The current study Pathway does not assume any prior knowledge beyond high school (i.e., aviation experience). However, it was built assuming that, in the event of pilot incapacitation, the ground pilot will be able to use the onboard automation (e.g., autopilot, FMS) to land the aircraft safely (i.e., it is not expected that the ground pilot will control/fly the aircraft manually).

NEW ENTRANT GROUND PILOT: Skilling		
FORMAL TRAINING		
	Main Topic	**Description of content**
Theoretical Training: Learning Courses and Instruction required to being ex. Pilot	VFR and IFR communications	Definitions Transmission of letters, numbers, etc. Read-back requirements Weather information terms Level changes and reports Procedures in event of loss of communications Distress and urgency procedures
	Air law	International law Airworthiness Aircraft registration Licensing Rules of the air Procedures for air navigation services Air traffic services and ATM Aeronautical information services Aerodromes Search and rescue
	Principles of flight	Airflow Aerodynamic forces and moments Wing shape Lift Drag Angle of attack Stall, Flaps and slats Speed brakes Mach Compressibility Stability and control

	Aircraft performance	Stages of flight Variables affecting performance Speed definitions Takeoff performance Climb performance Cruise performance Descent performance Landing performance Cost Index Performance with one engine inoperative	
	Aircraft systems	Hydraulics Landing gear Pneumatics Anti-ice and de-icing systems Fuel system Electrics Power plants (turbine engines) Smoke, fire, and rain protection systems Oxygen systems	
	Flight planning	Mass and balance Weather forecasts and reports Flight plan Fuel NOTAMs Takeoff calculations	
	Navigation	Principles of navigation Radio navigation Satellite navigation Inertial navigation	
	Surveillance	PSR SSR ADS-B Weather radar TCAS TAWS EGPWS	

	The flight deck	Cockpit layout Cockpit instruments and displays (PFD, ND, EICAS, overhead panel, central pedestal, standby instruments, radios, etc.) Cockpit controls (sidestick, rudder pedals, MCDU, FCU, switches, levers, buttons, etc.) Cockpit alerting
	Meteorology	The atmosphere Wind Clouds Precipitation Air masses and fronts Pressure systems Flight hazards Gathering and interpreting weather information (forecasts and reports)
	Human performance and limitations	Human information processing Situation awareness Safety awareness Threat and error management Workload management Crew Resource Management (CRM)
	Operational procedures for ground pilots	Responsibilities of the ground pilot Responsibility to record voice/data during a flight Responsibilities of the ground pilot about MEL Flight preparation forms to be completed before flight Low visibility operations Aerodrome operating minima ETOPS operations Abnormal and emergency procedures (pilot incapacitation, loss of link, emergency landing, etc.) Requirements for training of ground pilot (including recurrent training) Requirements for ground pilot to operate on more than one type/variant Duty-time limitations and rest requirements of ground pilot Requirements regarding minimum equipment of GCS Handover procedures
	Automatic flight control and management	Primary and secondary flight controls Fly-by-Wire (FBW) control systems Autopilot FMS Auto thrust Autoland Control laws and flight envelope protection

	Ground control station systems	Communication, control, and telemetry links Communication system Controls and displays Multi-modal user interaction (touch, voice, etc.) Decision support systems (including AI-enabled support systems) Alerting Voice and data recording (both flight data and GCS data) GCS redundancy requirements
	Flight path monitoring	Principles of effective monitoring Aircraft performance monitoring Aircraft systems monitoring Monitoring of operational factors (weather, etc.) Monitoring of the single on-board pilot
	Cybersecurity	Security threats in aviation systems Common attack methods (hacking, spoofing, jamming, etc.) Countermeasures (GNSS augmentation, anti-jam antennas, encryption, anomaly detection, etc.) Threat detection and alerting
	Main Topic	**Description of content**
Practical Training: All the hands-on training, which can include simulation, on-site training, supervision flying…	VFR and IFR Radio Telephony (RT) training	RT phraseology Departure procedures (establishing communication with the on-board pilot and ATC; clearances; frequency changes; etc.) En-route procedures (position reporting, frequency changes, etc.) Circuit and arrival procedures (circuit calls, frequency changes, etc.) Procedures in case of loss of communication between the ground pilot and ATC Procedures in case of loss of communication between the ground pilot and the on-board pilot Distress and urgency procedures (PAN PAN, MAYDAY, etc.)
	Basic ground pilot training	This part of the training will focus on 'simple' aircraft (single engine, basic instrumentation, and automation) and VFR operations (local and cross-country flying). The training exercises will be carried out using a combination of simulator training (where the aircraft is simulated) and real-life training. Irrespective of the type of training, the on-board pilot will be an actual pilot. Operation of GCS hardware and software Familiarization with aircraft type, systems, and instruments Establishing communication and telemetry links with the aircraft and checking their integrity Pre-flight planning (weather, NOTAMS, flight plan, fuel, mass and balance, takeoff performance, etc.) Monitoring of the aircraft's flight path (position, trajectory, energy state, etc.) based on GCS data and pilot communications Monitoring of the aircraft's systems (fuel, electrics, etc.) based on GCS data and pilot communications Monitoring of other operational factors (weather, traffic, terrain, etc.) along the flight path using GCS surveillance tools Monitoring of the on-board pilot and cross-checking of his/her actions Communicating with the on-board pilot and sharing information (e.g., weather updates, position reports, etc.)

		Executing checklists together with the on-board pilot (e.g., startup, taxi, takeoff, landing, etc.) Supporting the on-board pilot in normal, abnormal, and emergency situations (e.g., engine failure, low fuel, diversion, weather avoidance, etc.) Delegation of tasks from the on-board pilot to the ground pilot Procedures in the event of loss of communication with the on-board pilot Procedures in the event of loss of telemetry link Debriefing Procedures for handing over to another ground pilot at the end of a shift
	Advanced ground pilot training	This part of the training will focus on more advanced aircraft (multi-engine, advanced instrumentation, and automation) and IFR operations (local and cross-country flying). The training exercises will be carried out using a combination of simulator training (where the aircraft is simulated) and real-life training. Irrespective of the type of training, the on-board pilot will be an actual pilot. Operation of GCS hardware and software Familiarization with aircraft type, systems, instruments, and automation Establishing communication, control and telemetry links with the aircraft and checking their integrity Pre-flight planning (weather, NOTAMS, flight plan, fuel, mass and balance, takeoff performance, etc.) Monitoring of the aircraft's flight path (position, trajectory, energy state, etc.) based on GCS data and pilot communications Monitoring of the aircraft's systems (fuel, hydraulics, avionics, etc.) based on GCS data and pilot communications Monitoring of other operational factors (weather, traffic, terrain, etc.) along the flight path using GCS surveillance tools Monitoring of the on-board pilot and cross-checking of his/her actions Communicating with the on-board pilot and sharing information (e.g., weather updates, position reports, etc.) Executing checklists together with on-board pilot at various stages of the flight (e.g., startup, taxi, takeoff, landing, etc.) Supporting the on-board pilot in normal, abnormal, and emergency situations (e.g., engine failure, low fuel, diversion, weather avoidance, etc.) Delegation of tasks from the on-board pilot to the ground pilot Procedures in the event of loss of communication with the on-board pilot Procedures in the event of loss of control and telemetry links Procedures for taking over control of the aircraft (e.g., in the event of pilot incapacitation) via the GCS Control of aircraft automation (autopilot, FMS, etc.) and other equipment (e.g., radios) via the GCS Procedures for selecting an appropriate airport/runway and landing the aircraft remotely via the GCS (precision approach, missed approach, etc.) Debriefing Procedures for handing over to another ground pilot at the end of a shift

| Type-specific ground pilot training | This training will focus on the specific type(s) of aircraft which will be handled by the ground pilot during commercial operations. The training exercises will be carried out using a combination of simulator training (where the aircraft is simulated) and real-life training. Irrespective of the type of training, the on-board pilot will be an actual pilot.

Operation of GCS hardware and software
Familiarization with aircraft type, systems, instruments, and automation (for this part of the training, the ground pilot will be exposed to the flight deck of the aircraft, particularly to the on-board automation which the ground pilot will interact with should he/she need to take over control of the aircraft. This will give the pilot an appreciation for the on-board automation and how it relates to the GCS)
Commercial considerations
Standard Operating Procedures (SOPs)
Establishing communication, control and telemetry links with the aircraft and checking their integrity
Pre-flight planning (weather, NOTAMS, flight plan, fuel, mass and balance, takeoff performance, etc.)
Monitoring of the aircraft's flight path (position, trajectory, energy state, etc.) based on GCS data and pilot communications
Monitoring of the aircraft's systems (fuel, hydraulics, avionics, etc.) based on GCS data and pilot communications
Monitoring of other operational factors (weather, traffic, terrain, etc.) along the flight path using GCS surveillance tools
Monitoring of the on-board pilot and cross-checking of his/her actions
Communicating with the on-board pilot and sharing information (e.g., weather updates, position reports, etc.)
Executing checklists together with on-board pilot at various stages of the flight (e.g., startup, taxi, takeoff, landing, etc.)
Supporting the on-board pilot in normal, abnormal, and emergency situations (e.g., engine failure, low fuel, diversion, weather avoidance, etc.)
Delegation of tasks from the on-board pilot to the ground pilot
Procedures in the event of loss of communication with the on-board pilot
Procedures in the event of loss of control and telemetry links
Procedures for taking over control of the aircraft (e.g., in the event of pilot incapacitation) via the GCS
Control of aircraft automation (autopilot, FMS, etc.) and other equipment (e.g., radios) via the GCS
Procedures for selecting an appropriate airport/runway and landing the aircraft remotely via the GCS (precision approach, missed approach, etc.)
Debriefing |
|---|---|

TECHNICAL COMPETENCES					
Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	*Short competence description*	*The individual should have knowledge of…*	*With this skill someone should be capable of….*	*Beginner Intermediate Advanced*	*How to acquire the skill?*

Application of Procedures	Identify and apply procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge	- Airline SOPs in normal scenarios - Airline SOPs in abnormal and emergency scenarios e.g., on-board pilot incapacitation, loss of communication link, loss of control and telemetry link, etc. - Air law	- Identify the source of operating instructions - Follow SOPs unless a higher degree of safety dictates an appropriate deviation - Identify and follow all operating instructions in a timely manner - Comply with applicable regulations - Apply relevant procedural knowledge	Beginner	Operational procedures for ground pilots Air law
Aircraft Flight Path Monitoring and Pilot Monitoring	Demonstrate effective monitoring of the aircraft and of the single on-board pilot	- Monitoring role of the ground pilot - Operational policies, procedures, and practices for effective monitoring - Monitoring of automated systems - Monitoring in normal and abnormal situations - Aviation physiology and psychology (human factor limitations, etc.) - Aircraft general knowledge - Aircraft performance - Surveillance systems (to monitor weather, traffic, and terrain)	- Monitor the flight path of the aircraft, including the trajectory, energy state, power settings and automated systems directly affecting the flight path (e.g., autopilot, auto-thrust, FMS) - Monitor the aircraft systems, excluding those directly affecting the flight path (e.g., fuel, hydraulics, pressurization) - Monitor other operational factors affecting the flight (e.g., weather and traffic) - Monitor the actions and condition of the on-board pilot - Clearly alert the on-board pilot if any deviations or inconsistencies are detected (e.g., aircraft actions don't agree with expected actions, or the on-board pilot takes the wrong action) - Monitor the aircraft and on-board pilot regularly, deliberately, and systematically - Cross-check/cross-verify information from multiple independent sources - Maintain the required level of vigilance for low and high workloads - Perform all the above for one or more aircraft with a single on-board pilot	Beginner	Flight path monitoring Human performance and limitations
Aircraft Flight Path Management, automation	Control the aircraft flight path through automation, including appropriate use of flight management system(s) and guidance. (IN THE EVENT OF PILOT INCAPACITATION ONLY)	- Automatic flight control systems - Fly-by-wire (FBW) - Aircraft automation (autopilot, Flight Management System, auto-thrust, auto-land, etc.) - Flight envelope protection - Aircraft performance - Flight deck controls and displays (PFD, ND, ECAM, MCDU, FCU, etc.)	- Take over control of the aircraft to divert to a suitable airport and land using the on-board automation only - Detect deviations from the desired aircraft trajectory and take appropriate action - Contain the aircraft within the normal flight envelope - Maintain the desired flight path and delegates other tasks to another ground pilot or to the supervisor - Select the appropriate level and mode of automation in a timely manner - Effectively monitor automation, including engagement and automatic mode transitions	Beginner	Automatic flight control and management Aircraft performance

| Operation of Ground Control Station (GCS) tools/automation | Demonstrate effective use of GCS tools and automation to monitor and support flights with a single on-board pilot | - GCS hardware and software
- GCS controls and displays (related to primary flight data, navigation, traffic, systems, weather, terrain, procedures/checklists, radios, etc.)
- Similarities and differences between the GCS and the flight deck
- Communication link between the GCS, the aircraft and ATC
- Control and telemetry link between the GCS and the aircraft
- Multimodal interaction between the ground pilot and GCS (touchscreen gestures, voice commands, etc.)
- GCS redundancy | - Operate ground control station tools correctly, independently, and efficiently
- Use the right ground control station tools depending on the phase of flight
- Interact with ground control station tools using the appropriate means of interaction (e.g., touchscreen gestures, voice commands, physical controls, etc.)
- Use the ground control station tools to monitor the aircraft and on-board pilot and to communicate with the pilot and ATC
- Use the ground control station tools to manage the flight path of an aircraft in the event of on-board pilot incapacitation
- Monitor the ground control station tools for correct operation (display of information, etc.)
- Monitor the integrity of the communication (voice & data), control and telemetry links between the GCS and the aircraft | Beginner | Ground control station systems

AI-enabled automation and decision support systems

Cybersecurity |

KEY BEHAVIOURAL SKILLS AND COMPETENCES

Competence	Competence Description	Knowledge	Skill	Level	Preliminary Training Topics
Name	*Short competence description*	*The individual should have knowledge of…*	*With this skill someone should be capable of….*	*Beginner Intermediate Advanced*	*How to acquire the skill?*
Situation Awareness	Perceive and comprehend all the relevant information available and anticipate what could happen that may affect the operation	- Aviation psychology (human information processing, human error and reliability, situation awareness, safety awareness, etc.) - Threat and error management - Aircraft general knowledge (systems, instrumentation) - Aircraft performance (climb performance, variables effecting aircraft performance in different phases of flight, etc.) - Surveillance systems (for weather, traffic, and terrain avoidance)	- Identify and assess accurately the state of the aircraft and its systems - Identify and assess accurately the vertical and lateral position of the aircraft and its anticipated flight path - Identify and assess accurately the general environment (weather, traffic, terrain) as it may affect the operation - Keep track of time and fuel - Maintain awareness of the onboard pilot and his/her capacity to perform as expected - Gather information from all sources at his/her disposal and shares relevant information with the onboard pilot to ensure a shared mental model of the situation - Anticipate accurately what could happen, plans, and stays ahead of the situation	Beginner	Human performance and limitations Flight path monitoring

			- Together with the onboard pilot, develop effective contingency plans based on potential threats e.g., pilot incapacitation - Together with the onboard pilot, identify and manage threats to the safety of the aircraft and passengers - Recognize and effectively respond to indications of reduced situation awareness - Perform all the above for one or more aircraft with a single onboard pilot		
Communication	Demonstrate effective oral, non-verbal, and written communications, in normal and non-normal situations	- RT communications / RT phraseology (IFR and VFR) - Datalink systems (CPDLC, etc.) - Types of communication (verbal, non-verbal, etc.) - Effective communication techniques - Crew Resource Management (CRM) - Operational procedures	- Ensure that the recipient (on-board pilot, ATCO, other ground pilot, etc.) is ready and able to receive the information - Select appropriately what, when how and with whom to communicate - Convey messages clearly, accurately, and concisely - Confirm that the recipient correctly understands important information - Listen actively and demonstrates understanding when receiving information - Ask relevant and effective questions - Adhere to standard radiotelephone phraseology and procedures - Accurately read and interpret required company and flight documentation - Accurately read, interpret, construct, and respond to datalink messages in English - Complete accurate reports as required by operating procedures - Correctly interpret non-verbal communication - Use eye contact, body movement and gestures that are consistent with and support verbal messages - Perform all the above for one or more aircraft with a single on-board pilot	Beginner	VFR and IFR communications Human performance and limitations
Workload Management	Manage available resources efficiently to prioritize and perform tasks in a timely manner under all circumstances	- Aviation psychology (human overload and underload, fatigue, and stress management, etc.) - Threat and error management - Time management / planning - Multi-tasking strategies	- Maintain self-control in all situations - Plan, prioritize, and schedule tasks effectively - Manage time efficiently when carrying out tasks - Offer and accept assistance and asking for help early - Review, monitor and cross-check actions conscientiously - Verify those tasks are completed to the expected outcome	Beginner	Human performance and limitations

| | | | - Manage and recover from interruptions, distractions, variations, and failures effectively
- Perform all the above for one or more aircraft with a single on-board pilot | | |