Recommendation 15-10: Guidance Material Addressing Intervention Strategies

I. Submission

The recommendations below were submitted by the Flight Path Management Workgroup (FPM WG) for consideration by the Air Carrier Training Aviation Rulemaking Committee (ACT ARC) Steering Committee at F2F-6. The ACT ARC Steering Committee adopted the recommendations with unanimous consent, and the recommendations are consolidated and submitted to the Associate Administrator for Aviation Safety (AVS-1) as ACT ARC Recommendation 15-10.

II. Background & Statement of the Problem

The Federal Aviation Administration (FAA) posed the following questions to the ACT ARC to obtain industry input on pilot monitoring issues:

- Identify best practices for intervention strategies of the pilot monitoring.
- Does current CRM guidance need revision to support the intervention strategies identified above and pilot monitoring in general?

After the ACT ARC Steering Committee assigned the task to the FPM WG, the FPM WG formed the Flight Path Monitoring Intervention Strategies Action Team, which included industry subject matter experts to review, discuss, and propose recommendations in response to the questions posed.

The industry has recently published two documents (the Performance-Based Operations Aviation Rulemaking Committee (PARC) Flight Deck Automation WG (FltDAWG) final report, and “A Practical Guide for Improving Flight Path Monitoring,” published by the Flight Safety Foundation (FSF)) containing valuable insights and recommendations on flight path and flight guidance monitoring. Less work has been done specifically on the subject of intervention. Nonetheless, there is sufficient information to provide initial recommendations for policies, procedures, and training, but additional study is needed.

III. Recommendations

The ACT ARC submits the following recommendations for FAA consideration:

The ACT ARC recommends the FAA develop and publish advisory guidance for industry stakeholders (e.g., operators and 142 training centers) and inspector guidance for FAA personnel suggesting: Each operator's policies, procedures, and training should adequately cover Flight Path Intervention, including, but not limited to Human → Human Intervention and Human → Machine Intervention.

Note: For purposes of this recommendation, this topic is not limited to the duty position currently known as "pilot monitoring" – monitoring is an activity performed by both pilots on the flight deck.

Sample content might include the following:

1. **Human → Human Intervention**
   a. Pilot Monitoring (PM) communicating effectively to the Pilot Flying (PF) about the flight path problem, expecting that the PF will then correct the problem.
      i. Policies & Procedures:
         (1) Deviation Callouts
         (2) Expected responses to callouts
      ii. Training Objectives:
         (1) Communications (what to say, how to say it, when to speak up, etc.)
         (2) Assertiveness (various levels, appropriate choice of level)

   b. PM taking over the PF role if it is determined that the PF is not correcting the flight path problem in a timely manner.
      i. Policies & Procedures:
         (1) Conditions for takeover (e.g., subtle incapacitation, and/or no correction after 2 challenges)
         (2) Callouts and actions associated with a takeover. Positive change of control must be ensured.
         (3) PF's expected actions after a takeover. Policies must be clear to ensure there is no crewmember conflict over who is PF at any time.
      ii. Training objectives:
         (1) Judgment & decision-making (how bad is it; how much time is acceptable to wait, etc.])

2. **Human → Machine Intervention**
    a. PF correcting the flight path problem by taking action with the flight path guidance or control equipment.
        i. Policies & Procedures:
            1. Automation management expectations; appropriate use of automation for various situations.
        ii. Training Objectives:
            (1) Basic hand-flying (both as a cognitive framework for understanding the automation, and also as a foundation skill in cases hand-flying is the needed intervention)
            (2) Automation system behavior (including errors/gotchas)
            (3) Automation management (what guidance/control intervention is needed, and how to do it)
            (4) Cognitive skills for manual flight ops – visualization, spatial reasoning, decision making about correct responses after assessing the situation
    b. Deciding not to interfere with the flight path guidance or control equipment – correctly recognizing when the machine self-stabilize, such that the best action is to do nothing.

IV. Rationale

The recommendations regarding Intervention are confined to the following:

- **Post-detection**. Intervention assumes an actual, or potential, problem has been detected. Actions/activities required to detect the problem (necessary before intervention can begin) are outside of the scope of this recommendation.
- **Flight Path only**. We will only discuss intervention as it relates to the area of Flight Path (trajectory/energy, in flight or on the ground), and/or Flight Guidance/Control states. Interventions to correct problems not related to flight path are outside the scope of this recommendation.

In support of the recommendations above, the FPM WG offers the following additional considerations.

<u>Implications for Management/Guidance</u>:

- Policies/procedures for expected interventions should be established, including: deviation parameters, required callouts, conditions for "take-over" (e.g., "2-challenge rule"), automation management standards (e.g., "reduce level of automation under the following conditions ___"), etc.
- An operator should develop Intervention policies and procedures before developing intervention training. A training program is not likely to be successful or effective unless it is built on the foundation of documented policies defining acceptable, and expected, behaviors.

Implications for Pilot Training:

- Communications skills, automation system behavior and management, and hand flying skills can and should be trained. Judgment and decision-making skills are harder to train.
- Although we specifically mention communications and assertiveness skills, there are a variety of other "non-technical" skills generally contained in the best Crew Resource Management (CRM)/Threat and Error Management (TEM) training programs, such as teamwork, time & task management, etc., that are also very valuable in support of a pilot's ability to intervene effectively.
- To add emphasis to the importance of the topic of "automation system behavior", the human cannot intervene unless a condition requiring intervention is correctly recognized. (i.e., effectively monitor). Also, if the monitoring activity was successful (problematic condition recognized), the pilot must know what intervention is appropriate. Therefore, training programs should ensure that pilots develop a thorough understanding of flight guidance and flight control systems, such that the pilot's mental model of system behavior permits detection of situations requiring intervention, and that the pilot's system understanding permits selection/implementation of the correct intervention action.
    - Two specific examples of automation "gotcha's" worthy of mention:
        - Takeover pushbutton on Airbus side sticks
        - A/T disconnect vs TOGA button placement on throttles of different aircraft types

Note about "Hard Protections": In aircraft with hard protection capability (e.g., Airbus A320/330/340 series aircraft), the airplane may take control from the PF. (One might consider this to be a case of Machine → Human Intervention.) For our purposes however, we may consider this to be a class of automation system behavior – behavior that must be thoroughly understood by pilots so that, again, the pilots are able to discern whether or not the behavior requires the human to intervene.

Note about Crew Duties and Human → Human intervention: It should be noted that the types of Human-to-Human intervention mentioned in our recommendation are simplified somewhat to focus on flight path control vs flight path guidance. This is only for simplicity and readability. It is not intended to imply that intervention to correct flight path guidance errors is unimportant. Recommendation 2, item 1.a., was worded, "*PM communicating effectively to the PF about the flight path problem, expecting that the PF will then correct the problem*." Flight path control is, by definition, the responsibility of the PF, whereas flight path guidance may be the responsibility of either pilot, depending on the operator's SOP. For example, in some organizations, if the AP is off with the FD on, the PF hand-flies the aircraft, but the PM makes all flight guidance inputs. In this situation, consider the case where the PM makes an erroneous flight guidance input, and the PF notices it. In this case, Human->Human intervention would involve the PF verbalizing to the PM the error and desired correction. (E.g., "Hey, approach mode still isn't armed – arm approach, please."). To capture all this, the recommendation wording would have had to be something like: "*PM communicating effectively to the PF about the flight path problem, expecting that the PF will then correct the problem, or the PF communicating to the PM about a flight guidance problem (if the PM is responsible for flight guidance inputs), expecting that the PM will correct that problem*." Therefore, to avoid lengthy and complex wording, we chose the simpler version, and added this discussion note to convey the nuances.

Examples of Interventions:

1. **Human → Human Intervention**
    - **a.** PM communicating effectively to the PF about the flight path problem, expecting that the PF will then correct the problem.
        - **i.** Example: PM calls "1 dot high", PF calls "correcting" and returns to glidepath in a timely manner.
    - **b.** PM taking over the PF role if it is determined that the PF is not correcting the flight path problem in a timely manner
        - **i.** Example: PF does not respond to 2 successive challenges, then, per operator's procedure, the PM announces "I have control, going around", and initiates a go around as PF.
2. **Human → Machine Intervention**
    - a. PF correcting the flight path problem by taking action with the flight path guidance or control equipment
        - i. Example 1: PF notes speed increasing on a path descent and deploys the speedbrakes.
        - ii. Example 2: PF notes aircraft descending slightly below glidepath and speed decreasing, but the "Windshear" warnings immediately annunciate and the flight guidance automation switches to Windshear escape commands. The PF decides NOT to interfere with the machine. (Deciding not to interfere with the flight path guidance or control equipment – correctly recognizing when the machine self-stabilize – can mean that sometimes the best intervention is to do nothing.)
        - iii. Example 3: After a change to the FMS, the PF expected a level turn to the right at constant speed. Instead, the aircraft begins to roll into a left turn, the power begins to increase, and the aircraft starts to pitch up. The PF immediately disengages the AP and AT and manually returns the aircraft to the desired flight path & energy.

V. Background Information

ACT ARC Initiatives:

ACT ARC Recommendation 15-10 partially addresses the following initiative assigned to the FPM WG:

Initiative #35: Develop training/qualification to improve knowledge and skills for successful flight path management, to include:

- Manual flight operations, including training, practice, and checking.
- Management of automated systems for flight path management, especially autoflight mode awareness.
- Pilot monitoring and intervention for flight path management.
- Instructors/evaluator training for the development of skills and knowledge to teach and evaluate airplane flight path management, including use of automated systems.

Reports:

Operational Use of Flight Path Management Systems: Final Report of the Performance-Based Aviation Rulemaking Committee (PARC)/Commercial Aviation Safety Team (CAST) Flight Deck Automation Working Group (FltDAWG), September 5, 2013 at pgs. 55-56, 68-75, 99-101. (See Finding 9 - Operator Policies for Flight Path Management; Finding 12 - Current Training Time, Methods, and Content; and, Finding 24 - Organizing and Analyzing Operations Data).

A Practical Guide for Improving Flight Path Monitoring: Final Report of the Flight Safety Foundation Active Pilot Monitoring Working Group), November 2014.