Mandates: A Canadian Perspective

Avionics mandates are a fact of life in aviation. Many are currently in various phases of implementation around the world—and more are coming!

Barry Aylward *of Kitchener Aero and* ***Bill Arsenault*** *of Mid-Canada Mod Center reprise their Ontario Aircraft Maintenance Engineer (AME) Presentation: "What We Know To Be True Now," and "A Look Into the Crystal Ball."*

During the Ontario AME conference in October 2004, Barry Aylward and Bill Arsenault gave a presentation on new avionics modifications for Canada, North America and Europe. What follows is a text review and transcript for the session—one that became very interactive with questions and answers and was played to a standing room only crowd.

The presentation focused first on RVSM—given its impending implementation early in 2005, and then on a series of mandates dealing with 406 MHz UHF ELTs, TAWS, TCAS/ACAS and some specific European considerations. The purpose of this discussion is to review what needs to be done by Canadian operators and when.

Starting with RVSM, the bottom line as you read this is that *Time Has Run Out!*

Nav Canada is committed to implement DRVSM (Domestic Reduced Vertical Separation Minimums) for all Canadian Domestic Space at the same time and with the FAA. January 20, 2005 was the deadline.

For those unable to have the required avionics updates installed and certified by then, you will be able to operate your aircraft; however, you will be relegated to the lower altitudes—below flight level 290. Those who have RVSM capability will be able to operate at the higher, more efficient flight levels.

According to recent U.S.–based research, RVSM equipment will make the cost and effort worthwhile over the long term. The fuel savings benefits from 2005 to 2016, for all aircraft, is estimated to be $5.3 billion USD at a 6/1 benefit/cost ratio. This means $393 million in the first year of savings, with a 2 percent annual increase thereafter. In addition to use of more fuel-efficient altitudes comes increased probability that an aircraft with RVSM will be cleared onto a desired route or altitude quicker and with more efficiency by Air Traffic Control (ATC).

The NAS (North American Air Space) Air Traffic Operations benefits will show that ATC gains greater flexibility with RVSM aircraft. For example, routing aircraft around storm systems mitigating conflict points, and enhancing the volume of aircraft that can be accommodated in a given sector or the sector throughput. RVSM also enables crossing traffic flows and helps reduce controller workload—specifically the amount of vectoring and flight level changes that used to be the norm or would be in the reduced airspace separation between aircraft that RVSM uses. RVSM also provides for growth in NAS enroute airspace capacity—creating up to eight additional flight levels that did not exist before.

The complexity/cost for RVSM equipment and installation vary widely from one aircraft to another. STC approval is required and approval may be by Group or Non-Group (Individual) approvals. In simple terms, if someone has already done the required RVSM installation, mods and paperwork on your aircraft, they will have blazed the approval trail and have the requisite STC already in place. It takes a five aircraft sampling of the same type and configuration (i.e. autopilot and air data equipment) to constitute a "Group" classification. If, however, you are the very first in your aircraft model and type to do the RVSM mod, or you elect to use a set-up or equipment option that has not been previously applied to your aircraft type and model, then you are creating a "Non-Group" scenario. Non-Group is very time and process intensive, requiring a much higher level of flight testing and approval. One important note—flight testing/height monitoring is required for all aircraft. There are two methods of performing height monitoring testing. The first is to fly the aircraft over one of the Height Monitoring Units operated by FAA or Transport Canada. The second is to have an approved technician install a temporary GPS–based monitoring unit (GMU) in the aircraft and fly at an RVSM altitude for around 30 minutes. Although this might sound more intensive, the equipment installs in minutes. From experience, the GMU is the more reliable of the two methods.

The bottom line on RVSM is that if you have not booked an appointment with an approved service facility, chances are you will be waiting a while. The last minute rush is well and truly underway now—and even when you get into a facility, allow anywhere from two to as much as six weeks on average—depending upon

your aircraft type—to have the work, testing and certification completed. Equipment lead times are also high—in some cases as much as 18 to 24 weeks.

The next topic is 406 MHz UHF ELTs. The current standard is TSO-C91a, which states the minimum performance standard for VHF ELT equipment operating on 121.5 and 243.0 MHz. TSO-C126—406 also lays out the minimum performance standard that a 406 MHz ELT must meet.

According to the FAA, turbojet-powered aircraft operators installing an ELT for the first time are encouraged (but not required) to install a 406 MHz frequency unit. The key point—while there is no mandate as yet, it will probably come sooner or later.

Why the move to the 406 MHz UHF standard? The bottom line is the higher frequency ELT provides greater reliability and more life-saving benefits, especially for operations conducted over water and in remote areas. Search and Rescue operations are more closely linked to this signal and better able to respond. Systems can also be interfaced to GPS or FMS on the aircraft allowing the transmission of aircraft position should the aircraft go down.

One big consideration regarding ELTs is that in 2009, the international COSPAS-SARSAT satellite system will no longer provide satellite-based monitoring of the 121.5/243 MHz frequency, focusing totally on 406 frequency. Once that date rolls around, older units will only be monitored through local, ground-based stations at airports. This will render the range and reliability at the very low end of the scale for safety and acceptability by international standards. When emergency services are called to find a downed aircraft, time is the biggest factor—and the 406 UHF ELT gives SAR a big head start.

Internationally, some aircraft require the 406 standard even sooner. JAA/ICAO JAR-OPS 1.820 and ICAO Annex 6 and Annex 10, specifies ELTs transmit on both 121.5 MHz and 406 MHz simultaneously or one 406-MHz unit. Depending upon operational requirements, two ELTs per aircraft may be required. At present, Canadian aircraft are not affected by this—but that too could change in the years ahead.

As for the home market, a Transport Canada mandate is in the works. The Aircraft Electronics Association advises that NPAs (a Notice of Proposed Amendment) are being readied for CARAC presentation in 2005. We can most likely expect that the TSO 126 Equipage Requirement will likely coincide with the discontinuance of VHF Satellite Monitoring in 2009.

One area of concern to aircraft owners is always the cost for such changes. As the time for implementation draws closer, newer, lower cost ELT options will come to the market. The first few of the lower-cost UHF ELT systems are being readied for market now and should be available in 2005.

Any talk about avionics mods always turns to TAWS (Terrain Awareness Warning System)—also known as EGPWS (Enhanced Ground-Proximity Warning System). The governance for this is currently laid out in TSO-C151a—which prescribes the minimum operational performance standards for TAWS Class A or B systems.

Class B systems are a Terrain database with GPS Position and Altitude inputs (one that retains GPWS Modes 1 & 4). It provides predictive terrain avoidance. On the other hand, a Class A system retains all the functionality of the older GPWS Systems, (GPWS Modes 1- 6 and optionally WindShear) but adds the predictive Terrain database technology.

The "Modes" referred to are TAWS Alerts and GPWS Alerts. There are six in total and they are as follows:

• Mode 1 (Excessive Rate of Descent) Uses a combination of barometric altitude and radar altitude, alerts excessive barometric rate of descent when close to the ground. When radar altitude is not available, the calculated height above terrain from the terrain database is substituted.

• Mode 2 (Excessive Closure Rate to Terrain) Alerts on high rates of change of radar altitude when close to the ground. (Class A only)

• Mode 3 (Negative Climb Rate After Takeoff) Uses radar altitude, barometric vertical speed, and barometric altitude to detect negative climb rates and/or accumulated altitude loss after take off or a missed approach. When radar altitude is not available, the height above takeoff altitude is substituted.

• Mode 4 (Flight Into Terrain Not in Landing Configuration) Uses radar altitude to detect too low an altitude without gear and/or flaps in landing configuration.

• Mode 5 (Excessive Downward Glideslope Deviation) When in landing configuration, provides an alert in the event of an excessive downward deviation from an ILS Glideslope when below 1000 feet radar altitude. When radar altitude is not available, the calculated height above terrain from the terrain database is substituted.

• Mode 6 (Altitude Callout). Can provide the flight crew with altitude call outs when programmed to do so. Can also provide a "smart" "Five Hundred" callout when the aircraft descends through 500 feet of radar altitude with the gear down. In a Class B installation without radar altimeter, this callout will occur 500 feet above the runway elevation using aircraft altitude compared to the nearest runway elevation.

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Table 1	Proposed Aircraft TAWS Requirements		
Operating Regulation and Passenger Configuration	NPA #	Class B TAWS TSO C-151 or later	Class A TAWS TSO C-151 or later
CAR 605 (Turbine-Powered and 6+ pax.)	2003-302, 2003-304	Minimum Required (Notes 1,2,3)	Acceptable (Notes 1,2,3) NPAs withdrawn.
CAR 703 (6+ pax.)	2003-092, 2003-091	Minimum Required (Notes 1,2,3)	Acceptable (Notes 1,2,3)
CAR 704 (6-9 pax.)	2003-090, 2003-089	Minimum Required (Notes 1,2,3)	Acceptable (Notes 1,2,3)
CAR 704 (10 + pax.)	2003-090, 2003-089	Not Acceptable	Required with Display (Notes 1,2,3)
CAR 705	2003-088, 2003-087	Not Acceptable	Required with Display (Notes 1,3)

Notes
1) Alerting independent of altimeter setting or deviations from ISA
2) Provisions for relief from TAWS for day VFR operations
3) Provision for Compatibility of Terrain database with area of operation

GPWS Requirements
GPWS will no longer be required after promulgation plus 2 years of TAWS regulations per NPA 2003-095 for GPWS (CAR 605.37). (GPWS intended to be replaced by TAWS).

TAWS provides the ability to add other components and build the "system." We are starting to hear more about Runway Awareness and Advisory System (RAAS) for corporate aviation. Presently proprietary technology to Honeywell, it is available on their MK-V & MK-VII EGPWS systems. RAAS helps reduce occurrences of runway incursions, other airport catastrophes, and advises the aircrew of the aircraft's location on runways and taxiways. It heightens pilot awareness of the aircraft's position relative to nearby terrain. This function can typically be added with no new hardware or wiring changes. RAAS technology is quickly becoming "standard" on newer corporate aircraft as a factory direct OEM feature.

Another TAWS add-on gaining in popularity is Windshear Detection & Avoidance. There are two basic systems—Passive Windshear detection (which uses angle of attack rate, IAS and vertical and longitudinal acceleration to warn that Windshear has been encountered) and Active Windshear detection (this forms part of a weather radar system to warn against oncoming WindShear as detected by active Doppler radar). While WindShear has long been used in the larger commercial arena, it is just now finding its way into the cockpits of the corporate realm. Like RAAS, these systems are becoming part of the OEM factory installed avionics package on new aircraft.

For those having avionics renewals or overhauls performed, adding RAAS or Windshear is fairly straight forward and something well worth considering.

Over the next while, there are a number of NPAs that will affect TAWS applicability. Table 1 best summarizes the "who and what." One big issue will be that under the new (and at this time, proposed NPAs), GPWS will no longer be required after promulgation plus two years of TAWS regulations (per NPA 2003-095 for GPWS on CAR 605.37). It is intended that conventional GPWS will be replaced by TAWS/EGPWS. As for when all these NPAs may become rule? Transport Canada's TAWS (and TCAS) Rulemaking remains at NPA status and there is no chance for a harmonized implementation date with FAA. The TAWS & TCAS NPA's in this country are basically 'bundled' together. The best information at present suggests that the final implementation date for Canadian TAWS & TCAS equipage requirements will be the "Date of Final Rule" (whenever that occurs) plus two years. The betting money for final implementation is sometime in 2007 or 2008.

Staying with the subject of not bumping into or hitting things, TCAS/ACAS is also very topical and the subject of some NPA activity. Basically, there are two levels of TSO'd Collision Avoidance Systems—TCAS I and TCAS II. The TCAS II product has the ability to generate both traffic and a Resolution Advisory—a command to climb, descend or monitor vertical speed. The Resolution Advisories in TCAS II are coordinated between the TCAS II equipped aircraft via Mode S Transponders. In comparison, TCAS I can only generate Traffic Advisories (TAs) but not Resolution Advisories (RAs).

As of today, all TCAS/ACAS II Systems must have Software Version 7.0 as a requirement for operations in RVSM airspace. In addition, Mode S Transponders are required for TCAS/ACAS II. The JAA takes this a step further and requires Mode S elemen-

tary surveillance (flight ID).

To clarify, TCAS II is FAA verbiage—while ACAS II is the JAA term. They are in effect the same thing. A TCAS II with Change 7 software is the same thing as ACAS II. Earlier software versions are not.

Another note is FAA activity in this area. As of January 1, 2005, all Commercial turbine-powered aircraft with passenger seating (excluding any pilot seat) of 10 to 30 seats must be equipped with TCAS I (as a minimum) or TCAS II. Additionally, all turbine-powered aircraft of more than 33,000 pounds MCTOW will require TCAS/ACAS II under that FAR. The FAA TCAS rules, (unlike TAWS) are Part 129 (Foreign Air Carriers) and are applicable to all commercial aircraft operating in U.S. airspace. Canadian commercial carriers will be affected by this! At the present time, there is no NPRM changing the FAA's TCAS rule which currently reads that in Part 91—it is not required, Part 135 over 9 passenger seats—TCAS I, Part 135 over 29 passenger seats—TCAS II and Part 121—TCAS II. As for part 129, It requires 704 aircraft with 10 or more seats must have TCAS I and 705 aircraft are to have TCAS II. That is the way the rule is now.

There is one huge difference between Canada's (proposed) rules and the FAA rules over TCAS. Transport Canada is requiring TCAS II be the minimum CAS requirement for RVSM airspace. Our industry has objected—to no avail! Accordingly, a smaller Canadian operator who might otherwise only be required to have TCAS I will need TCAS II if operating above FL 290 in RVSM airspace! This is a significant de-harmonization from the FAA rulemaking—especially when one considers that we are essentially sharing the same airspace!

Another difference to note is that as things sit right now, CAR 703/704/705 NPA's are the ones that apply—to all aircraft regardless of power plant type. The actual final implementation date of the Transport Canada TCAS rulemaking is going to be the "Date of Final Rule" (whatever that is), plus two years—which once again is thought to be around 2007/8? This too is a de-harmonization with the FAA standard. Table 2 again lays out which CAR is being considered for which NPA.

Lastly, the European considerations.

The shift to 8.33 khz VHF COM spacing, which began in 2002, is continuing with the addition of more countries requiring the change. Also remember when operating overseas that you require VOR/ILS equipment that meets the FM Immunity requirements of ICAO Annex 21. As well, Mode S Elementary surveillance—which requires upgraded Mode S Transponders with Flight ID will be required March 31, 2005. We also understand there are serious considerations being given to Mode S Enhanced Surveillance for phased implementation by 2007/2008. And lastly, we are waiting to hear the final decision on what the JAA proposes to do with precision RNAV.

The key thing to remember with all these mandates, regardless of which country they originate in, is that they can—and historically have been—moving targets. The information provided to us and to you can and does change. New regulations in other operational areas or regulatory regions can impact Canadian operators. The best advice is always to consult your avionics service provider or trusted sources like the AEA website to get the latest information. If your travels do take you into a different country and region, make sure that your current hardware will be acceptable and applicable before you go. It can be much easier than finding out the hard way. ❑

Table 2 Proposed Aircraft ACAS Requirements

Operating Regulation	NPA #	TCAS I Equivalent to TSO C-118	TCAS II TSO C-119 (SW 6.04A or 7.0) & Mode S transponder meeting TSO C-112
CAR 702	2003-104, 2003-105	Not required	Required for turbine-powered land aircraft of MCTOW exceeding 33,000 lb. (Note 1)
CAR 703	2003-101, 2003-100	Minimum Required for aircraft of MCTOW exceeding 12,500 lb. (Note 1)	Not Required by applicability of CAR 703
CAR 704	2003-099, 2003-098	Minimum Required for aircraft of MCTOW exceeding 12,500 lb. (Note 1)	Required for turbine-powered aircraft of MCTOW exceeding 33,000 lb. (Note 1)
CAR 705	2003-097, 2003-096	Minimum Required for all aircraft (Note 1)	Required for Turbine powered aircraft (Note 1)

Notes:
1) TCAS II SW 7.0 and Mode S required for RVSM airspace