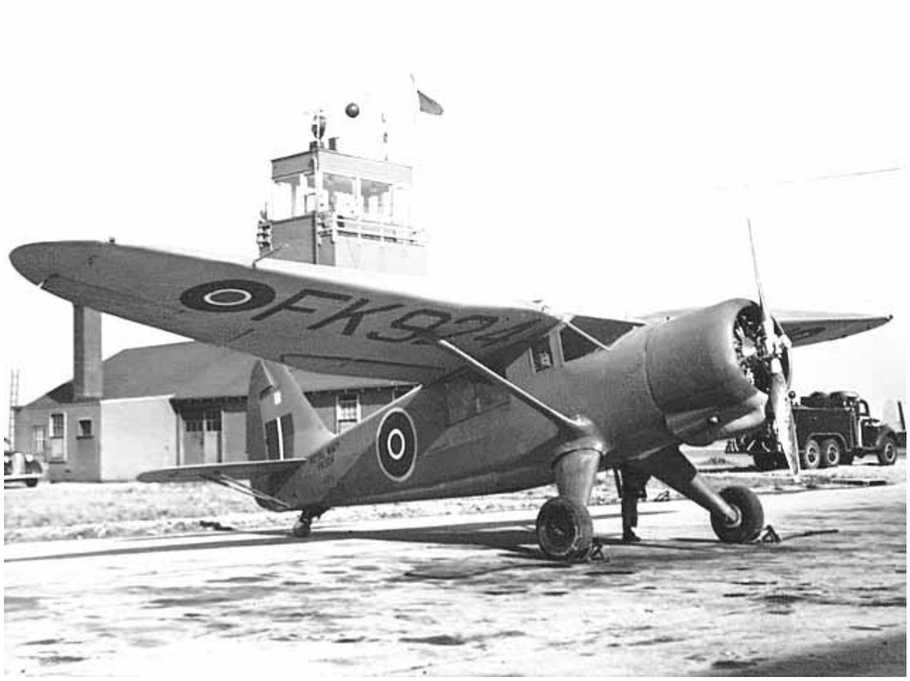

Figure 2 – Stinson HW-75

Operations at Rivers concluded in August of 1945 with the end of the war. No. 1 CNS disbanded on 15 September 1945. These two schools, 1 ANS and 1 CNS, trained 11,406 navigators on behalf of the BCATP.[9[9]]

In addition to the military navigation schools, there were ten civilian operated observer/navigator schools in Canada during the war - suitably designated No.1 through No. 10.[10[10]] These schools opened between May 1940 and September 1941, and the majority closed in April 1945. All used Avro Anson aircraft and civilian pilots. The busiest of these civilian training facilities was No. 7 Air Observer School (7 AOS) in Portage-la-Prairie, Manitoba. It graduated over 5000 navigators[11[11]]. Following the war, No. 3 Air Navigation School opened at Portage. This number of graduates in a five-year period is extraordinary given the weather

[9[9]] *Canadian Forces Sentinel,* Vol 5, 1975 p. 14.

[10[10]] Milberry, *RCAF at War 1939-1945*, p. 456

[11[11]] Ibid, p. 71

conditions endured year-round. Winters were harsh, and the aircraft did not have the advanced anti-icing equipment of modern aircraft. Spring and autumn were no easier, with heavy rainfall leading to mud-caked runways. In comparison, CFANS will graduate approximately 40 students this year[12[12]], using four advanced navigation training aircraft with full de-icing and anti-icing capabilities, plus an air-search radar to avoid weather. No. 7 AOS used 25 Anson aircraft with no de-icing or anti-icing capability and no radar. Staff still graduated over four times the number of students CFANS could with the same number of planes. These numbers are difficult to compare, however, as the role of the navigator was much different. There was no data available on the syllabus of these schools, however looking back it would seem to be much more basic than navigator training today. The output of navigators was still impressive given the conditions. This is only one example of the ten civilian-run observer schools in Canada during the Second World War. The conditions experienced at each one would be comparable, as would be the efforts of the civilian pilots and military instructors.

With ten civilian and five military-run navigator/observer schools, the biggest challenge would have been to maintain an acceptable standard of instruction. CFANS has difficulty maintaining standardization of training and evaluation today, with only thirty instructors and forty to fifty students per year. The difficulty of maintaining standardization among fifteen schools and thousands of students must have been very difficult. There was no statistical data available to properly analyze student performance against the set standard of the time. Most likely the students would have had to demonstrate an ability to adapt to the air and provide suitable navigation. With the demand for navigators being so high, the standards required may have slipped at the schools, with the instructors expecting further training to be provided in-

[12[12]] CFANS has a maximum capacity of 64 students per year, running 8 serials of 8 students. With an historical failure rate of 25%, that equals 48 graduates. Recent years have seen a decline in the number of students to 6 serials of 6 to 8 students, with approximately 40 graduates per year.

theatre. In addition to student standards, instructor standards would have been difficult to maintain, as instructors are usually chosen by seniority or personality rather than instructional ability.[13[13]] Instructors today are chosen in the same manner, based on experience in the field of navigation. This does not always translate to good instructional ability; however, there have been huge advances in the study of human behaviour and how people learn. New instructors at CFANS are given a dedicated three-month course of instructional styles and learning types.[14[14]] It is doubtful whether there would have been time to run such a course during the war.

The wartime syllabus of navigator training was composed of deduced reckoning, map reading, graphical air plot, and celestial navigation. Given the nature of the missions flown during the war, i.e. bombing and reconnaissance missions, the navigator would need all of these skills to get to and from the target. Various methods of expressing position were taught, for example latitude and longitude, and the grid system. The grid system, still used today, consisted of dividing a map into equal sized squares and labeling them. This system allowed navigators to express position easily between aircraft, without relying on complex names or directions.[15[15]] The missions flown in the Second World War were almost exclusively large-scale bombing raids, where geographical features were used for navigation. The navigator in the lead aircraft was responsible for guiding the entire squadron. The use of a grid system to express position rather than explaining terrain features would have greatly reduced confusion among the aircraft. If weather did not permit visual navigation, deduced reckoning and air plot were used. Night

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[13[13]] Earl L. Wiener and David C. Nagel, (editors). *Human Factors in Aviation.* (London: Academic Press Inc, 1988), p. 252.

[14[14]] The Flight Instructors Course (FIC) is detailed later in the paper

[15[15]] *Canadian Air Publication 12, Part One, 2nd edition.* Navigation chapter, p. 14.

missions relied on celestial navigation; therefore cloud cover would have made finding the target nearly impossible.

Training over the prairies for bombing and reconnaissance missions over the English Channel and Europe was good from a weather standpoint, but not from an operational standpoint. Royal Air Force (RAF) Air Vice Marshall D.C.T. Bennett, who founded the Pathfinder Group of Bomber Command, and helped establish the trans-Atlantic ferry organization during the war, was asked about navigation training in the BCATP. His reply was "it was very sound but it was training and you cannot duplicate real experience in training."[16[16]] Air Vice Marshall Bennett felt that newly graduated navigators who flew over to Europe rather than sailing on a ship gained valuable experience and were therefore more valuable assets. His opinion of the BCATP-trained navigators was that they "…were basically sound..."[17[17]] That may sound like faint praise, however it is one of the warmer sentiments ever uttered by an RAF senior officer.

After the Second World War ended, all observer and navigator schools were disbanded, as there was no longer a need for new navigator trainees. The specialist wing of 1 CNS was the only section that survived the post-war disbandment. This group was moved to Summerside, PEI, to form the basis of a new Air Navigation School (1 ANS). This new school graduated two courses of navigator instructors during 1945-1946. Training then ceased at 1 ANS for 18 months pending research on the best direction to take navigation training in Canada. Royal Canadian Air Force (RCAF) training in the specialty recommenced in 1948 with the first Staff Navigator Instructor Course (SNIC) followed by the first specialist navigator

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[16[16]] F.J. Hatch, *Aerodrome of Democracy: Canada and the British Commonwealth Air Training Plan 1939-1945.* Ottawa: Directorate of History, 1983, p. 172.

[17[17]] Ibid, p. 172 & 173.

course.[18][18] The Korean War and Canada's increased commitment to NATO created a demand for more navigators. A second Air Navigation School (2 ANS) opened in Winnipeg in 1951. In January 1952, 2 ANS had 600 students and over 100 Beechcraft Expeditor aircraft. The majority of the students at the time were RCAF and Royal Air Force (RAF). However, students from France, Belgium, Holland, Denmark, Portugal, Norway, Italy and Turkey also trained in Winnipeg.[19][19] The Central Navigation School (CNS) was reborn in Summerside, with the added roles of standards, test, and evaluation in addition to instruction. Canada now had three navigation schools, two in Summerside and one in Winnipeg. Change and consolidation came with the closure of 1 ANS, Summerside, in 1953 and its incorporation into 2 ANS, Winnipeg. CNS remained at the Prince Edward Island station until 1954, when it too moved to Winnipeg.

In the early 1950's, the basic navigation course lasted 22 weeks, comprising 781 hours of ground instruction and 150 hours of airborne instruction.[20][20] The syllabus remained the same as the one used during the Second World War – with the aim of training prospective navigators to fly with confidence under any circumstances. Graphical air plot, where the aircraft's position and heading are determined using mathematical vectors, was combined with celestial fixing to navigate the aircraft. Using an aircraft's estimated position, the students would use celestial sight reduction tables[21][21] to determine where to look for a particular star or celestial body. A sextant was used to look for the star, and the actual position of the celestial body in relation to the aircraft would determine the position of the aircraft over the earth. This type of navigation,

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[18][18] *RCAF Navigation Bulletin*, Vol. 1, No. 1, January 1949, p. 4.

[19][19] *RCAF Navigation Bulletin*, Vol. 7, No. 2, April 1955, p. 64.

[20][20]*Canadian Forces Polaris* Vol. 4, No.2, 1975 p. 7. Article written by Capt J.G. Parent.

[21][21] Sight Reduction Tables are used to determine to position of a celestial body, using an aircraft's estimated position as a starting point. The SRT will then tell the navigator where in the sky to look with his sextant, a type of telescope. The actual position of the celestial body in relation to the aircraft is used to calculate aircraft position.

which seems archaic by today's standards, is quite accurate, and is still in limited use. In addition to navigation training, the students were being prepared to hold the Queen's Commission. Officer professional training played a large role in the training of navigators, and still does today. There is a military adage that says "You are an Officer first, and a navigator second.[22[22]]"

The arrival of the CF-100 all-weather fighter caused a radical shift in navigator training. The course was split into a basic and advanced course. The basic course, discussed earlier, increased to 39 weeks to cover basic theoretical and practical navigation principles. The advanced course was further split into long-range (LR) navigation and airborne interception (AI) navigation. Basic navigator training was conducted in Winnipeg on the C-45 Expeditor (Figure 3) aircraft. All navigator students took the basic course, and then continued on to the advanced course in either AI or LR navigation. The basic course consisted of deduced reckoning (DR) navigation theory, where aircraft heading and ground speed were used to determine position, compass and instrument theory, electronics theory, meteorology, and celestial navigation.[23[23]]

[22[22]] A saying heard by every new navigator student at CFANS in the Officer Development syllabus.

[23[23]] Milberry, *Sixty Years*, p. 287

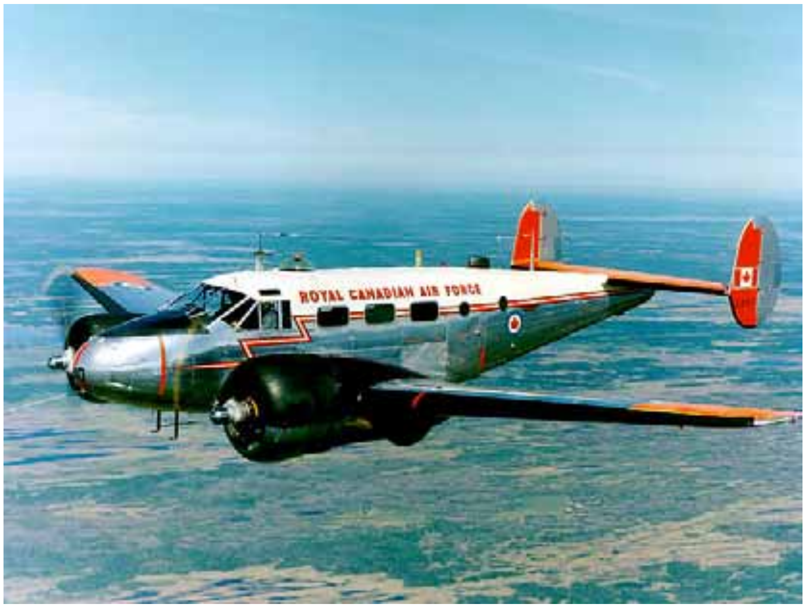

Figure 3 – Beechcraft C-45 Expeditor

AI training was conducted in the North American B-25 Mitchell (Figure 4), and LR navigator training used the Douglas C-47 Dakota (Figure 5). The AI course lasted seventeen weeks and consisted of 406 academic hours and 76 flying hours.[24[24]] Radio Officer (RO) training started in Winnipeg on the Dakota following the incorporation of the Air Radio Operators School (AROS) into No. 2 ANS in 1954. AROS had resided at RCAF Station Clinton, Ontario since 1946. The arrival of AROS in Winnipeg formed the third side of the navigator-training pyramid.[25[25]]

[24[24]] Ibid, p. 287

[25[25]] *Canadian Forces Polaris*, Vol. 4, No. 2, 1975 p. 7.

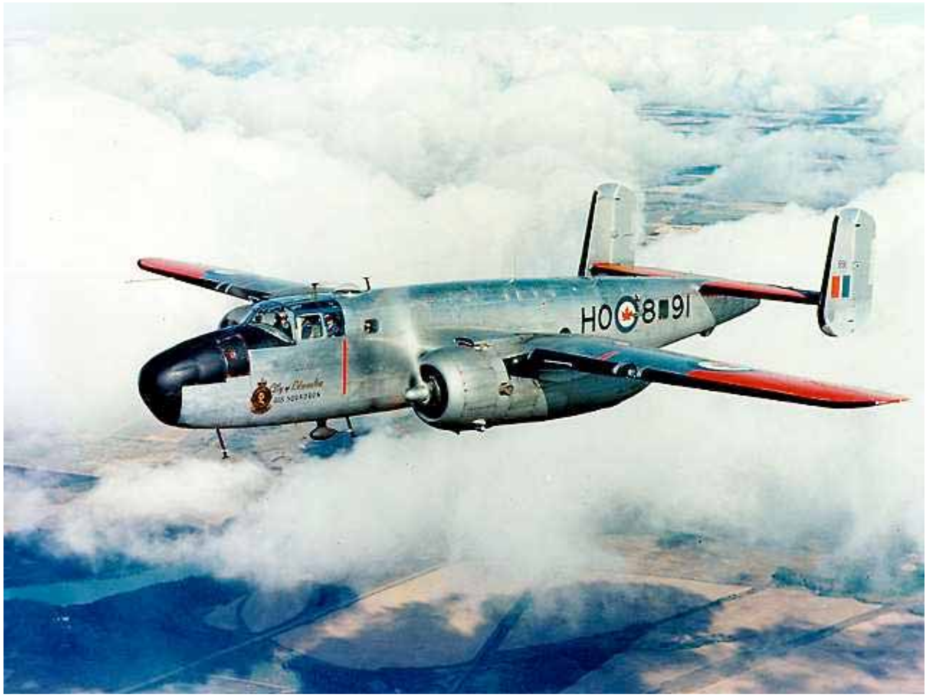

Figure 4 – North American B-25 Mitchell

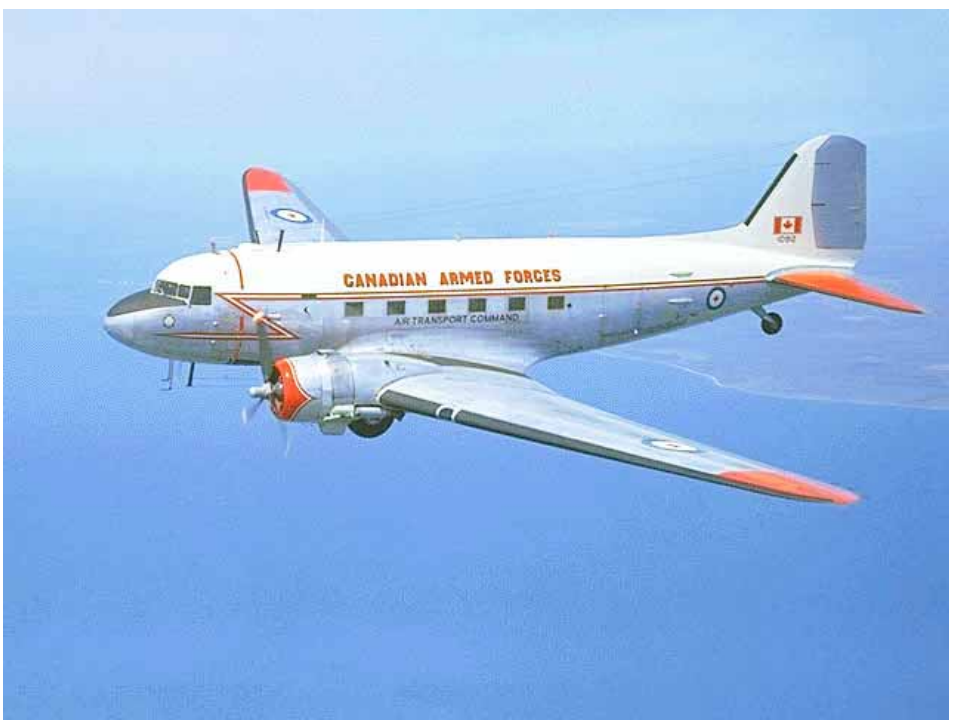

Figure 5 – Douglas C-47 Dakota

The consolidation required new facilities. Consequently, on 26 July 1954, a new building opened in Winnipeg to house ANS. ANS's Ground Instruction School (GIS) was named Mawdesley Hall on 7 October 1958 to commemorate Group Captain F.J. Mawdesley (AFC).[26[26]] In the fifties, the new school taught basic navigation to all students for 22 weeks on the Expeditor. The students then branched into either the applied long-range course (24 weeks) or the applied radio officer course (25 weeks) on the Dakota, or the Applied Airborne Interceptor Course (17 weeks) on the Mitchell. This three level training continued until 1961, when the AI training ceased and the Mitchell's were transferred to Cold Lake, Alberta.[27[27]]

During the same time period, CNS conducted advanced navigator training through three different courses – the Specialist Navigator (Spec N) course, the Staff Navigation Instructor/Navigator (SNIN) course, and the Staff Radio Officer Instructor (SROI) course. The Spec N course lasted 19 weeks, and was similar to the old Advanced Radio Navigator Course. The Spec N course had four main goals:

1) 1) To familiarize students with all aspects of air navigation and associated subjects;
2) 2) To present students with a picture of navigation in its widest sense, the problems to be faced and the development trends in navigation, along with any solutions to the problems;
3) 3) To provide students with the opportunity to visit training, operational, experimental, and manufacturing establishments in Canada, the United States, and Britain; and
4) 4) To provide a flying program that would give the student an opportunity to test and evaluate navigation equipment and techniques.[28[28]]

[26[26]]*Canadian Forces Polaris,* Vol. 4, No. 2, 1975, p. 8 – The Canadian Forces Air Navigation School (CFANS) still resides in Mawdesley Hall to this day. A picture of the official renaming of the GIS is on display at the school.

[27[27]] *Canadian Forces Sentinel,* Volume 5, 1975 p. 16.

[28[28]] The goals of the Spec N course were taken from archival information in the CFANS Unit Historian files.

This course evolved and lengthened over several years to a point where ‘specialist navigation” became a misnomer. It was renamed the Aerospace Systems Course (ASC) in 1962, with a duration of 43 weeks, and remains that today, pursued mainly by navigators, although some pilots and engineers also attend. Members of the air force who wish to be posted to test and evaluation or project management jobs take the course. The course no longer includes a flying program; however, project management and development is heavily weighted.[29[29]]

The SNIN course was designed to qualify selected candidates as instructors and to provide them with knowledge of navigation so that they could assume positions at training units, or at group or command headquarters. The course lasted 17 weeks, the first two at the School of Instructional Technique (SIT) in Trenton. The SROI course aim was similar to the SNIN, however it was for navigators to become electronics instructors for junior radio officers. The course was the same length as the SNIN, and also included two weeks in Trenton. These courses evolved over the years, changing to the Staff Observer Navigation Instructor (SONI) course and Staff Observer Radio Instructor (SORI) course in 1957. January 1958 marked the beginning of advanced training in the Airborne Interceptor field at CNS. The Staff Observer (Airborne Interceptor) Instructor or SO (AI) I course was introduced to develop instructors for Airborne Interceptor training.

The three staff navigator instructor courses continued at CNS until 1965, when they were combined into the Advanced Radio Navigator Course (ARNC). ARNC lasted until 1971, when the Staff Air Navigator Course (SANC) was born. SANC lasted twelve weeks, and was similar

[29[29]] ASC is a high profile “career” course and is a prerequisite for many postings in the project management or test and evaluation fields. The syllabus information came from interviews with co-workers who have taken the course.

in nature to the ARNC course. SANC still exists today, however it is only five weeks in duration.

The Expeditor was removed from navigation training in 1964, leaving the flying work to the C-47 Dakota. The navigation syllabus changed again to form the Undergraduate Radio Navigator's Course (URNC). The first of the URNC courses began in September of 1964. The course lasted 46 weeks, and consisted of electronic navigation equipment theory and application, and limited communication training. This limited communications training caused difficulty for the graduates who went to the maritime community to fly the Canadair CP-107 Argus aircraft. Maritime navigators were still required to communicate using Morse code, and the limited training provided in Winnipeg did not prepare them for the communication workload at the Maritime Operational Training Unit (OTU). The realization of this weakness caused the ANS to once again create a dual-stream syllabus, with a 44-week radio navigator (long-range) course, and a 48-week radio navigator (electronic systems officer) course. The RN (ESO) course was essentially a maritime-oriented radio officer's course. The RN (ESO) and RN (LR) designations lasted until 1968, when they were both changed to Navigator. RN (ESO) training continued, however, with the creation of the Observer trade. This new trade consisted of non-commissioned officers (NCOs) that took a modified version of the RO (ESO) course, with limited emphasis on theoretical concepts. The training was more performance-oriented; the students only had to know how to operate a radio, they did not need to know why it worked. There was also no need to conduct Officer Development, reducing the course even further. The theme of re-inventing the wheel is prevalent in navigator/observer training. Observers were used during the First World War, first as spotters, then as radio operators. Here the trade is resurrected as a spin-off of the navigator trade. The names may change, but the roles and missions remain the same.

In August 1967, Central Flying School (CFS) and Central Navigation School (CNS) were combined to create the Central Flying and Navigation School (CFNS). CFNS shared Mawdesley Hall with the Air Navigation School, and was responsible for "post-graduate" training of pilots and navigators, as well as the maintenance of aircrew training standards in the Canadian Forces. A further reorganization took place in November 1968. The Director of Aerospace and Advanced Systems and his staff, which included the students of the Aerospace Systems Course (ASC), the Advanced Radio Navigators Course (ARNC), and the Navigation Instructor Course (NIC) became part of the ANS, which was renamed the Canadian Forces Air Navigation School (CFANS). The remaining staff, including the Commandant of CFNS formed the Canadian Forces Flying Training Standards Unit (CFFTSU), which fell under the direction of Training Command. CFFTSU was responsible for the quality control of all basic aircrew training in Training Command, just as CFNS had been. CFFTSU was essentially a combined pilot/navigator standards squadron, and was also responsible for Instrument Check Pilot (ICP) training, which focused on advanced instrument flying techniques. CFFTSU still exists today under the name of the Central Flying School (CFS). While the names and acronyms of schools seem to change regularly, the roles rarely do. Aircrew undergraduate training has evolved considerably, however the requirement to maintain high standards has not changed.

In the summer of 1974, the Dakota replacement aircraft was announced. The Lockheed C-130 Hercules would be the new navigator training aircraft used at CFANS. This caused a flurry of activity at the school, requiring the writing of a new syllabus, the formulation of new routes and their approval by Air Traffic Control, and the training of instructors on the new aircraft. A C-130 Training Development Section was created within the school to handle the changes. On 20 May 1975, the Dakota was officially retired and replaced by the Hercules (Figure 6).[30[30]]

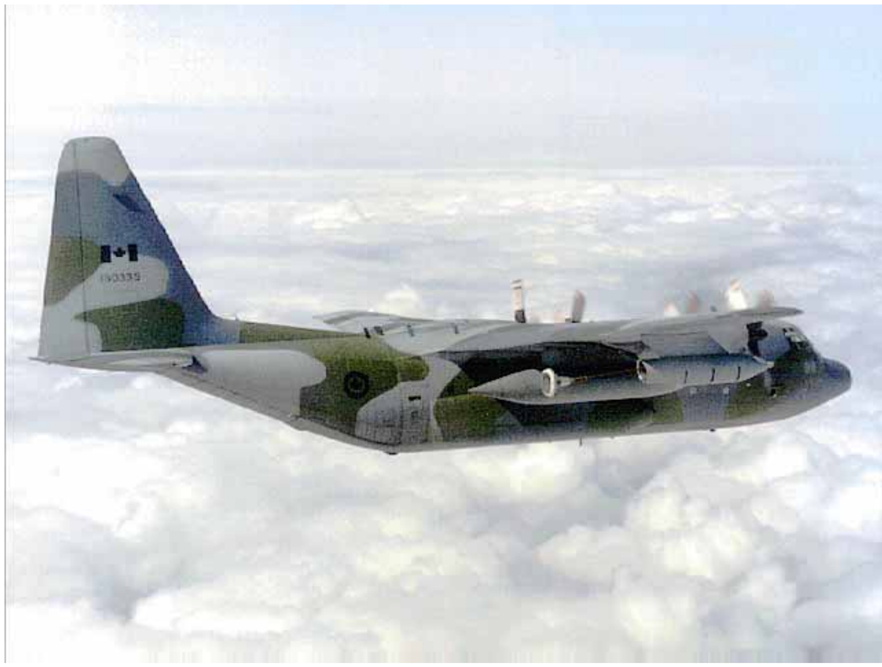

Figure 6 – Lockheed C-130 Hercules

In 1975 CFANS was composed of three squadrons; Basic Navigation Squadron, which conducted the 24-week basic course, Standards Squadron, which monitored and updated the syllabus and ran the instructor course, and the Aerospace Squadron, which ran advanced training for navigators, pilots, and engineers. Four Hercules aircraft were used by CFANS for navigator training, and could be configured for Transport or Maritime navigator training by using pallet-mounted consoles.[31[31]] Each console included one instructor and two student positions, with the instructor seated behind the two students. Two of these consoles could fit inside the Hercules, for a total of four students and two instructors.

[30[30]] *Canadian Forces Sentinel*, Vol. 5, 1975 p. 17.

[31[31]] *Canadian Forces Sentinel*, Vol. 5, 1975, p. 17.

The students worked in the rear of the Hercules at the consoles when acting as follow, or backup navigators. The lead student would work in the cockpit behind the pilots, just as a Hercules navigator does. This gave the lead student access to the avionics in the cockpit as well as to the sextant. The consoles were removable, so that a combination of transport and maritime students could share the same aircraft. CFANS supported C-130 operations when needed by removing the consoles from the aircraft and loaning them to 429 (Composite) Squadron in Winnipeg. The 24-week introductory course covered basic visual and radar navigation, as well as manual air plot and celestial navigation. The course consisted of academics, simulators, and flights, in addition to officer development. The flying missions lasted for five hours, just as in the Dakota. The Hercules flew at 300 knots, nearly double that of the Dakota, therefore the missions could cover more ground and provide a better lead-in to the navigator students' future aircraft.[32[32]]

For the next sixteen years, basic navigator training in Canada used the C-130 Hercules with its pallet-mounted consoles. While the basic tools of navigator training – manual air plot and celestial navigation – were still taught, the advent of new electronic navigation equipment aided the navigator students in transitioning to their later roles in Maritime and Transport Commands. The navigator students who graduated and went on to fly the Hercules had a simple transition to their new job. The maritime graduates however had a more difficult one. The role of the navigator on the Argus, soon to become the Aurora, was one of communications and tactics. The communication gear on the Argus was quite different from the Hercules, and

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[32[32]] Ibid, p. 17.

training for anti-submarine warfare (ASW) in a Hercules over the prairies would be somewhat of a challenge.[33[33]]

The syllabus of the BANC on the Hercules consisted of basic navigation, advanced navigation, celestial navigation, airmanship/air regulations, meteorology, and officer development.[34[34]] All subjects consisted of theory and practical application, theory being learned in the classroom and practical application taking place in the simulator and in the air. The syllabus was taught using a 'building-block' approach, where information is given to the students in stages, with each stage adding to rather than replacing older information. In the basic navigation syllabus, the students were taught how maps were made, how to express position on the Earth, how to do mathematical functions on the Jeppesen computer,[35[35]] and the principles of wind and drift. Once these principles were learned, the students moved on to methods of determining position using electronic navigational aids (navaids), radar, and Doppler.[36[36]] These fixing methods were combined with track plot, a method of using mathematical vectors to determine position and direction.

The celestial syllabus taught the students how to use celestial bodies – stars, planets, the moon, and the sun – to determine their position on the earth. This was a labour-intensive process that required in-depth mathematical calculations and information extracted from celestial

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[33[33]] *Canadian Forces Polaris*, Vol. 4, No. 2, 1975 p. 8.

[34[34]] *Canadian Forces Course Training Plan for the Basic Air Navigation Course* dated 01 November 1977. All subsequent information regarding the Hercules syllabus was taken from this document and from student testimonials.

[35[35]] The Jeppesen is a circular slide-rule, which is used in aviation to calculate airspeeds and altitudes as well as to calculate temperature corrections at altitude. It is still widely used today.

[36[36]] Doppler is downward-looking radar that is used to determine aircraft ground speed and drift.

publications to determine an estimated position. From this estimated position, one or more celestial bodies could be found, and a triangulated position could be derived.[37[37]] This position, or "fix", was exactly the same as a fix derived using electronic navaids or radar, and could be used to start or end a navigational cycle. The students would fix every 30 minutes, and the distance between their fixes would be doubled to determine their ground speed. Once ground speed has been calculated and indicated air speed (IAS) is known, the outside wind direction and speed can be calculated using the Jeppesen. Using the calculated wind, the student could then determine a correct heading for the aircraft to fly to arrive at a predetermined destination. The students would use Doppler to derive wind direction and speed if it was available, or air plot if it was not. The difference between air plot and Doppler track plot was one extra mathematical vector drawn on their chart. In Doppler track plot, one vector was drawn to denote the aircraft's path, or track, over the ground. This was known as the track vector. In air plot, the track vector was drawn, and a second vector, denoting the aircraft's True Heading (heading relative to the direction of true north) and true air speed (TAS) was also drawn. This was known as the air vector. When the student fixed his position, a third vector was drawn from the end of the air vector to the fix and was measured. The length of the vector was measured and doubled, and this gave the average wind speed from the previous half-hour. The wind direction was also determined using this vector by comparing the angle of the vector to true north. This calculated wind was used exactly as the winds calculated using Doppler.[38[38]]

[37[37]] Canadian Forces Air Navigation School *Navigation Procedures Handbook*, 01 Sep 1977

[38[38]] *Navigation Procedures Handbook*

Once the students had demonstrated proficiency using track plot and air plot, they were introduced to the Advanced Navigation syllabus. This syllabus taught advanced navigation principles and methods, like fuel management, calculating estimated times of arrival, and grid navigation. Grid navigation is used in the Arctic, where normal magnetic compasses are unreliable.[39[39]] The students were also introduced the along and across-track computer (AATC), a rudimentary Doppler-based computer that could determine an aircraft's position relative to a predetermined track. This computer was beneficial for search-and rescue (SAR) training, and SAR patterns are usually based on straight lines. The navigator could therefore use the AATC to steer an aircraft around a SAR pattern.

The air regulations syllabus covered the 'rules of the road' in aviation. Aircraft cannot just fly around without regulations, just as cars cannot drive anywhere without rules or speed limits. The air is divided into many classes of airspace; some controlled by air traffic control (ATC) and some not. The students learned the various types of airspace and the rules governing them. The large collection of publications used in aviation was also taught, with the students expected to become very familiar with them. After all, they would be guiding the aircraft through the air, and had to know what kind of airspace they were guiding the aircraft into. In addition to airspace and regulations, the Air Regulations syllabus covered aircraft checklists, and student responsibilities during a real or simulated airborne emergency. The students were taught about ATC services, how to talk to ATC, and how to get ATC to work for them.[40[40]]

[39[39]] Magnetic compasses become unreliable due to the convergence of lines of longitude and excessive magnetic variation. This leads to constant heading changes unless a different datum, or point of origin, is used for direction. Grid navigation is still used in the computer age.

[40[40]] Canadian Forces *Navigator Flying Training Manual* [CFP 139(2) Part One (A)], 30 Apr 1974

The aircraft and electronic systems (A&ES) syllabus covered the various electronic systems aboard the aircraft. The students studied navigational aids in detail, for example very-high frequency omni-directional range (VOR), tactical navigation (TACAN), and automatic direction finding (ADF). The students learned how they worked and how to use them for fixing position. How the navaids work is not important in this context; however, the students need to understand how they work in order to use them. The students also learned the components of the aircraft radar, Doppler, and radios, as well as the aircraft emergency equipment. The A&ES syllabus covered the theory of all aircraft systems, which the students would then use in the air on their navigation missions. This was and still is the most challenging syllabus for navigator students. The systems encountered on aircraft were completely different from anything they had seen before. Just learning the acronyms for all of the systems took many students a few weeks to get a handle on. Once the equipment was used on a mission, however, the students became more comfortable with how they worked and why.[41[41]]

The meteorology syllabus consisted of weather patterns, clouds, precipitation, icing, and how to read actual and forecast weather reports. This syllabus was extremely important, as the students would encounter weather, good or bad, on every mission. They were responsible for reading the weather and deciding if it was suitable for the mission.[42[42]] It was important for the students to understand weather patterns, as warm and cold fronts can have a tremendous impact on wind direction and speed in addition to temperature. It

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[41[41]] *Navigator Flying Training Manual, chap. 5.*

[42[42]] The instructors were ultimately responsible, however the lead student was asked his opinion on weather conditions to see if he understood the report.

was important for the navigator student to know if he was flying near or through a front when he was trying to calculate winds, lest they change dramatically and cause his navigation to be wrong.

The last two syllabi were Morse code and officer development (OD). The Morse code syllabus consisted of two periods, covering the phonetic alphabet and Morse code symbols. The students used this when identifying navaids airborne. Navaids use Morse code ‘identifiers’, signals sent out on a specific frequency. This allowed the student to confirm the navaid he was using to fix. The phonetic alphabet was and still is used to spell on the radio to avoid communication errors.[43[43]]

The OD syllabus covered the role of officers and military life in general. The students studied different forms of written military communication, such as memos and messages; and learned about individual and group dynamics. Effective speaking was a large part of the syllabus, requiring the students to give ten and twenty-minute oral presentations. OD is covered in one form or another on every course taken by officers in the Canadian Forces. In order to be effective officers and navigators, the students had to be able to communicate effectively. A navigator can hardly provide orders and direction to a crew if he is unable to speak clearly and confidently. The OD syllabus gave the students the opportunity to practice speaking in front of their peers and gain self-confidence.

The overall BANC syllabus followed the ‘building block’ format described in the Basic Navigation syllabus. A new concept was taught to the students in the classroom, practiced in the ground-based simulator, and then applied in the air. This sequence was repeated for each new

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[43[43]] *Navigator Flying Training Manual, chap. 9.*

concept, with the new material being emphasized and older material continuously reviewed. This allowed the students to learn and apply new material with a lower level of performance being expected, while the older material would have to be performed at a higher level. The rules of student assessment were spelled out in the Flying Instructor Handbook,[44[44]] which covered assessment guidelines, rules of learning, different types of students, and different methods of instruction. Not every student taking the BANC would learn the same way or at the same rate. Some would learn by listening to the lectures, some would learn by reviewing the material, others would only learn through practical application.[45[45]] The navigator course was not the same as a basic mathematics course. Navigation is an art, not a science. There are no two navigation situations that are exactly alike. Weather, aircraft issues, crew fatigue, and crew cooperation will affect two identical missions on successive days. Not everyone who walked through the doors of CFANS would adapt.

The basic air navigator course consisted of three stages in 1976.[46[46]] The basic navigation phase taught air plot, Doppler track plot, and celestial navigation. The last flight of the phase was a check mission, where no instruction was provided to the student. The instructor would monitor to confirm adherence to standard procedures. The second phase introduced digital computers like the AATC and ROHM[47[47]] to the students. The final phase was the advanced phase, which introduced search-and-rescue (SAR) techniques, low-level radar and visual navigation, and an introduction to high-level airway navigation. The final mission

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[44[44]] *CFANS Flying Instructor Handbook for the Basic Air Navigator Course*, 19 Oct 1976

[45[45]] *Flying Instructor Handbook, p 1-5 through 1-14.* These rules remain in place today, and are a constant challenge to instructors at the Navigation School. Methods need to be adapted to meet different learning styles.

[46[46]] *Flying Instructor Handbook, table of contents*

[47[47]] The ROHM was a digital computer that took airspeed, heading, and drift information to provide positional information to the navigator.

was a solo check mission, where all navigation techniques were checked. Passing this final check mission meant passing the course and earning navigator wings. The syllabus in 1976 was similar to the current BANC syllabus, with the exception of technology and order of instruction. The current syllabus teaches low-level visual and radar navigation first, then proceeds to computer navigation, with SAR and other tactical training last. Air plot is taught only as an emergency measure. In 1976, digital computers were still on the horizon, and air plot, radar, and visual navigation were the means of getting form one place to another. The situation has changed dramatically.

CFANS continued using the C-130 Hercules for navigator training until the summer of 1991, when the DeHavilland Dash-8 was introduced as the new CFANS aircraft. Though much smaller than the Hercules it replaced, the Dash-8, designated the CT-142[48[48]] and nicknamed "Gonzo" (Figure 7) was able to carry four students and two instructors, just like the Hercules. It was nicknamed "Gonzo" due to its elongated nose, which housed the aircraft's radar. The four students and two instructors sat in six

consoles along the aircraft's starboard side. Each console was equipped with a cathode ray tube (CRT) display, a touch-sensitive plasma panel, and a bank of instruments to indicate airspeed, altitude, and heading. All six consoles were run through a central navigation training systems computer (NTSC), which took information from aircraft

instruments and computers and sent it to the navigator students.

[48[48]] CT stands for Canadian Forces Training aircraft. 142 is the CF registration number for the Dash 8.

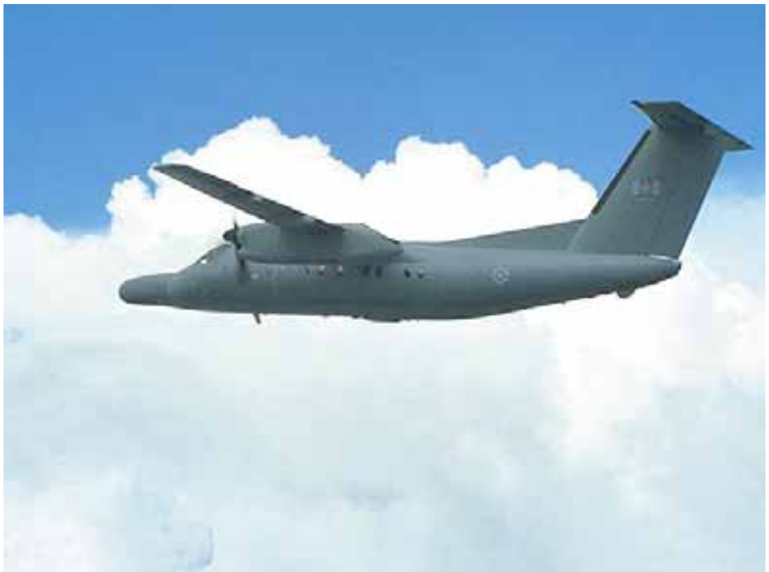

Figure 7 – CT 142 “Gonzo”

The training syllabus was modified slightly to accommodate the new aircraft and changes to the roles of the navigator at operational units[49[49]]. The academic syllabus was similar in nature to the one taught on the Hercules, with the exception of the aircraft systems material. The basic navigation syllabus was identical, as was the officer development syllabus. Celestial navigation did not change either, as the CT-142 came equipped with two sextants in the aircraft cabin. This was an improvement over the Hercules where only one student could use the sextant at a time, and had to climb up to the cockpit to use it.

The flying syllabus was changed somewhat, with a greater emphasis on the differences between the maritime and transport navigator roles. The basic phase consisted of two low-level radar and visual navigation flights and fourteen air plot missions. The first two low-level flights were more of an introduction to flying the aircraft than instructional missions. The remainder consisted of electronic navaid, radar and celestial fixing, with air plot as the means of directing the aircraft. The sixteenth mission was the air plot check mission, where air plot and fixing

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[49[49]] As a navigator student in 1992, I flew on the CT-142 and can therefore speak firsthand on the academic and flying syllabus on the CT-142.

procedures were tested as well as high-frequency (HF) radio communications.[50[50]] After the basic phase was completed the students completed the intermediate phase, consisting of four flights, which introduced them to navigation computers. The students used the Inertial Navigation System (INS) and the Omega system, which was a computer that used the phase shift between received radio signals to determine position on the earth.[51[51]] The intermediate phase also included the operational training unit (OTU) visit, where students got the chance to visit the squadrons where they would fly during their careers. It was a chance for the communities to present the students with a picture of what life would be like on squadron. The OTU visit was an important part of the syllabus, as most students had limited knowledge of what navigators in the various communities did. The basic training portion of a new navigator's career was limited to officer training and language training. There was limited time to experience operational units. At the end of the intermediate phase the students chose what form of advanced training they wished to undertake – maritime or transport. Students submitted a first and second choice, and selection was based on class standing and number of spots available. The advanced phase of the BANC consisted of twelve flights, and included computer and degraded navigation. The Maritime syllabus was more heavily weighted to systems management and communications. The transport phase introduced the along and across track computer (AATC), at that time still used in the Hercules. Both syllabi incorporated degraded navigation, which involved denying the students access to the computers and forcing them to revert to air plot.

The Hercules had used actual navigation computers in the back of the aircraft – the CT-142 used emulated computers, with the control panels displayed on the plasma screens. The

[50[50]] Canadian Forces *Course Training Plan for the Basic Air Navigator Course*

[51[51]] Omega used broadcast stations world wide to send out radio signals. The computer to determine position used the phase shift between the various signals. Omega is obsolete today.

NTSC ran all the emulated systems and allowed the computers to be run independently at each station. This allowed each student the ability to set up their own computer before each mission rather than having students take turns on different flights. This significantly increased the speed at which the navigator students learned how the computers worked. The NTSC also gave the instructors the ability to deny the students access to the computers by using the 'deny' function on their plasma screen. The instructors had an access page on their plasma screens, and could give or deny the students access to the radar, Doppler, or navigation computers. This forced students to fall back on the air plot skills they had learned in the Basic phase.[52[52]]

The BANC syllabus remained the same on the Dash 8 until 1998, when a completely new direction was taken in navigator training. A training standard (TS) review board had taken place in 1996, including representatives from all of the operational units that employed navigators as well as representatives from the training community. The role of the navigator was studied, and it was determined that navigation was no longer the primary focus of the navigator. Tactical direction, mission management, and crew management were the new tasks that navigators were expected to carry out. From this TS review board; a new BANC syllabus was created, using senior instructors from CFANS. Every task taught to the students was reviewed, and either accepted into the new syllabus or discarded. The process of inventing and implementing the new syllabus took two years. Navigator training was about to take a revolutionary step forward.[53[53]]

[52[52]] Canadian Forces Air Navigation School *Flying Instructor Handbook For the Basic Air Navigator Course,* Sep 1984

[53[53]] Canadian Forces *Course Training Standard (Air Navigator Basic),* 02 Nov 1998

On 4 May 1998, Air Navigation training in Canada took that step. With the introduction of the new BANC syllabus, CFANS did away with the old forms of vector addition air plot and celestial navigation. Navigator training would now focus on the current roles of air navigators - tactical employment of aircraft and management of aircrews. Today's navigator does not navigate aircraft from one point to another. The advent of Global Positioning System (GPS) satellites and Inertial Navigation Systems (INS) has taken the guesswork out of navigation. Today's navigator is a systems manager and mission commander, given an airplane and a mission to fulfill. These missions can range from anti-submarine warfare (ASW) on the Sikorsky Sea King helicopter and Lockheed Aurora maritime patrol aircraft, to flying personnel and equipment into hostile territory in a Hercules. CFANS gives navigator trainees the tools to work in today's challenging environment. Navigation and communication skills are taught to the students, as well as crew and mission management skills.[54[54]]

To accomplish these aims, CFANS employs 30 instructors who conduct day-to-day classroom, flying, and simulator instruction. The flying is done on DeHavilland Dash-8 aircraft, a two-engine aircraft that is capable of flying for up to seven hours continuously. Two pilots fly the aircraft, and the back compartment of the aircraft is composed of four training consoles, two instructor consoles, and two crew rest stations. The navigator training system (NTS) is the computer that runs the emulated instruments and computers used by the students and instructors. The aircraft has a fixed GPS system as well as an INS system that feed information to the NTS. The NTS then provides simulated information to the students that they use to navigate. The students each have a GPS, an INS, radar, and a Doppler. The instructors have the same equipment, and also have the ability to give

[54[54]] *Training Standard, p 1-1*

or deny student access to their computers. The transitional tactical awareness trainer (TTAT) is a personal computer (PC)-based simulator that runs similar software to the aircraft. Developed in-house, the TTAT gives the students the ability to practice procedures exactly as they would on the airplane. This is a large step forward from the previous generation air navigation procedures trainer (ANPT), which was completely different from the back of the airplane and had been developed for the old BANC syllabus. The next step for CFANS is the tactical mission trainer (TMT), which is another PC based system developed for CFANS. The advantage of the TMT is that it uses the same software as the aircraft NTS. The NTS is scheduled for replacement in the summer of 2001, and will provide the students with a newer-generation tactical display system (TDS). The TDS has the ability to provide the user with a two-dimensional view of the aircraft position, superimposed on the radar picture. The advantage of having a simulator and an aircraft using the same software and equipment cannot be overstated. This allows training to be seamless rather tan introducing “trainerisms”, a term used to describe procedures used in a simulator and not on the aircraft.

CFANS and the OTUs focus on actively developing the following key attributes throughout the candidates training:

- • **Spatial Awareness** - the ability to accurately determine the aircraft position relative to external references in three-dimensional space and time;
- • **Tactical Awareness** - the ability to accurately evaluate mission related occurrences and requirements and their importance to successful mission accomplishment. The proper prioritization of tasks is an element of sound tactical awareness;
- • **Decisiveness** - the analytical process of combining options for solutions to problems, and all other pertinent factors in order to select the decision which best meets the aim;

- • **Problem Solving** - the process used to determine a solution to an individual situation or dilemma;
- • **Risk Management** - the process used to produce the implementation plan of the decision. This process ensures all risks and consequences are examined and monitored to ensure the appropriate levels of actions are conducted;
- • **Information Management** - the ability to internalize and communicate information in a timely manner; and
- • **Air Leadership** - the art of influencing crewmembers in the airborne environment so as to accomplish the mission in the manner chosen by the leader.[55[55]]

The BANC course is separated into three distinct phases. Phase one consists of six weeks of ground school, four synthetic trainers, and thirteen flights - six on the Slingsby Firefly (T-67) aircraft in Portage-la-Prairie, and seven on the DeHavilland Dash-8. The students begin with three weeks of introductory ground school, where they learn the very basics of air navigation theory and basic communication skills. These first weeks are critical, as the students are being introduced to the skills that they will carry with them through their entire career. They are taught generic navigation terms, such as meridian (line of longitude on a navigation chart), isogonal (line of equal magnetic variation on a chart), and parallel (line of latitude on a navigation chart). They learn how to express position and direction by learning about wind, drift, and airspeed. They are given rudimentary skills in mental math calculation, to help them determine rates of drift while flying. Drift is the lateral motion of an aircraft in relation to the ground. The students

[55[55]] These seven attributes were taken directly from the CFANS Instructor Guide, an aide-memoire for CFANS instructors that covers the laws of learning, instructional techniques and guidance, and an overview of the Basic Air Navigator Course. The RAF Navigation School at RAF Finningley has copied these seven attributes verbatim.

are introduced to the Slingsby T-67 (Figure 8) aircraft and its various characteristics and capabilities. Finally they are shown examples of how to navigate

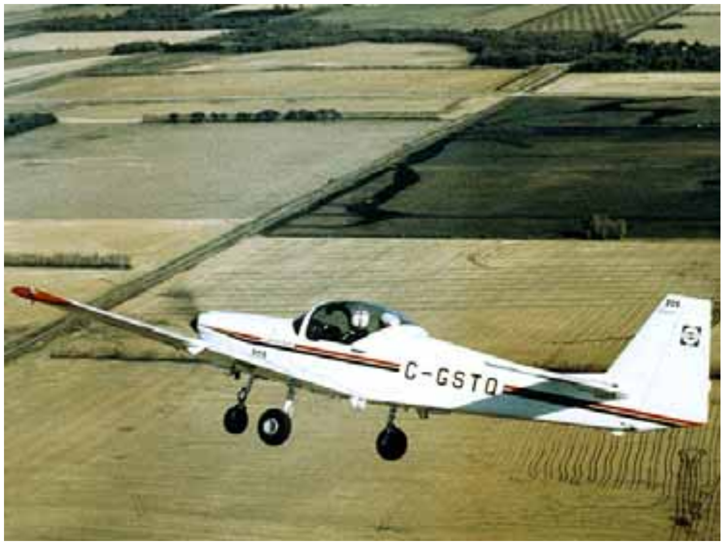

Figure 8 –Slingsby Firefly (T-67)

an aircraft visually given a watch and a navigation chart.[56[56]] The students conduct a communications simulator, where they practice the radio and intercom calls they will make while in Portage. Finally the students go to Portage for three weeks of flying training. While in Portage they will undergo two more days of classroom training and will then fly six flights.

At the conclusion of these flights they will return to CFANS for a further three weeks of classroom work. During these three weeks they learn more detailed information on the Dash-8 aircraft, the airplane they will fly for the remainder of their course. They learn about the aircraft's safety features, and are introduced to radar theory of operation. During their Phase one flights on the Dash-8, the students will conduct radar as well as visual navigation. Following the building-block process of learning, the students are given more tools to complete the mission, however they are also given more responsibility. The students are given a Doppler radar, which uses a downward-looking radar beam to determine the aircraft drift. They are also using radar to

[56[56]] Canadian Forces *Course Training Plan for the Basic Air Navigator Course*, 19 Dec 1998 navigate, which gives precise bearing and distance to their targets or turning points. Phase one missions are broken into four legs - two visual legs and two radar legs. While on the visual legs, the student uses their map and watch to navigate, just as they did in Portage. The difference is that the aircraft is flying twice as fast and the map being used is not as detailed. This causes the navigation to be quite challenging, and requires the student to think on their feet. The radar legs are similar in their difficulty, requiring the students to identify radar points that do not always look like the map does. In addition to their navigation duties, the students are required to make radio calls announcing their position to other aircraft. This is also the students' first exposure to a multi-crew aircraft. While flying on the Slingsby, the students were flying with a single pilot and had no distractions. The Dash-8 flies with three other students and two instructors, making for a busy intercom system. After six flights on the Dash-8, the students are given a check-ride on visual and radar procedures. When they successfully complete the check-ride, they can continue on to phase two.[57[57]]

Phase two consists of twelve weeks of classroom training, eight synthetic trainers, and nine flying missions. The first few weeks have the steepest learning curve of the entire course. The students are inundated with advanced theory of navigation computers, systems management, and communications theory. They learn how GPS works, how an INS works, and how to use electronic fixing aids to determine position. Radar is an electronic fixing aid, as well as TACAN, ADF, and VOR. These navigation aids, or navaids, provide a combination of bearing and distance from a known geographical position, thereby providing position of the aircraft. The students take this information

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[57[57]] The *Training Standard, Training Plan, CFANS Instructor Guide,* and *CFANS Student Guide* cover these requirements and compare it to their computer position, and determine their best source of information. Usually the navigation computers are determined to be the primary source of navigation, and can therefore be used throughout the flight. The students also begin to communicate using the high frequency (HF) radio. The HF radio can be used to communicate over long distances, due to the (relatively) low frequency. Despite being called a high frequency radio, the system actually operates low in the radio frequency spectrum. This low frequency allows the radio signal to "bounce off" the Earth's atmosphere and be

received at great distances. It is not uncommon for Canadian Forces aircraft to be flying in Europe and talking via HF to Trenton, Ontario. The students use the HF to pass message traffic to 'Pipeline', the CFANS HF radio station. These messages can include estimated time of arrival (ETA) as well as exercise traffic, which is simulated message

traffic to a tasking authority. At this point in the course, the students embark on a motivational exercise (MOTIVEX), where they fly to visit the operational squadrons where they may eventually be employed. Courses alternately visit the east and west coast, where they are given briefings by navigators at the squadrons and taken on familiarization flights on the various aircraft. This allows the students to make informed decisions about what aircraft they wish to fly. When the students become more familiar with computer navigation and communications, the course becomes even harder. Computers are denied to the students, and they are forced to rely on electronic fixing aids and manual navigation, formerly referred to as air plot. The students can calculate a wind direction and speed given their Doppler information and their fixing. This allows them to calculate a heading for the aircraft to fly. At the end of phase two, the students are again given a check ride to determine how well they have learned the procedures. This is a large hurdle in the course, and a point at which many students have had difficulty. To date, eight students out of 50, or fourteen percent, have failed the phase two check ride. Of those students, four successfully re-flew the mission while four failed their re-attempt and failed the course.[58[58]] The phase two check ride is not difficult per se; rather it is an exercise in time management. There is no instruction provided on check rides, therefore the students have more time to fulfill their mission requirements without listening to instructor input. The goal is to set priorities and manage tasks, exactly as they will do on their operational missions.

Phase three consists of eleven flights and fourteen simulators, and lasts approximately twelve weeks. The phase begins with the F-USA, which is a familiarization of American airspace and procedures, something they see little of during the course. The students are responsible for choosing a destination, planning the route and mission, and getting accommodations at the destination. This is the students' first exposure to large-scale mission planning, a skill they will use extensively during the phase. After the students return from the F-USA, they begin classroom instruction in tactical employment of aircraft, tactical communications, and crew management. The phase is further sub-divided into three main areas – tactical navigation (TAN), which involves getting an aircraft to a target by a certain time; surveillance (SURV), monitoring activities or personnel while airborne, which is similar to a fisheries or drug patrol; and search-and-rescue (SAR), getting the aircraft to a crash location or last known position (LKP) and conducting a search for survivors. All three areas involve classroom instruction on the theory of the subject, followed by several trainers to practice procedures, and then finally several flights to put theory into practice. Each student flies the

[58[58]] These figures have been taken from a CFANS student database, used to track student performance during all stages of training. It is used to determine whether there are any common areas of student weakness that could or should be addressed by a shift in syllabus.

flights and trainers twice – once as the lead tactical navigator (TACNAV) and once as the navigator/communicator (NAVCOM). This teaches the students to work as a team and to conduct missions as a crew.[59[59]]

The purpose of phase three is to develop a big-picture air sense in the students, and to simulate operations on larger, multi-crew aircraft. This training in simulated tactical scenarios will better prepare the students for their future roles on Sea King, Hercules, and Aurora aircraft. While the scenarios are rudimentary in nature compared to actual tactical scenarios on operational aircraft, the students begin to get a feel for working in a crew environment and directing other aviators. This is a dramatic change from former navigator training that focused on purely navigating and communicating, which are now secondary duties aboard Canadian Forces aircraft. The demanding roles carried out by navigators include ASW, anti-surface warfare (ASuW), anti-drug operations, coastal surveillance, fisheries patrols, and SAR. Navigators fly aboard aircraft to the farthest reaches of the globe, and are expected to be crew experts in communications, flight planning, fuel management, and mission management.[60[60]]

The older generation of navigator training did not prepare the CFANS graduate for these roles; rather it provided them with the basic tools to navigate an aircraft from one point to another. They would then complete an OTU course that gave them specialized training on the respective aircraft. It is anticipated that this generation of training will ease the transition into the OTU and perhaps shorten it, improving the operational readiness of the navigator classification and the Canadian Forces. The announcement of the Sea King replacement project, the Aurora mid-life upgrade, and the new flight management system (FMS) on the Hercules

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[59[59]] *CFANS Instructor Guide* Chap 5 and *Student Guide* Chap 6

[60[60]] *CFANS Instructor Guide*

signal the future of integrated navigation systems. Multiple navigation computers (GPS, INS, and Doppler) will now provide input to an FMS, which will then provide positional and navigational information to the crew. The advanced technical nature of these systems will aid immensely in the navigational ability of CF aircraft, however they will be complex to operate, and the amount of information they provide would be overwhelming without training in systems and information management. The new BANC syllabus, along with the TMT and NTSR, will prepare new navigators with the skills necessary to extract and utilize the information provided. This will take the rote tasks of navigation out of their hands and place it in the hands of a navigation system, allowing them to complete their assigned mission.

The demands placed on military air navigators (ANAVs) in today's forces have increased and become much more complex. Due to advances in technology, ANAVs (also known as TACCOs or maritime helicopter observers in some maritime forces) are no longer totally engrossed in finding where their aircraft is positioned, as most aircraft will soon be outfitted with integrated electronic navigation suites. These navigation suites have freed the ANAV from the laborious job of ascertaining where along the route the aircraft is at any given time. Thus the focus of ANAV employment has shifted to a more eclectic role embracing mission management, leadership functions and many other aspects dealing directly with the accomplishment of a tactical mission.

In addition to basic navigator training, the various navigation schools have been responsible for continuation training among experienced navigators. This training included SANC and ASC, detailed earlier, and also the training of navigator instructors. The navigation instructor course (NIC) was created in April 1968, to train experienced navigators who had been selected as instructors. The course lasted 20 days, and taught the new instructors the policies, procedures, and instructional methods of CNS. The NIC course continued to evolve over the 30 years it was in existence, evolving to teach the new navigational techniques employed at the school. It was adapted to fit the Hercules aircraft when it was introduced in 1974, and it underwent a large change in direction and syllabus in 1991 with the introduction of the Dash 8 navigation training aircraft. The last NIC serial was run in July of 1998, and was replaced by the flying instructor's course (FIC), a standardized course for all flying instructors in the Canadian Forces. The course is given to all new instructors at the ab initio[61[61]] and OTU level, and covers instructional styles and techniques as well as the laws of learning. The course is adapted slightly by each school to teach their particular syllabus. The idea behind a standardized instructor course was to provide students with a consistent level of instruction and evaluation at all levels of aircrew training, from the BANC to any post-wings course.[62[62]] The qualification would remain with the instructor and they would only need to learn the particular syllabus. This course has been adopted air force wide, and will ensure that the training given in Canada to Canadian and foreign aircrew will be among the best in the world.

The training of foreign aircrew has a great history in Canada, and has started again after a 30-year absence. The last NATO exchange students graduated from CFANS in February 1969. ANS and CFANS had provided navigation training under the NATO Mutual Aid program from

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[61[61]] Ab initio refers to initial training provided in the Canadian Forces.

[62[62]] FIC information provided by Capt Denis Forest, CFANS Training Development Officer and driving force behind the FIC concept in the Canadian Forces. His input was invaluable.

1958 to 1969 to students from Norway, Denmark, and the Netherlands.[63[63]] This program came to an end and CFANS provided navigation training to only Canadian students until 1995, when CFANS began training students from the Republic of Singapore. New Zealand began sending their navigator students to CFANS in 1998 during a shutdown of the Air Navigation School in Australia. Three New Zealand students have taken the BANC in Winnipeg, and there was a staff member from the Royal New Zealand Air Force at CFANS from 1998 until 2000. New Zealand will begin sending its students to Australia again commencing in 2001. Singapore continues to send students to CFANS, and CFANS will again train students from NATO countries (Germany and Norway) starting in 2001. South Korea sent a member of its Air Force to CFANS in 2001, and several other non-NATO countries, such as Brunei and the United Arab Emirates have expressed interest in sending students to Winnipeg. CFANS has gained a worldwide reputation for its navigator training, and it has become the model for navigator training in Great Britain and the United States.

Navigation training in Canada has evolved tremendously over the past 65 years, in terms of technology, methods, aircraft, and focus. The goals of navigation have not changed – navigators still need to find out where they are, where they are going, and how they will get there. The differences lie in the details. Navigators now have automated systems and computers to tell them where they are and where they are going. The problem sometimes lies in between the two, as there may be significant obstacles to overcome to get to the destination. That is where the new roles of navigators take over, the roles of air leader and mission director. The spatial awareness needed to lead a crew and manage the information coming at him in large

[63[63]] *Canadian Forces Polaris*

quantities at high speed is critical for a mission to be successful. In 1936, a navigator was concerned with winds and drift and how they would displace his aircraft. During the Second World War, navigators also became keenly aware of mission timings to drop their bombs on the correct target, and were also concerned with winds and drift, lest they stray into enemy fighter territory. As technology and missions have evolved, navigators have drifted themselves, from "positional consultants" to mission commanders. Computers and tactical systems are part of the crew, tools that can be managed to meet mission goals. Navigators no longer need air plot to tell them where they are going. They need spatial awareness, air sense, and leadership ability to guide their aircraft and crews. The various iterations of the Canadian Forces Air Navigation School have been responsible for the training of navigators for those 65 years. The schools have seen tremendous change and even greater advancement in equipment and teaching methods. Canada and CFANS are the world leaders in navigator training, and Canada's NATO allies are taking advantage, just as they did during the Second World War.

Navigator Wings

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Historical List of Air Navigation and Observer Schools[64[64]]

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[64[64]] Milberry, Larry and Hugh Halliday. *The Royal Canadian Air Force at War 1939-1945.* Toronto: The Bryant Press, 1990, pg 456-457. Post War data extracted from paper and historical files.

Air Navigation Schools – Second World War

School #	Location	Opened	Closed	Aircraft Type
1	Trenton,ON	01 Feb, 1940	N/A	Anson
CNS*	Rivers, MB	11 May, 1942	15 Sep 1945	Anson
2	Pennfield Ridge, NB	21 Jul, 1941	30 Apr 1942	Anson
31	Port Albert, ON	18 Nov, 1940	17 Feb 1945	Anson
32	Charlottetown, PEI	18 Aug, 1941	11 Sep 1942	Anson
33	Hamilton, ON	09 Jun, 1941	06 Oct 1944	Anson
2	Charlottetown, PEI	21 Feb, 1944	07 Jul 1945	Anson

*#1 ANS moved to Rivers on 23 Nov 1940, and was renamed Central Navigation School on 11 May 1942

Civil Operated Air Observer Schools – Second World War

1	Malton, ON	27 May 1940	30 Apr 1945	Anson
2	Edmonton, AB	05 Aug 1940	14 Jul 1944	Anson
3	Regina, SK	16 Sep 1940	N/A	Anson
3*	Pierce, AB	12 Sep 1942	06 Jun 1943	Anson
4	London, ON	25 Nov 1940	31 Dec 1944	Anson
5	Winnipeg, MB	06 Jan 1941	30 Apr 1945	Anson
6	Prince Albert, SK	17 Mar 1941	11 Sep 1942	Anson
7	Portage, MB	28 Apr 1941	31 Mar 1945	Anson
8	Ancienne Lorette, QC	29 Sep 1941	30 Apr 1945	Anson
9	St Jean,QC	07 Jul 1941	30 Apr 1945	Anson
10	Chatham,NB	21 Jul 1941	30 Apr 1945	Anson

#3 AOS moved from Regina to Pierce on 12 Sep 1942

Air Navigation Schools – Post War

#1 Air Navigation School	Summerside, PEI	1948 - 1953	Expeditor
#2 Air Navigation School	Winnipeg, MB	1951- 1954	Expeditor
Central Navigation School	Summerside, PEI	1951- 1954	Expeditor
Central Navigation School	Winnipeg, MB	1954 - 1967	Expeditor/Mitchell/Dakota
Air Radio Officer's School	Clinton, ON	1951- 1954	Expeditor
#2 Air Observer's School	Winnipeg, MB	1954 -1958	Mitchell/Dakota

#2 Air Navigation School	Winnipeg, MB	1958 - 1964	Mitchell/Dakota
Air Navigation School	Winnipeg, MB	1964 - 1968	Dakota
Canadian Flight & Navigation School	Winnipeg, MB	1967 - 1968	Dakota
Canadian Forces Air Navigation School	Winnipeg, MB	1968 - 1975	Dakota
Canadian Forces Air Navigation School	Winnipeg, MB	1975 - 1991	Hercules
Canadian Forces Air Navigation School	Winnipeg, MB	1991 - present	Dash 8

List of Abbreviations & Acronyms

A&ES Aircraft and Electronic Systems

AATC Along and Across Track Computer

ADF Automatic Direction Finding

AFC Air Force Cross

AI Airborne Interceptor

ANAV Air Navigator

ANPT Air Navigation Procedures Trainer

ANS Air Navigation School

AOS Air Observer School

ARNC Advanced Radio Navigator Course

AROS Air Radio Operators School

ASC Aerospace Systems Course

ASuW Anti-Surface Warfare

ASW Anti-Submarine Warfare

ATC Air Traffic Control

BANC Basic Air Navigator Course or Basic Air Navigation Course

BCATP	British Commonwealth Air Training Plan
CFANS	Canadian Forces Air Navigation School
CFFTSU	Canadian Forces Flying Training Standards Unit
CFNS	Central Flying and Navigation School
CFS	Central Flying School
CNS	Central Navigation School
CRT	Cathode Ray Tube
DR	Deduced Reckoning
ETA	Estimated Time of Arrival
FIC	Flying Instructors Course
FMS	Flight Management System
F-USA	American airspace famil flight
GPS	Global Positioning System
HF	High Frequency
IAS	Indicated Airspeed
ICP	Instrument Check Pilot
INS	Inertial Navigation System

LKP	Last Known Position
LR	Long Range
MOTIVEX	Motivational Exercise
NATO	North American Treaty Organization
NAVCOM	Navigator/Communicator
NCO	Non Commissioned Officer
NIC	Navigation Instructor Course
NTS	Navigation Training System
NTSC	Navigation Training System Computer
OD	Officer Development
OTU	Operational Training Unit
PC	Personal Computer
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
RN (ESO)	Radio Navigator (Electronic Systems Officer)
RN (LR)	Radio Navigator (Long Range)
RO	Radio Officer

SANC	Staff Air Navigator Course
SAR	Search and Rescue
SIT	School of Instructional Technique
SNIN	Staff Navigation Instructor/Navigator
SO (AI)	Staff Officer (Airborne Interceptor)
SONI	Staff Observer Navigation Instructor
SORI	Staff Observer Radio Instructor
Spec N	Specialist Navigator
SROI	Staff Radio Officer Instructor
SURV	Surveillance
TACAN	Tactical Navigation
TACCO	Tactical Coordinator
TACNAV	Tactical Navigator
TAN	Tactical Air Navigation
TAS	True Air Speed
TDS	Tactical Display System
TMT	Tactical Mission Trainer
TS	Training Standard
TTAT	Transitional Tactical Awareness Trainer
URNC	Undergraduate Radio Navigator Course

VOR Very-high frequency Omni-directional Range

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