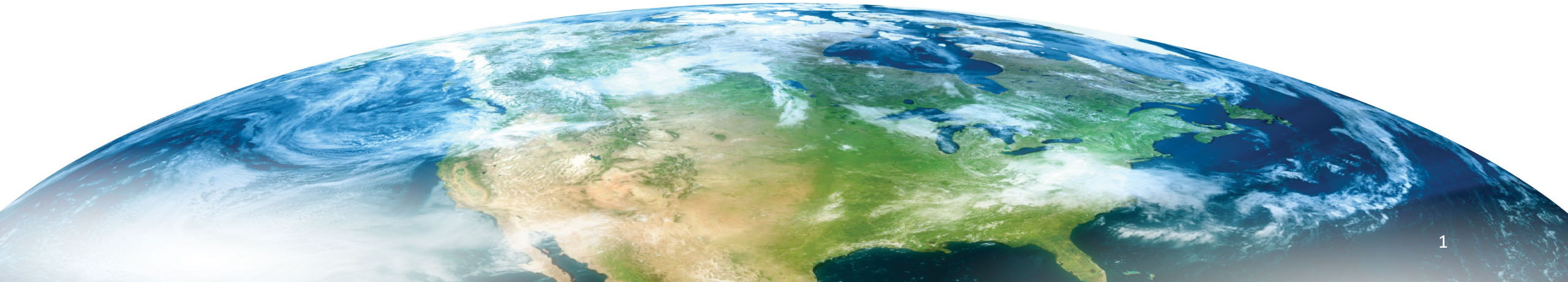
Flight Deck/Maintenance/System Integration Human Factors Research Program

Semiannual update to the REDAC Human Factors Subcommittee

Presenter: Chuck Perala, Ph.D., NextGen Human Factors Division (ANG-C1)

Budget Line Item (BLI) Number: A11G (8AA)

Date: August 29th, 2023



Flight Deck/Maintenance/System Integration Human Factors Research Program

Program Scope

- This program addresses research, engineering, and development requirements defined by technical sponsors in the Aviation Safety (AVS) organization. Requirements are driven by the human factors needs of FAA Aircraft Certification (AIR) and Flight Standards (AFX) personnel.
- This program also considers rapid changes to current-day technologies, procedures, and emerging issues

FAA Benefits

- Program outputs are transferred to AVS technical sponsors who develop and maintain, as appropriate, human factors-related regulations, guidance, procedures, Orders, standards, job aids, and other materials
- Work products benefit AIR and AFX personnel who are responsible for the evaluation, certification, approval, and continued airworthiness of aircraft; and certification of pilots and mechanics

Measures of Success

1. Sponsor Satisfaction – did the research meet AVS's needs?
2. Access to Research – is there sufficient awareness/access to results?
3. Application of Results – did the research support or inform a data-driven decision?
4. Benefits – how did the research contribute to safety, capacity, and/or efficiency?

Flight Deck/Maintenance/System Integration Human Factors Research Program

Team Members

- Tara Gibson, Division Manager (Tara.M.Gibson@faa.gov)
- Chuck Perala, Program Manager (Chuck.Perala@faa.gov)

Researchers and Laboratories

- FAA Civil Aerospace Medical Institute (CAMI)
- Volpe National Transportation Systems Center, Department of Transportation (DOT)
- MITRE Corporation, Center for Advanced Aviation System Development (CAASD)
- Academia: University of Michigan, University of Central Florida (UCF), Massachusetts Institute of Technology (MIT), Auburn University (AU)
- FAA Center of Excellence for Technical Training and Human Performance (COE TTHP)

Flight Deck/Maintenance/System Integration Human Factors Research Program accomplishments since FY2023 Q2

Operational Capability (OC) Number and Title	Project	Description/Product
OC 1: Improving Pilot Training, Operations, and Procedures	Modern Training Practices	**Milestone:** Researchers submitted six papers to two conferences for potential publication in late 2023. • Suitability of Virtual Reality for Supplemental Scenario-Based Training to Facilitate Crew Resource Management Outcomes, Human Factors and Ergonomics Society (HFES) 2023 • Training Effectiveness Evaluation: Frameworks and Considerations for Flightcrew Training Review & Approval, HFES 2023 • Flightcrew Procedures Experimental Training: Simulation Testbed Design, Development & Interactive Demonstration, HFES 2023 • Training Effectiveness Evaluation: Frameworks and Considerations for Flightcrew Training & Approval, HFES 2023 • Using AI Tools to Develop Training Materials for Aviation: Ethical, Technical, and Practical Concerns, HFES 2023 • On Episodic Memory in Experiential Learning via Flightcrew Training Simulations, Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC) 2023
OC 2: Mitigating Human Fatigue	Short Haul High Frequency Domestic Flight Operations	**Pilot Perceptions Focus Group, Study Report** • Published a technical report on pilot perceptions of fatigue in short haul domestic flight operations after recent changes to 14 CFR Part 117 Flight and Duty Limitations and Rest Requirements: Flightcrew Members (https://doi.org/10.1016/j.tranpol.2023.03.004).
OC 3: Supporting Improvements in Aviation Maintenance	Safety Culture in Aviation Maintenance	**Safety Culture, Literature Review Report** • Analysis of regulatory material, FAA technical reports, and 538 peer-reviewed sources published between 1980 and 2022 on safety culture, organizational behavior management, and change management (https://www.faa.gov/sites/faa.gov/files/23-13-Safety%20Culture%20Assessment%20and%20Continuous%20Improvement%20in%20Aviation-%20A%20Literature%20Review.pdf).
OC 5: Human Factors Considerations and Emerging Trends in Helicopter Air Ambulance Operations	Helicopter Air Ambulance (HAA) Operations	**HAA Human Factors Research, Literature Review Report** (note: report complete Feb. 2023 and it is now available) • Human Factors in Helicopter Air Ambulance Operations Annotated Bibliography (2014-2022), Literature Review Report (https://www.faa.gov/sites/faa.gov/files/Perceptions%20of%20Factors%20Influencing%20Effectiveness%20of%20ATC%20Field%20Training%20%282014-2022%29.pdf)

Overview of the Flight Deck/Maintenance/System Integration Human Factors Research Program

AVS sponsors **11 human factors research requirements** managed by the NextGen Human Factors Division (ANG-C1). Information in this briefing aligns with operational capabilities (OC) in the AVS budget line-item (BLI) plan for A11G.

OC 1: Improving Pilot Training, Operations, and Procedures
Primary Sponsor: AFS-280, Air Transportation Division, Training and Simulation Group

OC 2: Mitigating Human Fatigue
Primary Sponsor: AFS-220, Air Carrier Operations Branch

OC 3: Supporting Improvements in Aviation Maintenance
Primary Sponsor: AFS-320, Aircraft Maintenance Division

OC 4: Advanced Vision Systems, Head-Up Display, Head-Worn Display: Operation Standards & Approval Criteria
Primary Sponsor: AFS-410, Flight Technologies and Procedures Division

OC 5: Human Factors Considerations and Emerging Trends in Helicopter Air Ambulance Operations
Primary Sponsor: AFS-220, Air Carrier Operations Branch – Part 135 Operations Section

OC 6: Improving General Aviation Pilot Response to Unexpected Events
Primary Sponsor: AVP-230, Office of Accident Investigation and Prevention - Integrated Safety Teams

OC 7: Advances and Innovation in New Technology and Operations
Primary Sponsor: AIR-626, Human Machine Interface Section

OC 8: Air/Ground Integration of Technology, Systems, Operations, and Procedures for Trajectory-Based Operations
Primary Sponsor: AFS-410; AFS-280, AIR-626
Note: This OC is addressed in a separate briefing package

OC 9: Integrating Human Factors into Aircraft Certification and Flight Standards Policies and Processes
Primary Sponsor: AFS-100, Aircraft Evaluation Division (AED); AIR-600 Policy and Innovation Division

OC 10: Pilot Physiological State Monitoring Technologies and Mitigations
Primary Sponsor: AAM2, Office of the Deputy Federal Air Surgeon; AIR-626

OC 11: Current Flight Deck Operations and Pilot Procedures: Arrival, Approach, Departure
Primary Sponsor: AFS-410

Operational Capability (OC) 1: Improving Pilot Training, Procedures, and Operations

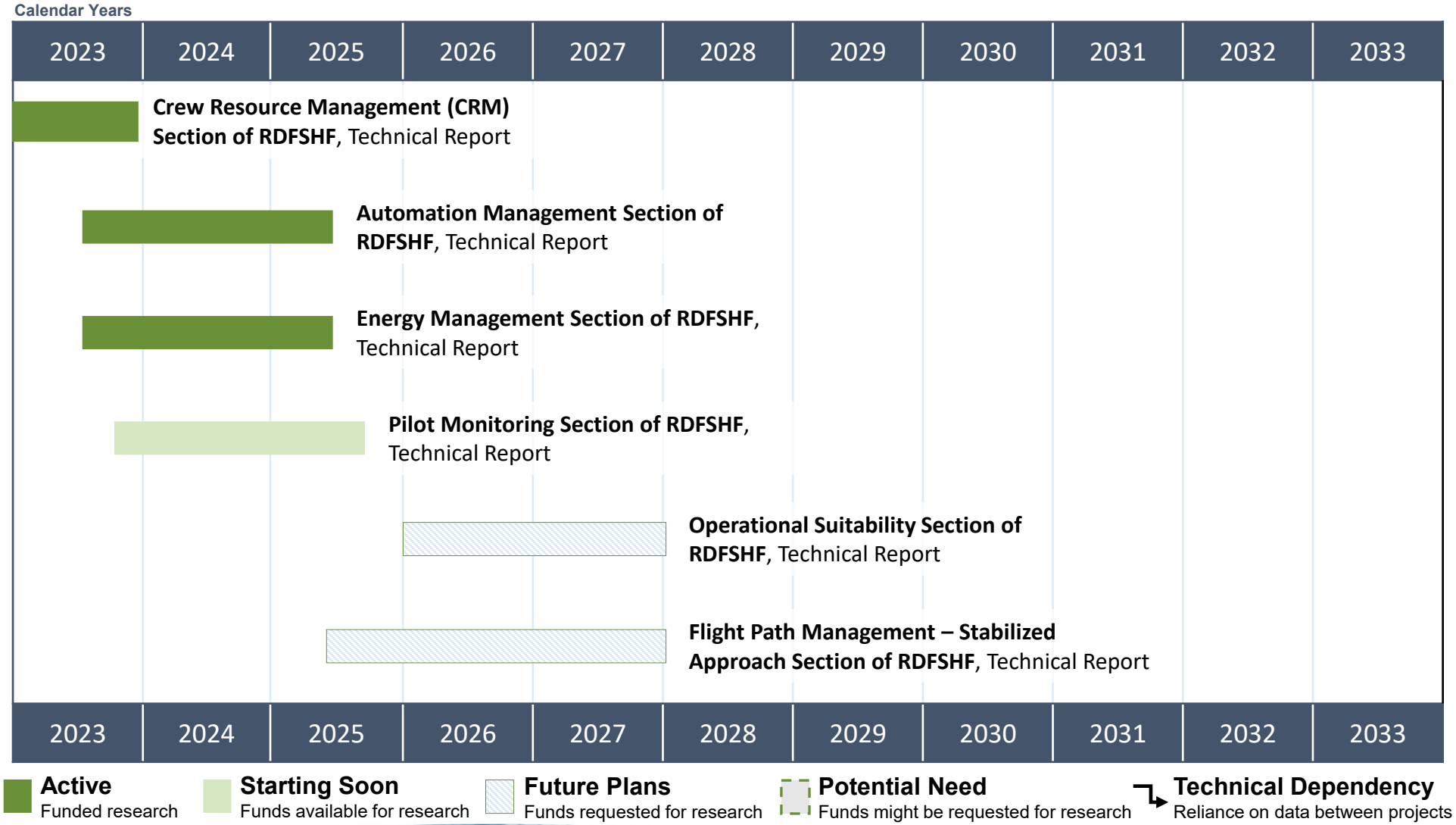
FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Single source reference document for Flight Standards human factors (RDFSHF)

Research Question: What human factors research data would support the Flight Standards personnel who must evaluate and approve operational suitability, training, procedures, operations, and maintenance?

***ACSAA related research**



OC 1: Improving Pilot Training, Procedures, and Operations

FY2023 Research and Potential Project Plans

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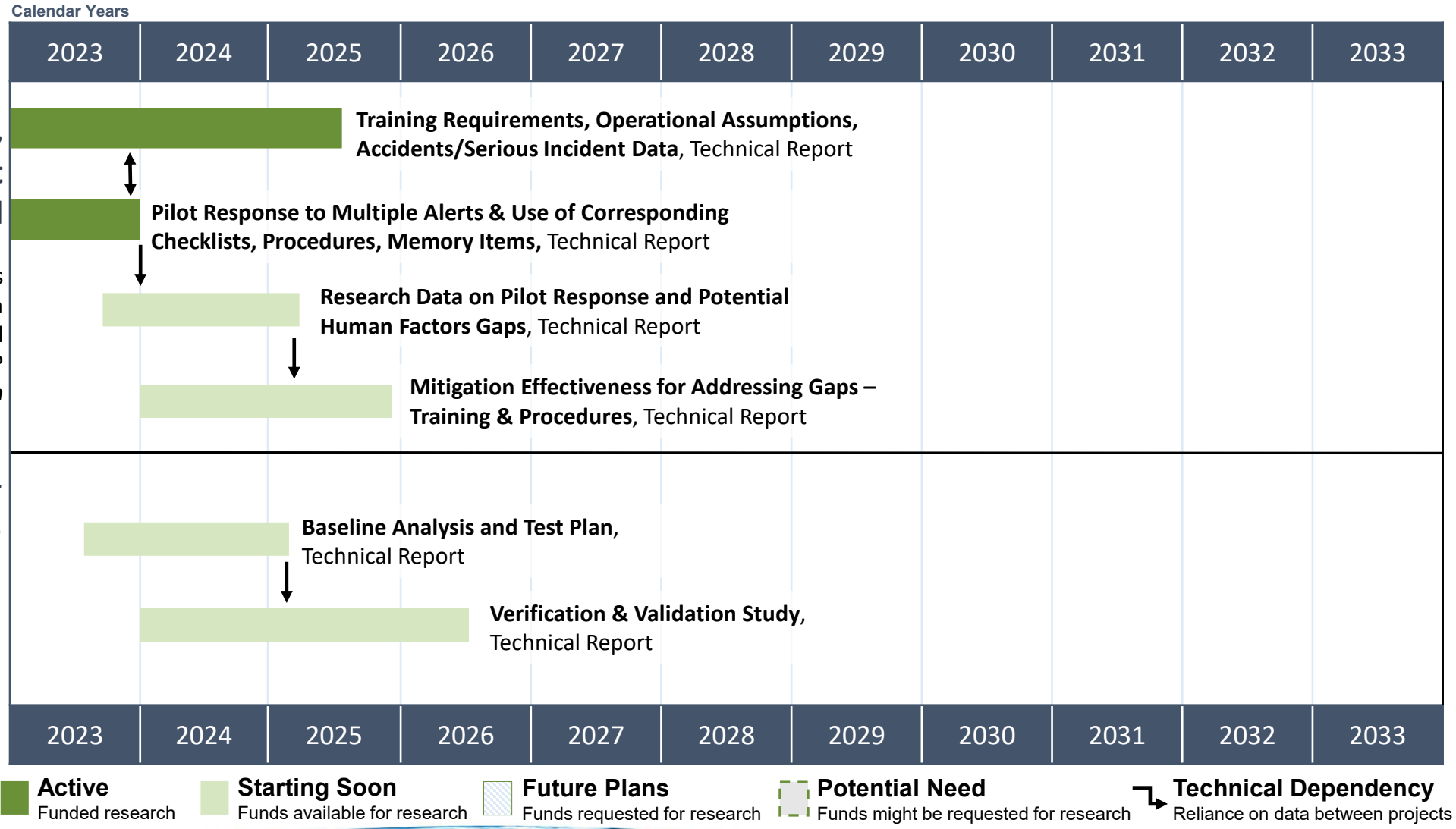
Pilot response to system failures, malfunctions, and systems not functioning as expected

Research Question: How and why do pilots react incorrectly to system malfunctions in transport aircraft, and what are potential mitigations to reduce these responses?
ACSAA related research

Crew resource management – cognitive indicators

Research Question: What are cognitive indicators of pilot performance in Crew Resource Management (CRM)?
ACSAA related research



OC 1: Improving Pilot Training, Procedures, and Operations

FY2023 Research and Potential Project Plans

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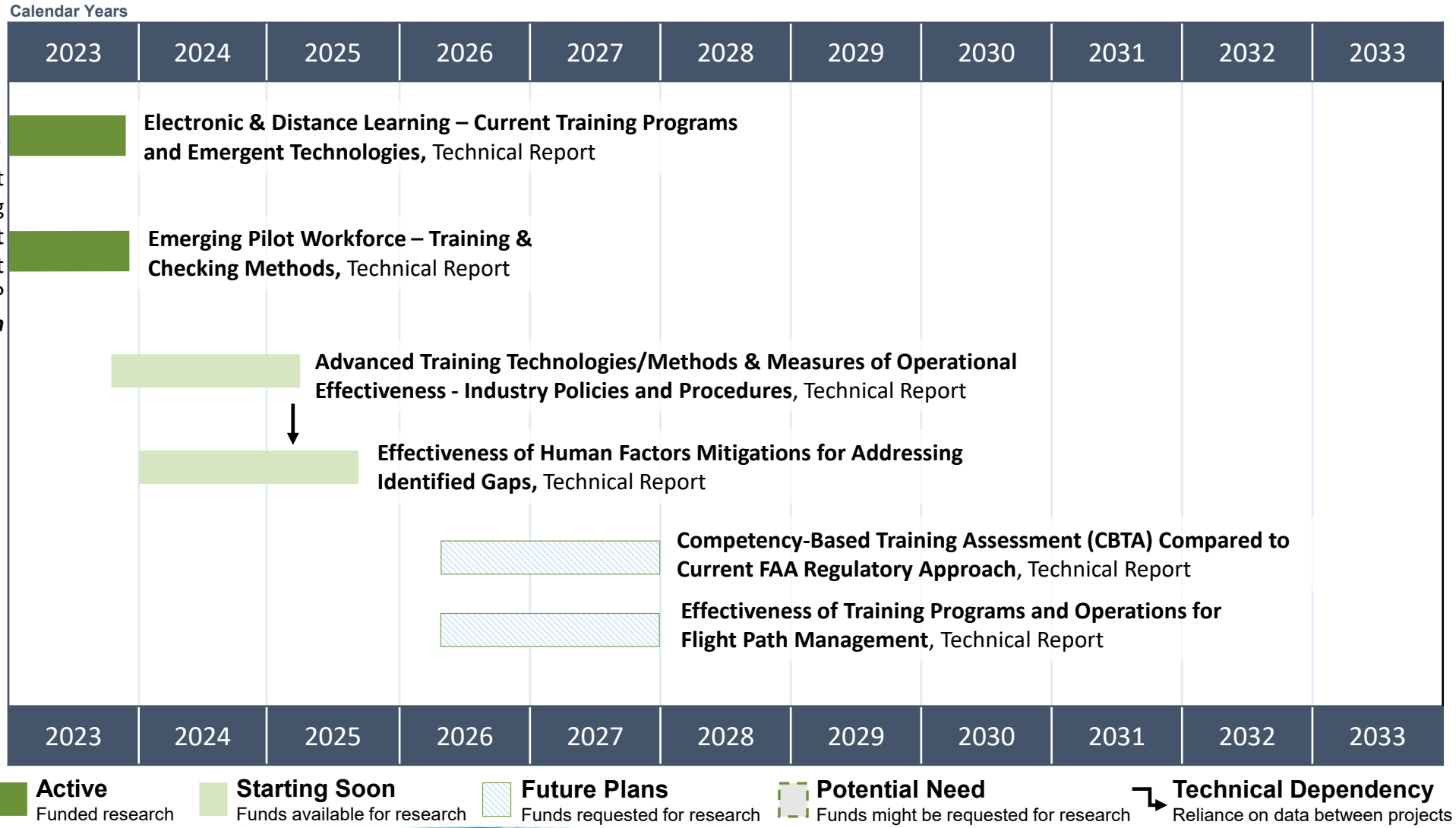
Pilot training and operational effectiveness

Research Question: How effective are current pilot training programs, including those using new training technologies and methods? What technologies and methods are most appropriate for which pilot training tasks?
ACSAA related research



OC 1: Improving Pilot Training, Procedures, and Operations

FY2023 Research and Potential Project Plans

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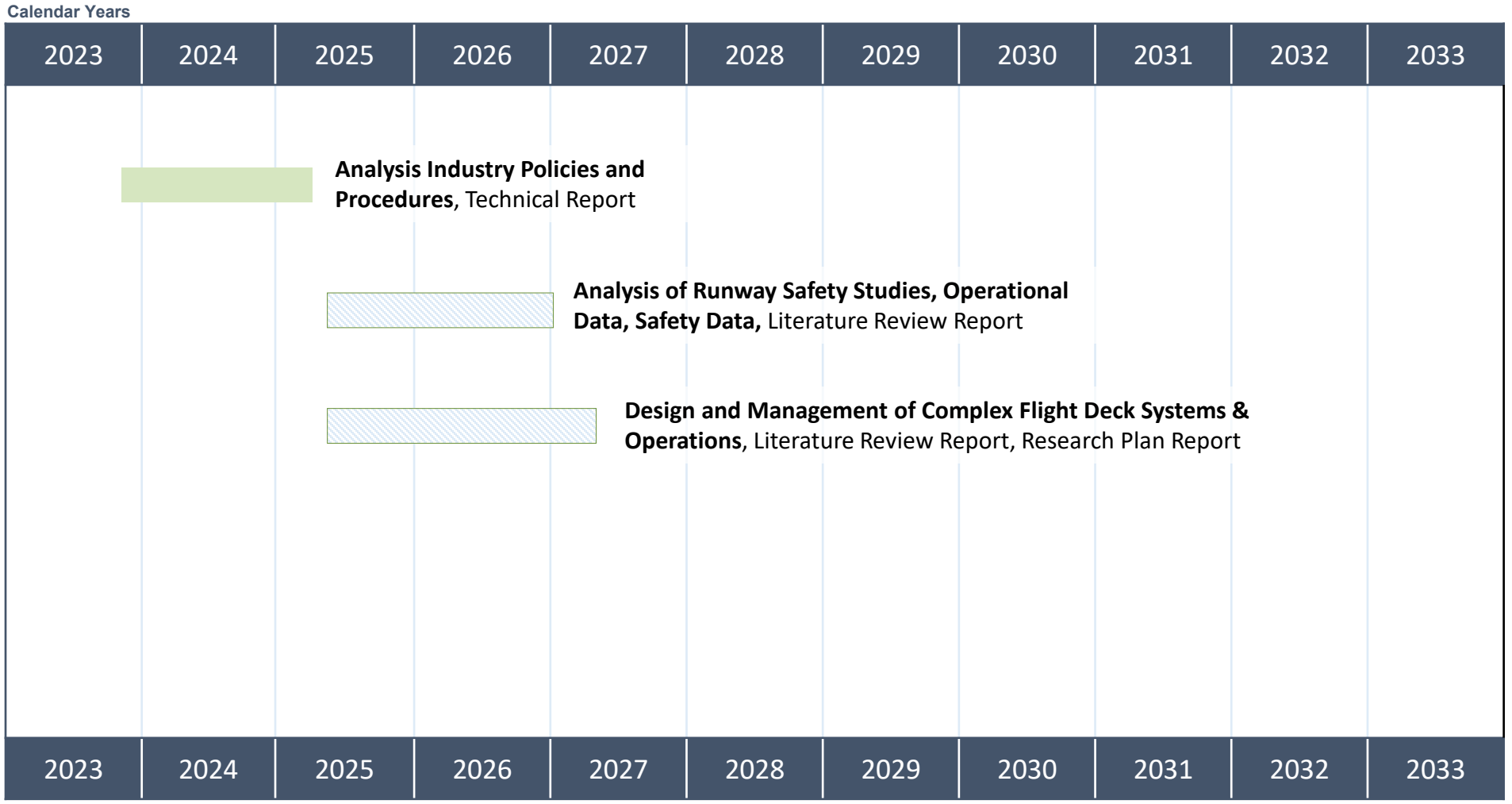
Adapting training and flight operations to emerging risks

Research Question: How should we adapt training and flight operations to respond to emerging risks, including pilot automation dependencies?

ACSAA related research



OC 2: Mitigating Fatigue in Flight Operations

FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Fatigue risk management - current flight operations

Research Question: What standardized methods and analyses are needed to record and provide relevant Fatigue Risk Management System (FRMS) data with FAA stakeholders?

Research Question: What mitigations effectively manage impacts to human factors and pilot performance caused by long-haul and ultra-long-range flight operations that exceed the table limits of 14 CFR Part 117 "Flight and Duty Limitations and Rest Requirements for Flightcrew Members"?

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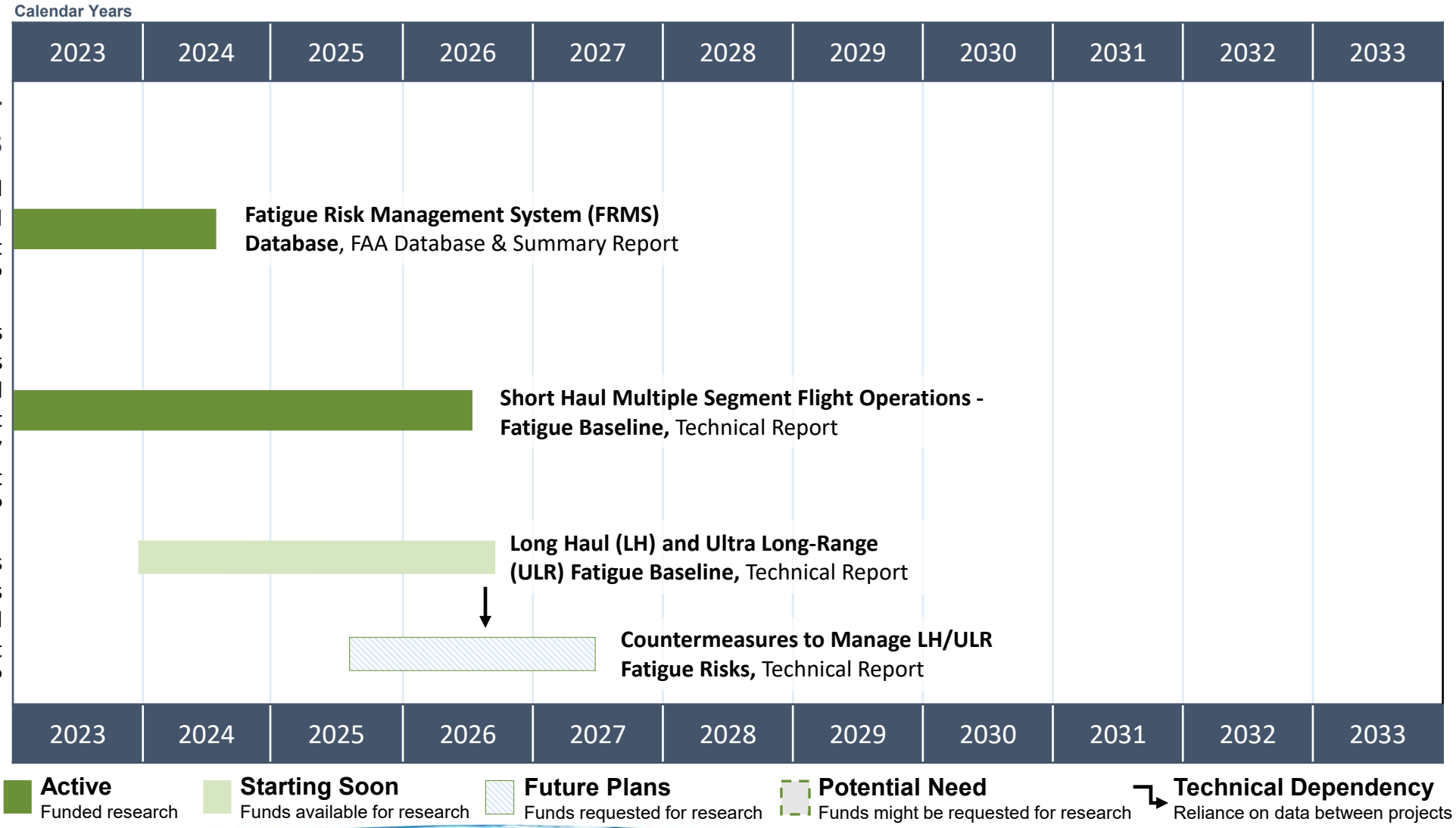

OC 2: Mitigating Fatigue in Flight Operations

FY2023 Research and Potential Project Plans

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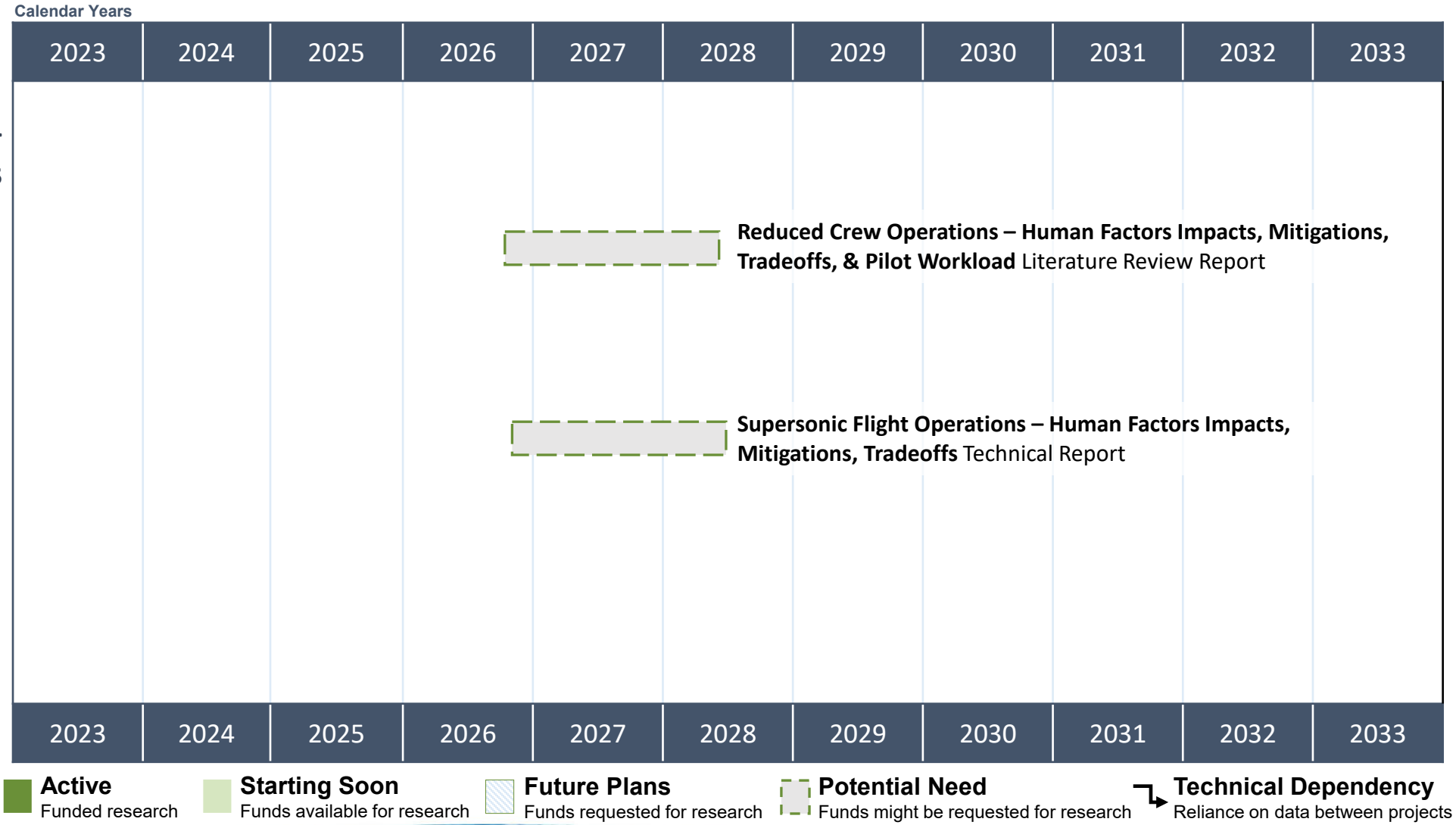
Fatigue risk management - future flight operations

Research Question: What are current and recommended mitigations to manage fatigue effects on pilot performance in reduced crew operations in transport category aircraft?

Research Question: What are current and recommended mitigations to manage fatigue effects on pilot performance in supersonic flight operations?



OC 3: Supporting Improvements in Aviation Maintenance

FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Maintenance training

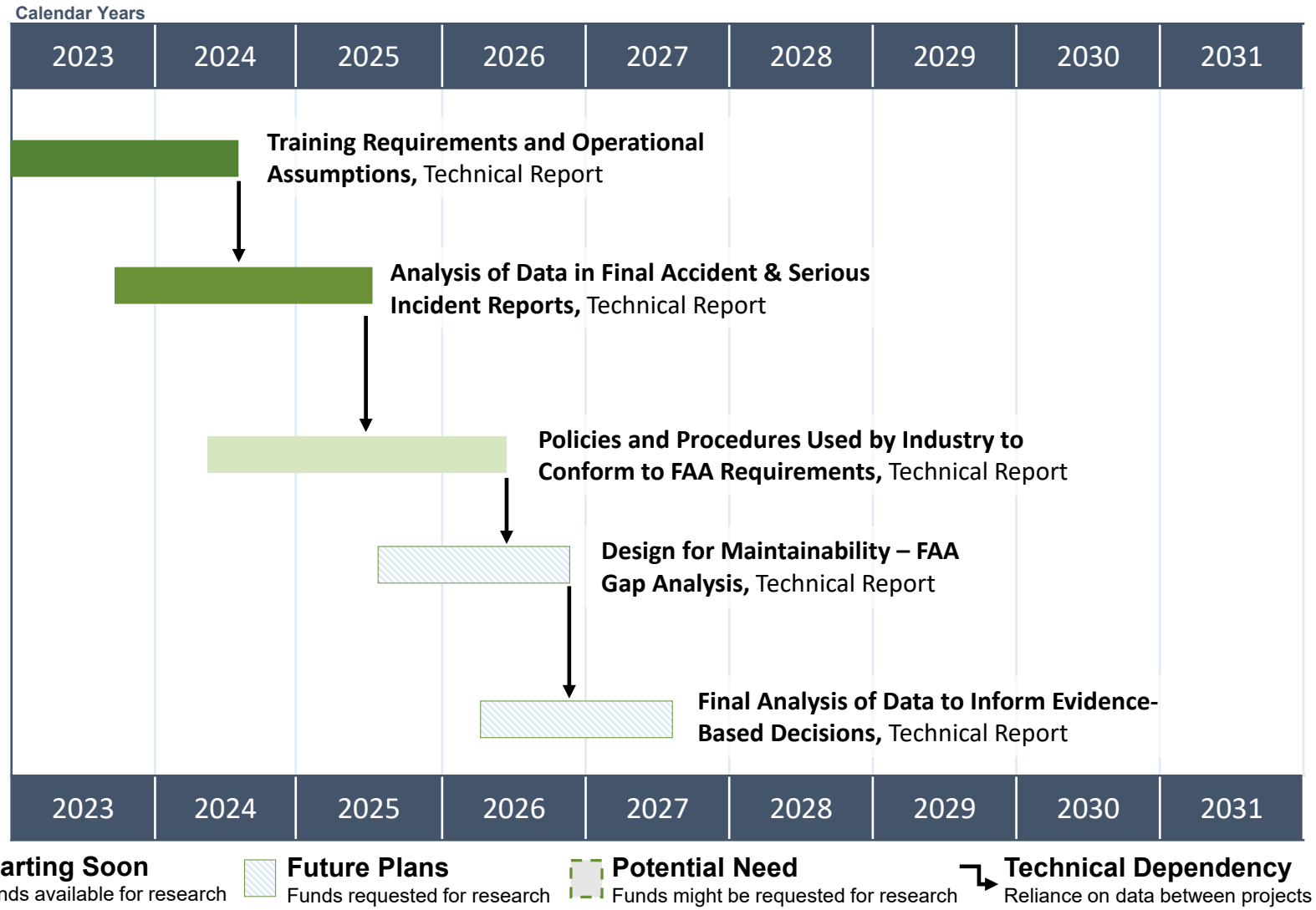
Research Question: What requirements & assumptions are currently used for aviation maintenance technician (AMT) knowledge, skills, experience, and training for transport category aircraft & airplane differences?
ACSAA related research

Research Question: What is the role and frequency of factors involving AMT knowledge, skills, experience, training, assumptions, & design for maintainability in global transport category aircraft accidents 2010-present?
ACSAA related research

Research Question: What training and operational policies/procedures are used by industry to conform to FAA AMT training requirements for transport category aircraft and airplane differences?
ACSAA related research

Research Question: What research & engineering data is needed to fill gaps in existing FAA guidance or to inform new guidance on design maintainability?
ACSAA related research

Research Question: Are FAA regulatory materials, guidance, and assumptions for maintenance training requirements for transport category aircraft adequate?
ACSAA related research



OC 3: Supporting Improvements in Aviation Maintenance

FY2023 Research and Potential Project Plans

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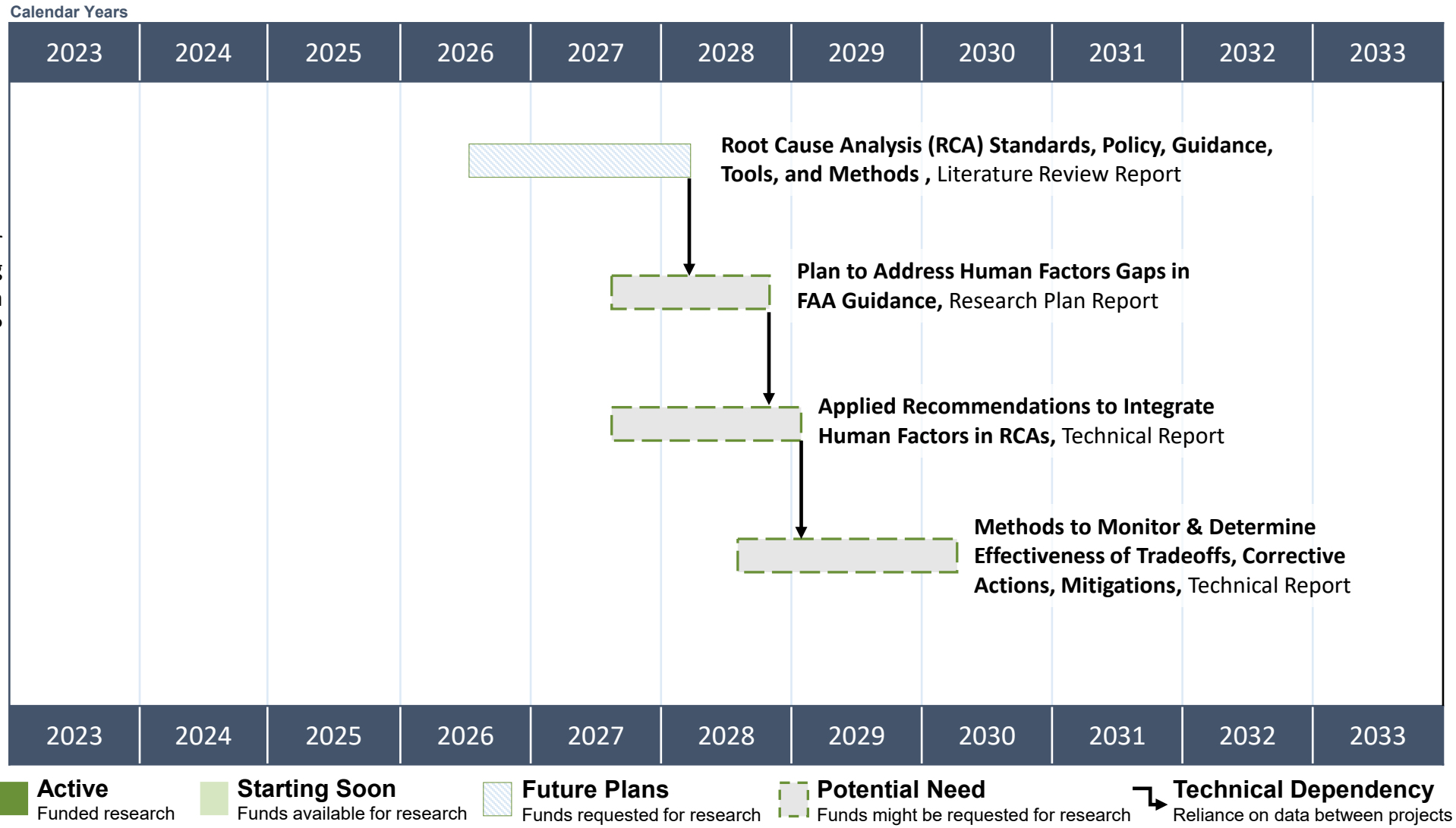
Methods to identify root cause(s) of human factors risks in maintenance programs

Research Question: Where are there gaps for human factors and operational data recording in existing Safety Assurance System (SAS) data collection tools (DCTs)?



OC 4: Advanced Vision Systems, Head-Up Displays, Head-Mounted Displays

FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

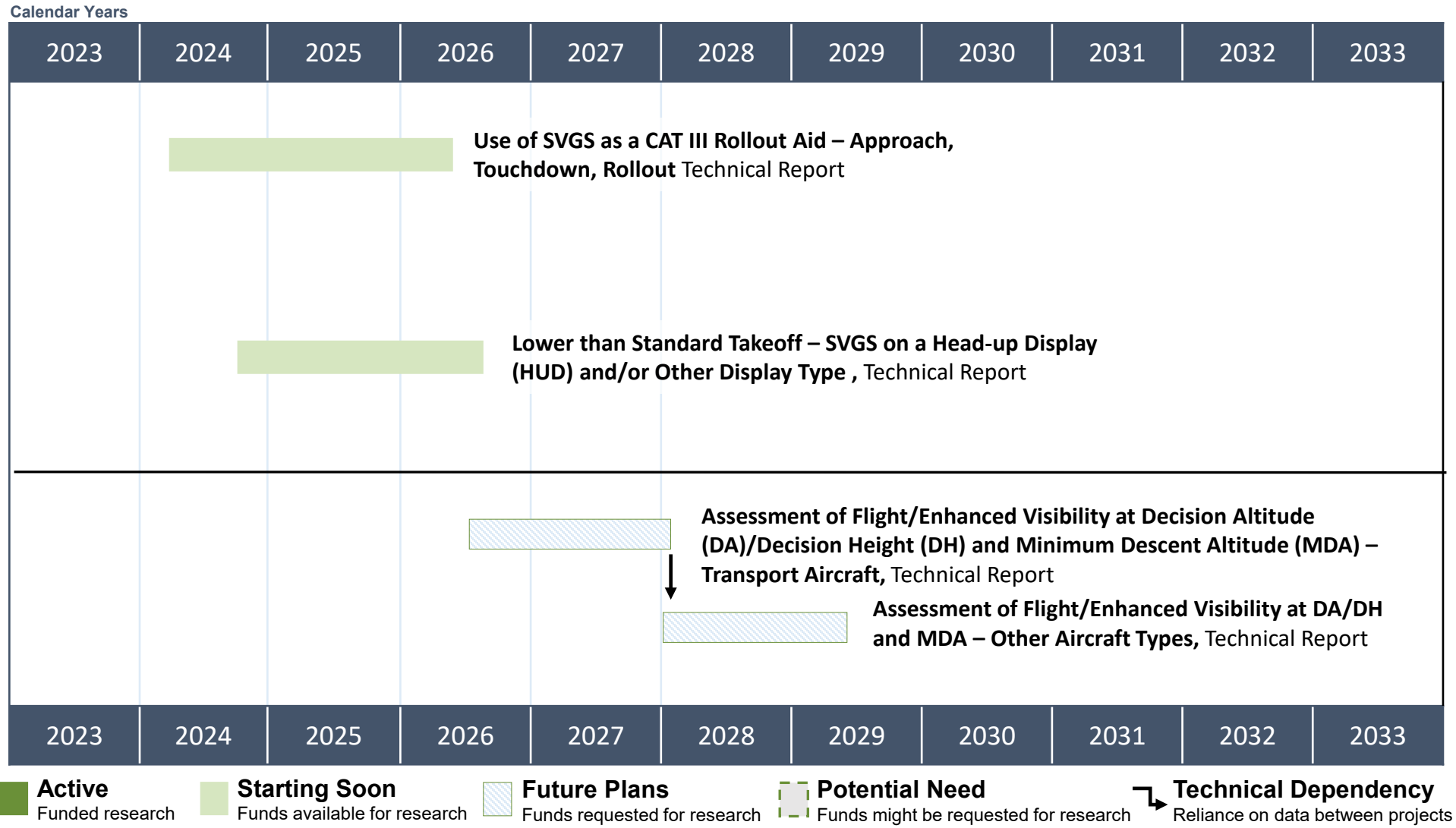
Synthetic vision guidance system (SVGS)

Research Question: Can SVGS technology be used as a substitute for any of the equipage and/or NAS infrastructure required to conduct CAT III flight operations?

Research Question: Can SVGS technology can be used as a possible substitute for certain airport/runway infrastructure currently required to conduct lower than standard takeoff minima operations when using natural vision?

Flight visibility assessment

Research Question: Does the use of an enhanced flight vision system (EFVS) on a head-down display to 100’ above touchdown zone elevation (TDZE) support an equivalent level of safety and pilot performance versus EFVS on a head-up display?



OC 4: Advanced Vision Systems, Head-Up Displays, Head-Mounted Displays

FY2023 Research and Potential Project Plans

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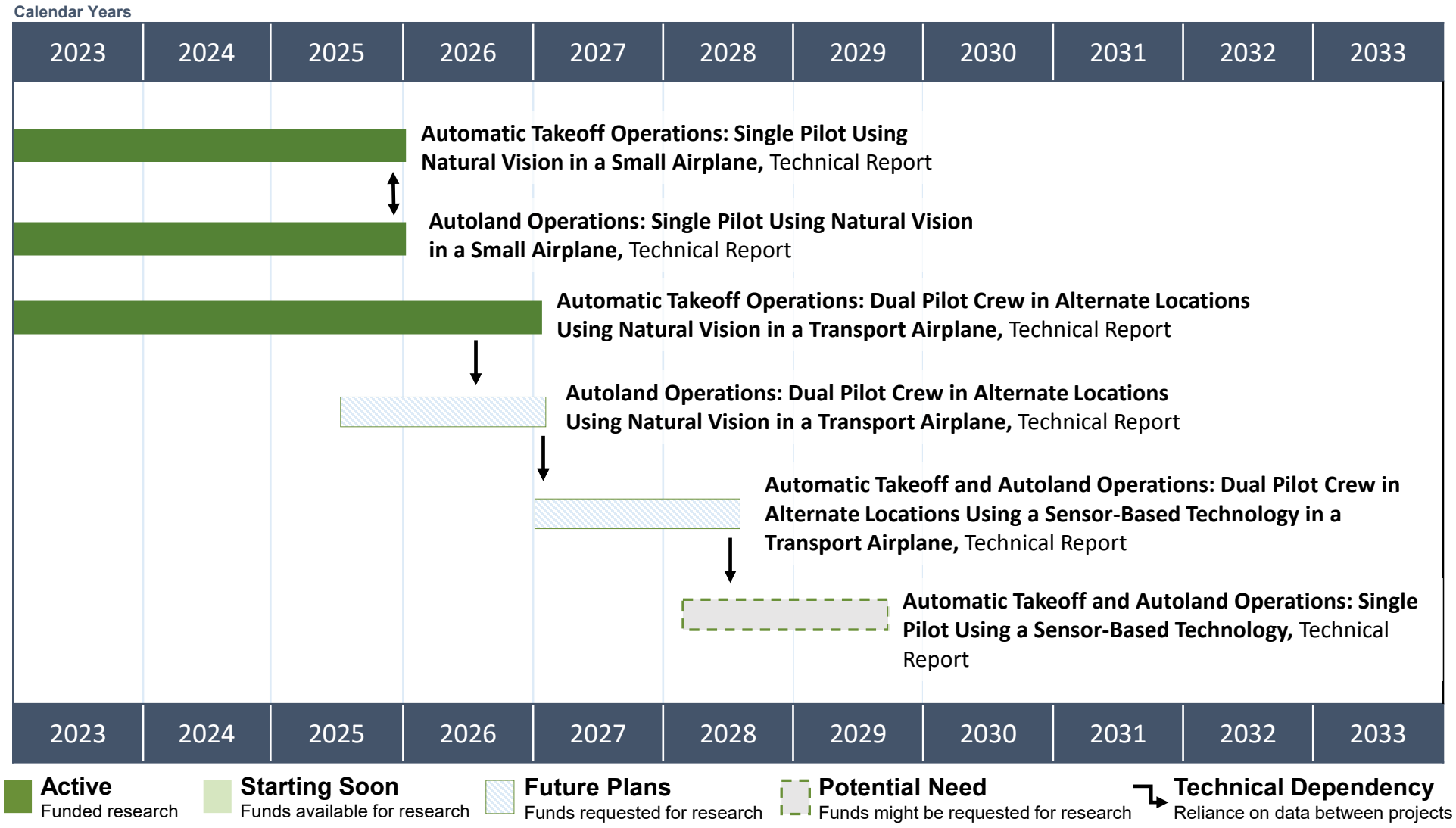
Automatic takeoff and landing operations

Research Question: Is single/dual pilot workload acceptable during new low visibility automatic takeoff and landing operations using unassisted vision or an emerging vision system technology to conduct and monitor the flight operation?



OC 4: Advanced Vision Systems, Head-Up Displays, Head-Mounted Displays

FY2023 Research and Potential Project Plans

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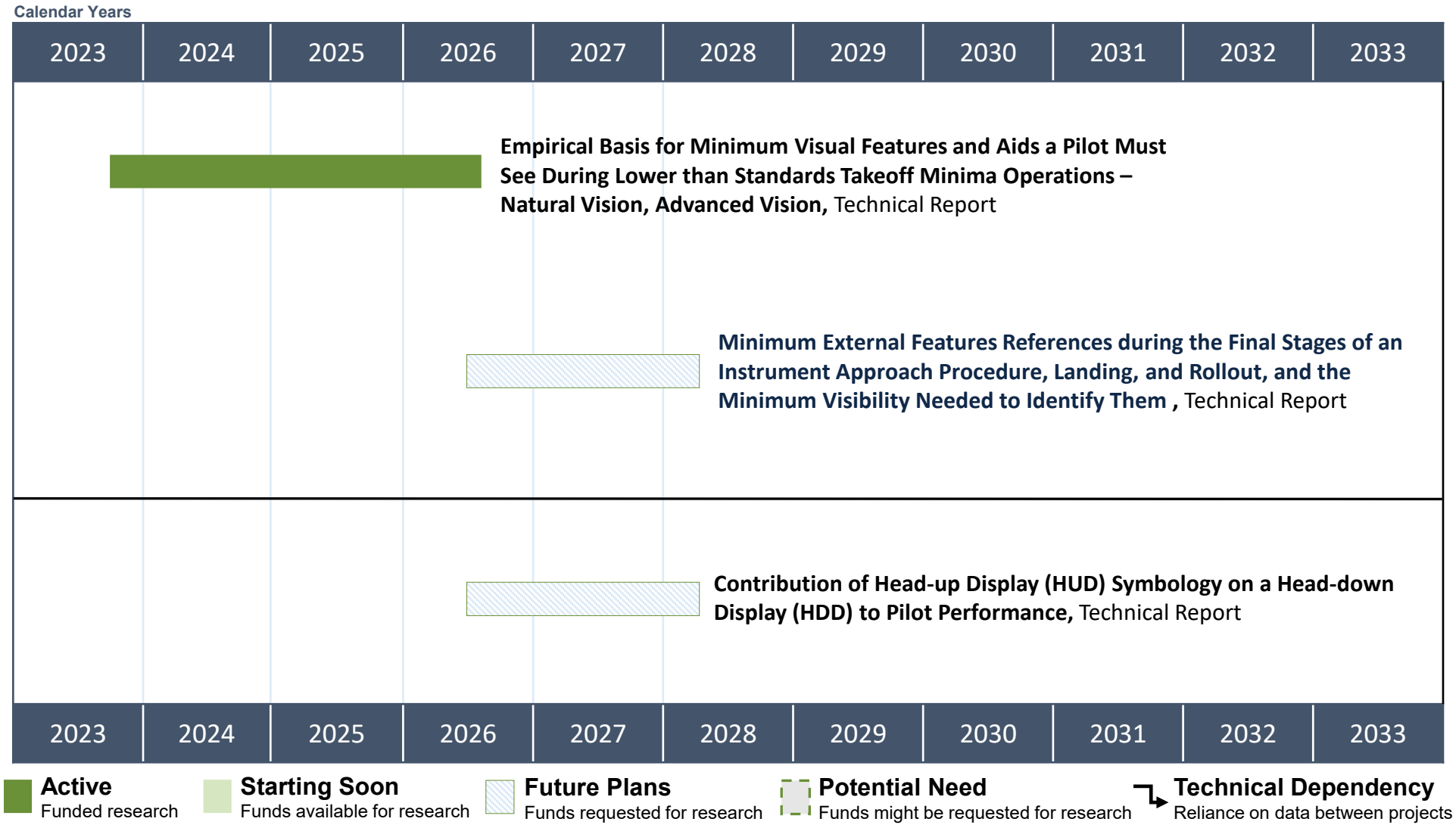
Minimum visual features and visual aids

Research Question: What are the minimum visual features and visual aids a pilot must see to safely takeoff in visibilities that range from 1600 RVR down to 300 RVR using both natural vision (with and without a HUD) and an advanced vision system (on a HUD)?

Research Question: What external features do pilots visually reference in the runway environment to manually land an aircraft, and the minimum visibility these references can be identified with natural vision?

Display symbology

Research Question: What is the contribution of head-up display (HUD) symbology on a head-down display (HDD) to pilot performance during low visibility flight operations?



OC 4: Advanced Vision Systems, Head-Up Displays, Head-Mounted Displays

FY2023 Research and Potential Project Plans

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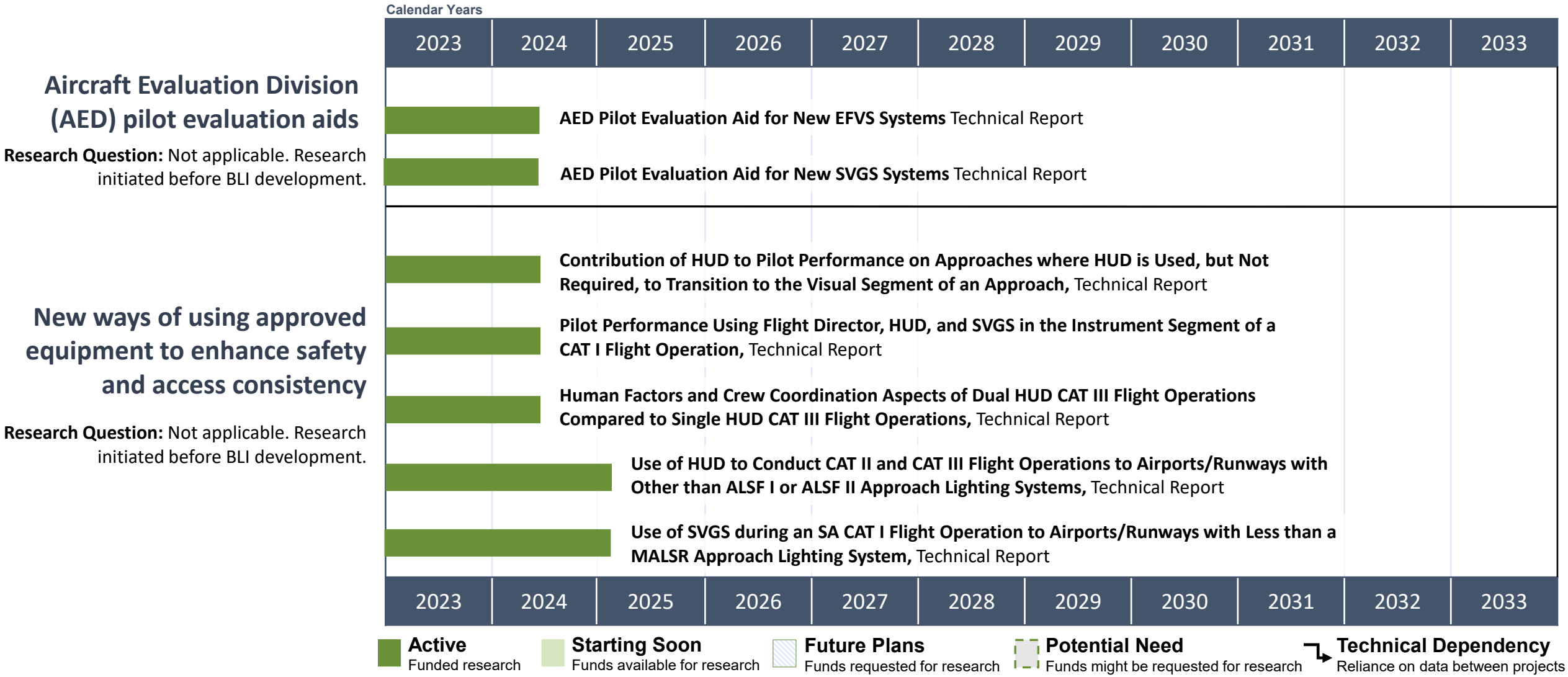


OC 5: Human Factors Considerations & Emerging Trends in Helicopter Air Ambulance Operations

FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Helicopter air ambulance (HAA) operations

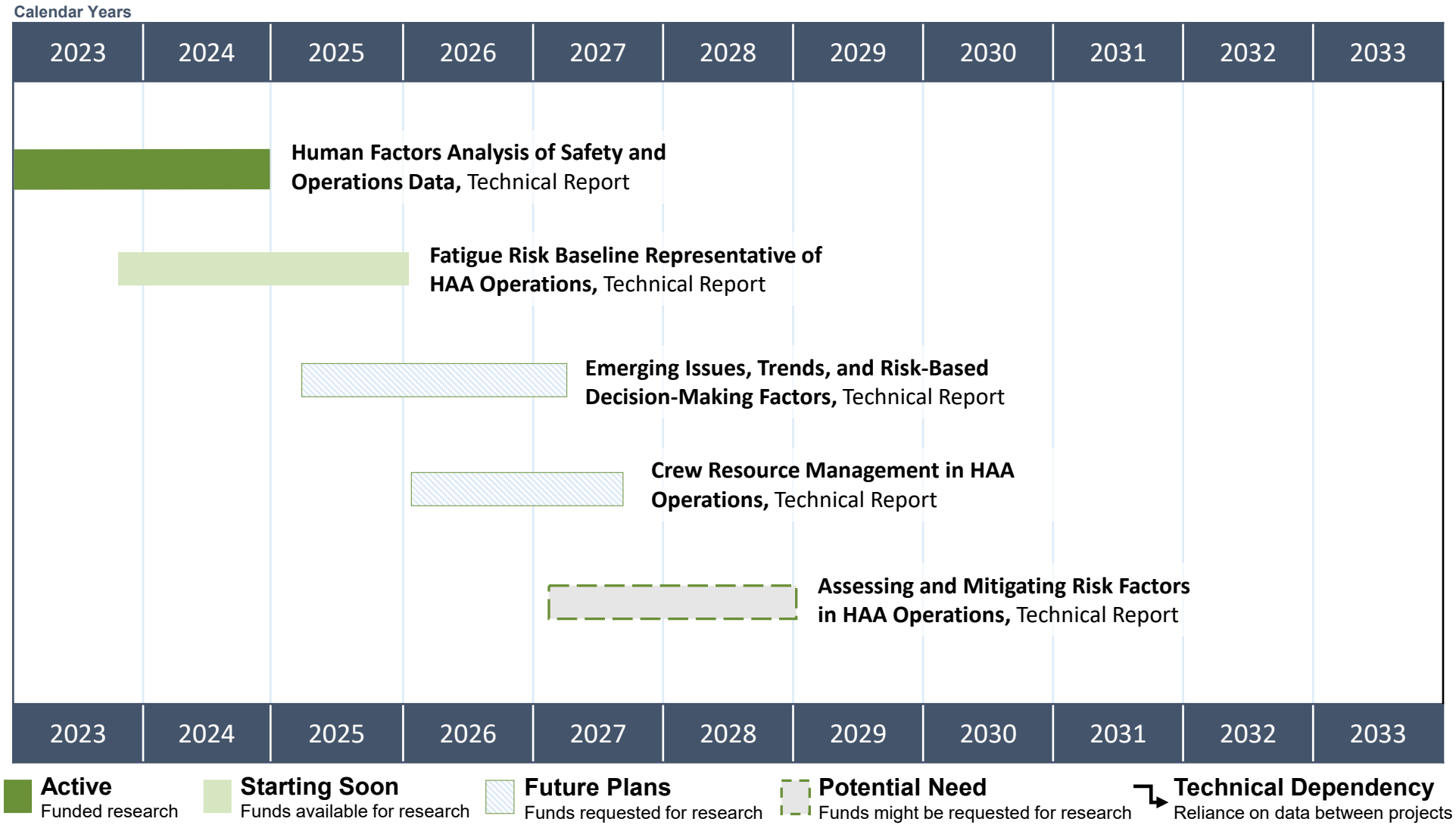
Research Question: What are casual or contributing human factors elements associated with HAA accidents and incidents?

Research Question: What are the current fatigue risks for the HAA Industry?

Research Question: What are human factors-related emerging issues and industry trends for HAA Operations?

Research Question: How Should HAA operations address crew resource management research recommendations?

Research Question: What are the industry best practices for assessing and mitigating risk factors in HAA Operations?



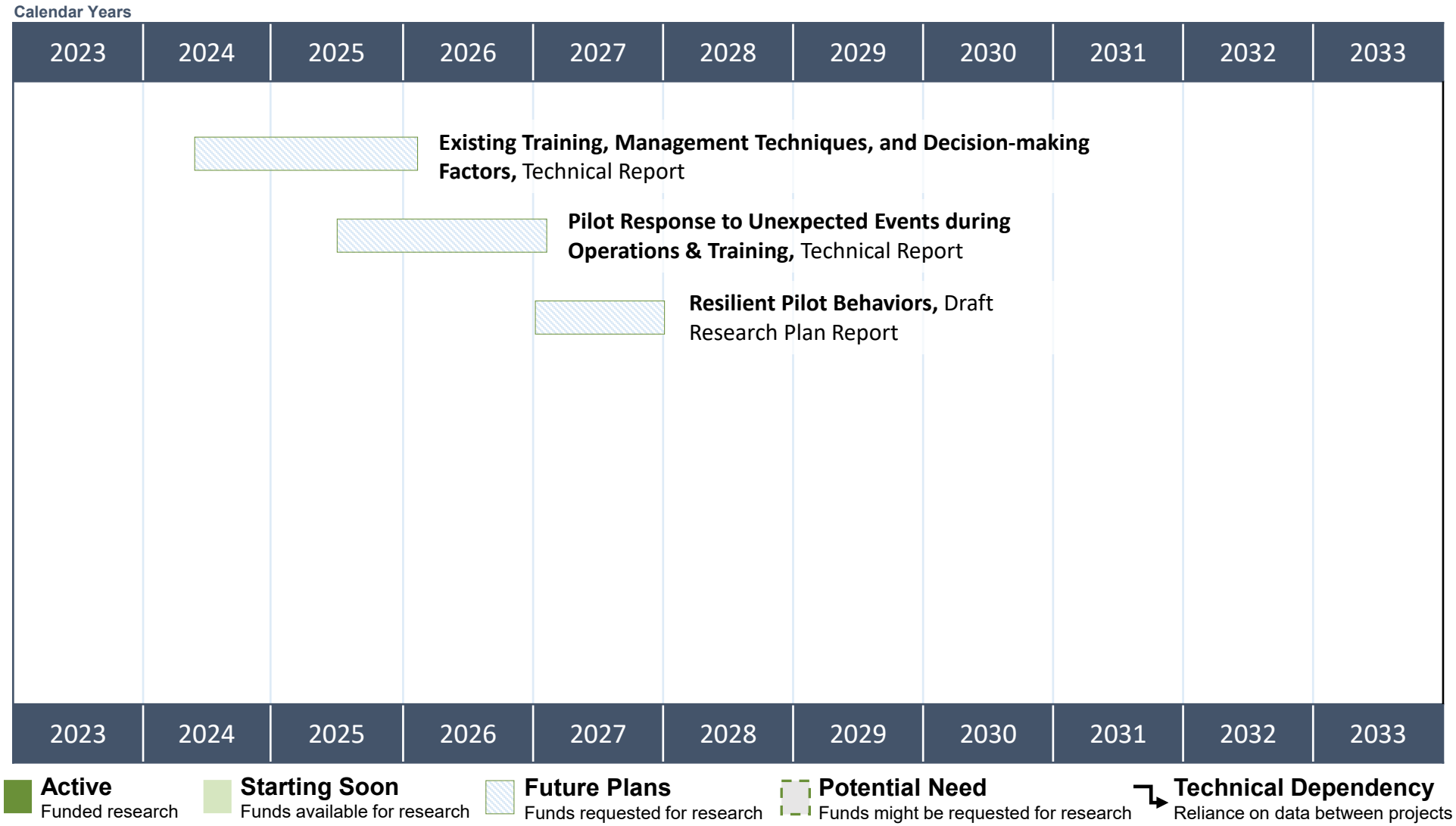
OC 6: Improving General Aviation Pilot's Response to Unexpected Events

FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Unexpected airplane state: general aviation

Research Question: How do General Aviation pilots react to unexpected events and what are potential mitigations to supporting appropriate responses?



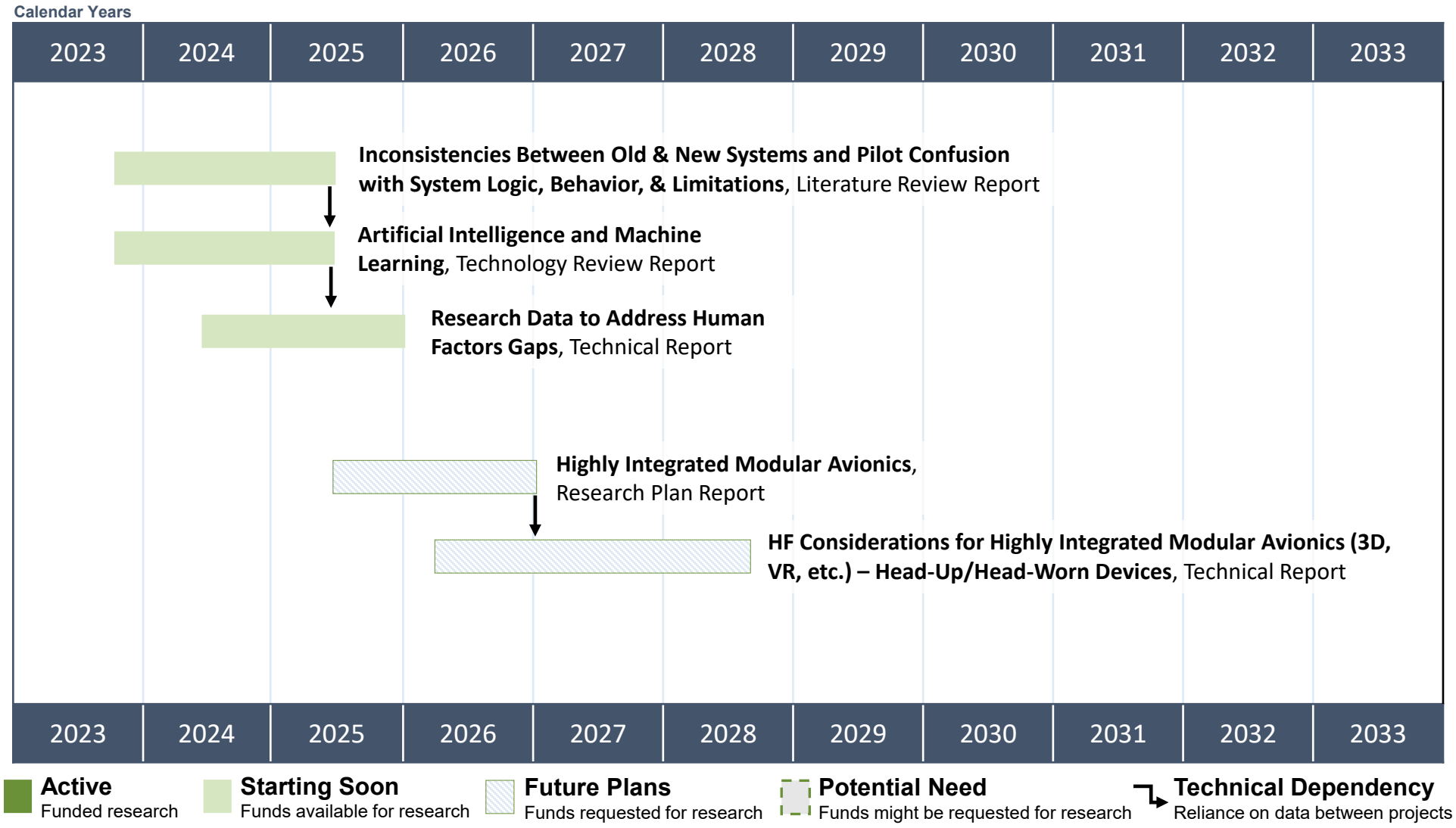
OC 7: Advances and Innovation in New Technologies and Operations

FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Pilot interactions with advanced technologies

Research Question: What are the human factors considerations for new flight deck interface technologies?
ACSAA related research



OC 7: Advances and Innovation in New Technologies and Operations

FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Pilot visual scanning techniques for flightpath management

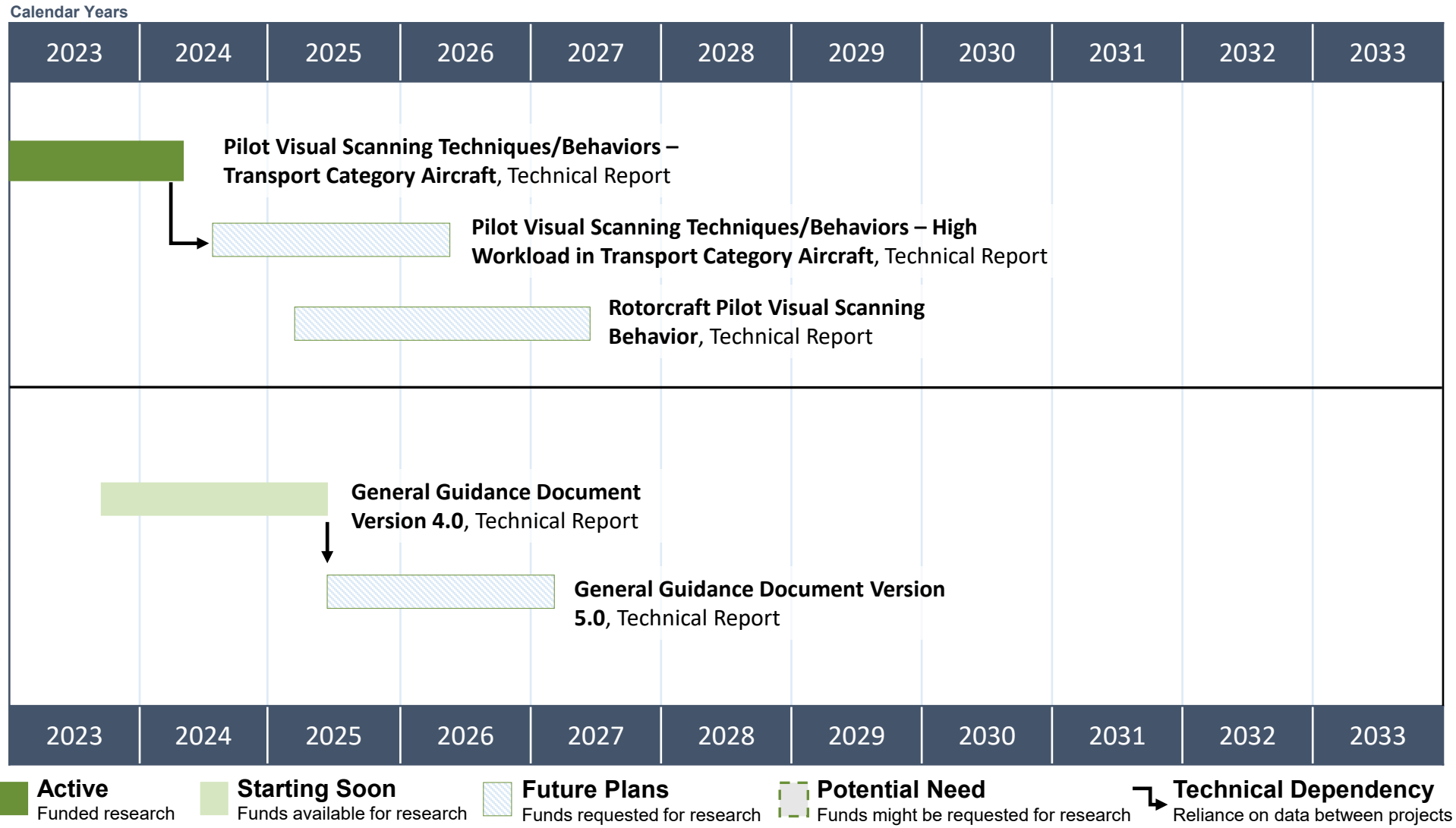
Research Question: What human factors aspects are involved in and affect flightpath management? What implications do these human factor aspects have on display design?

***ACSAA related research**

Human factors general guidance document

Research Question: What human factors research data would support the engineers, test pilots, and human factors specialists in Aircraft Certification who must evaluate and approve flight deck systems and equipment?

***ACSAA related research**



OC 7: Advances and Innovation in New Technologies and Operations

FY2023 Research and Potential Project Plans

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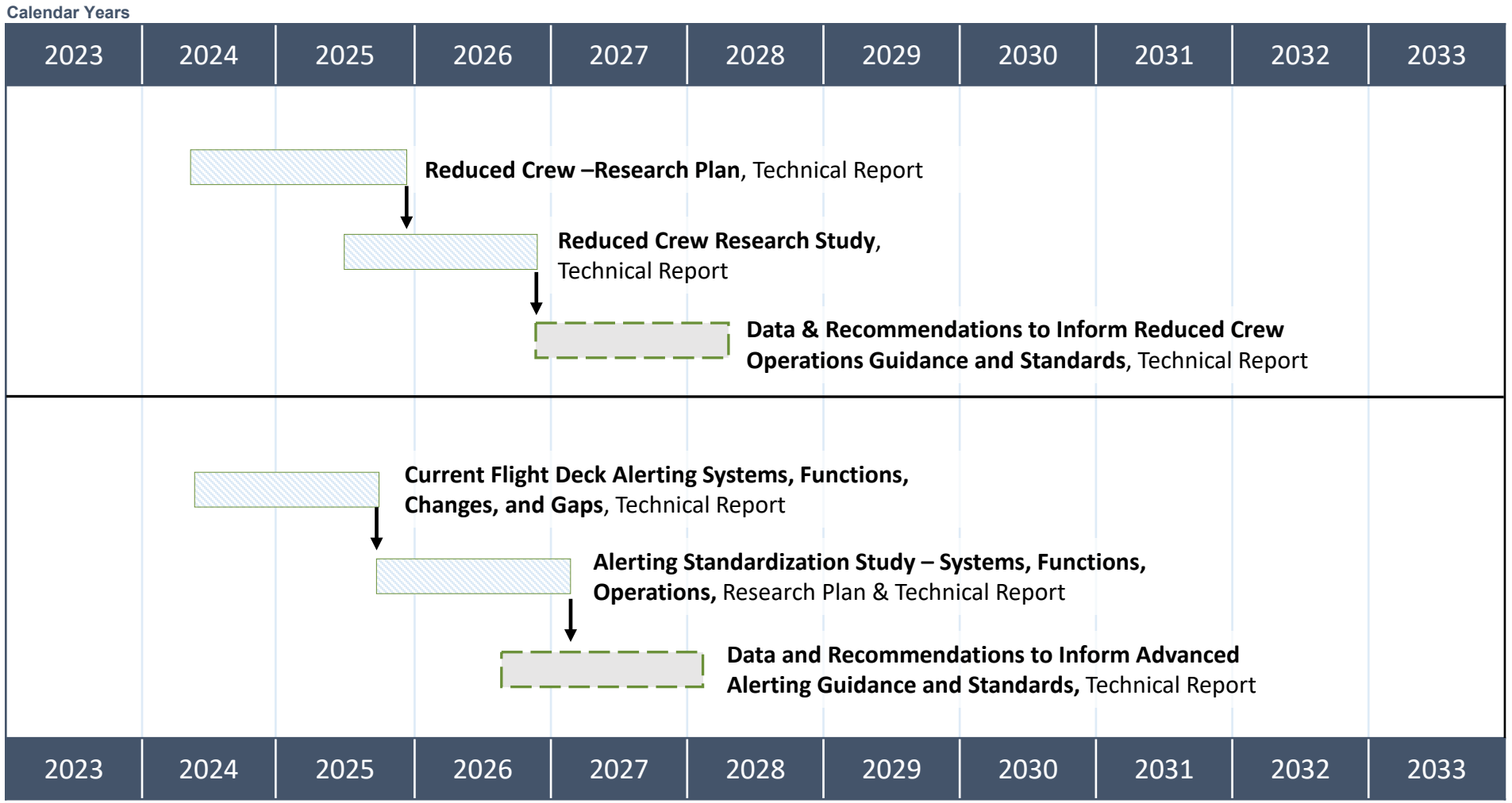
Reduced crew - transport aircraft

Research Question: Can we safely enable reduced crew operations at an equivalent level of safety as transport category operations, and if so, how?
ACSAA related research

Design standards for new and advanced alerting systems

Research Question: How should alerting system design standards be updated to reflect new technology and functionality in flight deck alerting systems?
ACSAA related research



OC 7: Advances and Innovation in New Technologies and Operations

FY2023 Research and Potential Project Plans

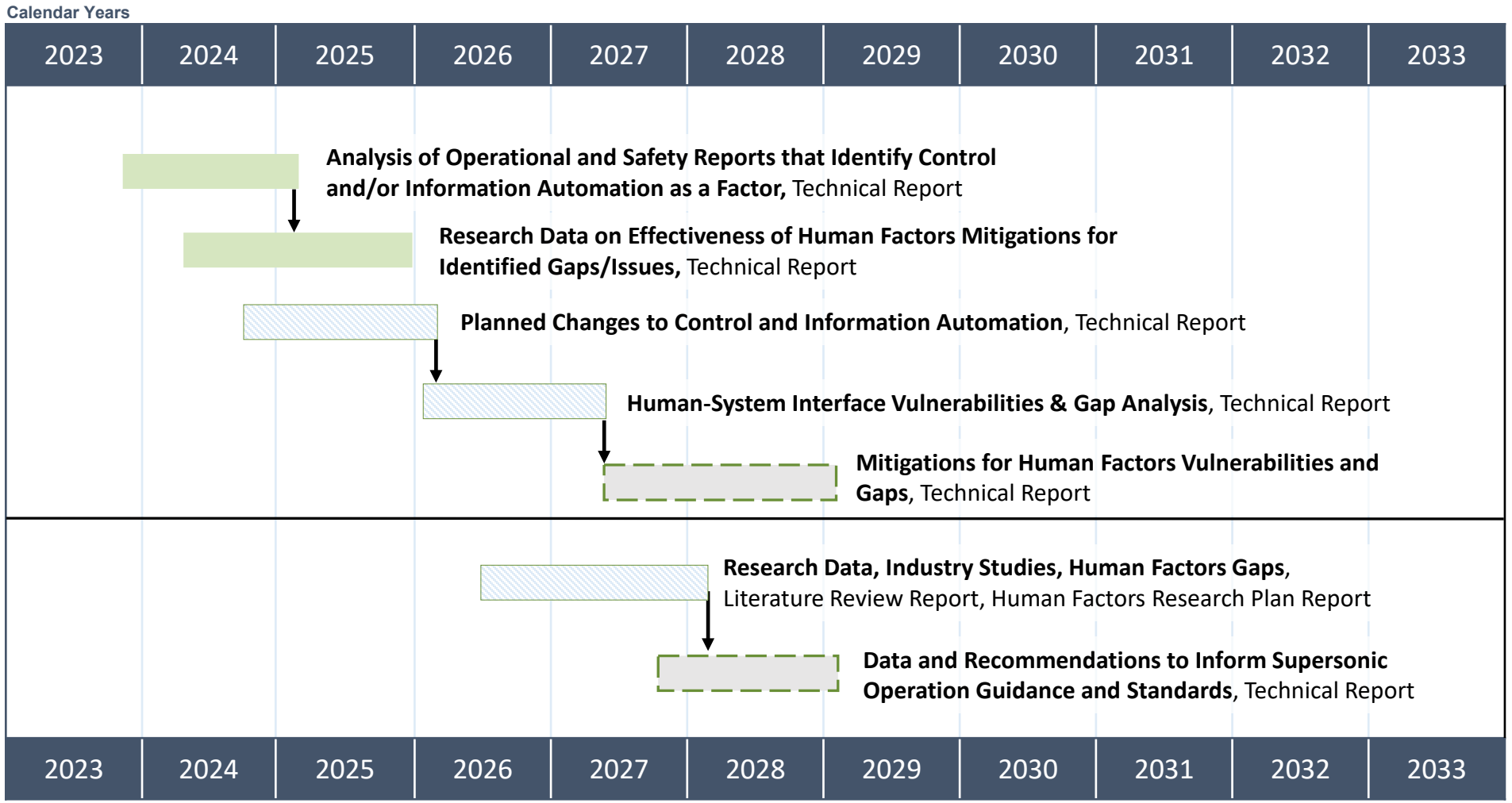
Potential project plans are subject to change based on FAA needs and availability of funds

Control automation and information automation

Research Question: What human factors issues and data are associated with automation, including control automation and information automation?
ACSAA related research

Supersonic aircraft

Research Question: Can we enable supersonic flight operations at an equivalent level of safety as transport category operations, and if so, how?
ACSAA related research



OC 9: Integrating Human Factors into Aircraft Certification & Flight Standards Methods & Processes

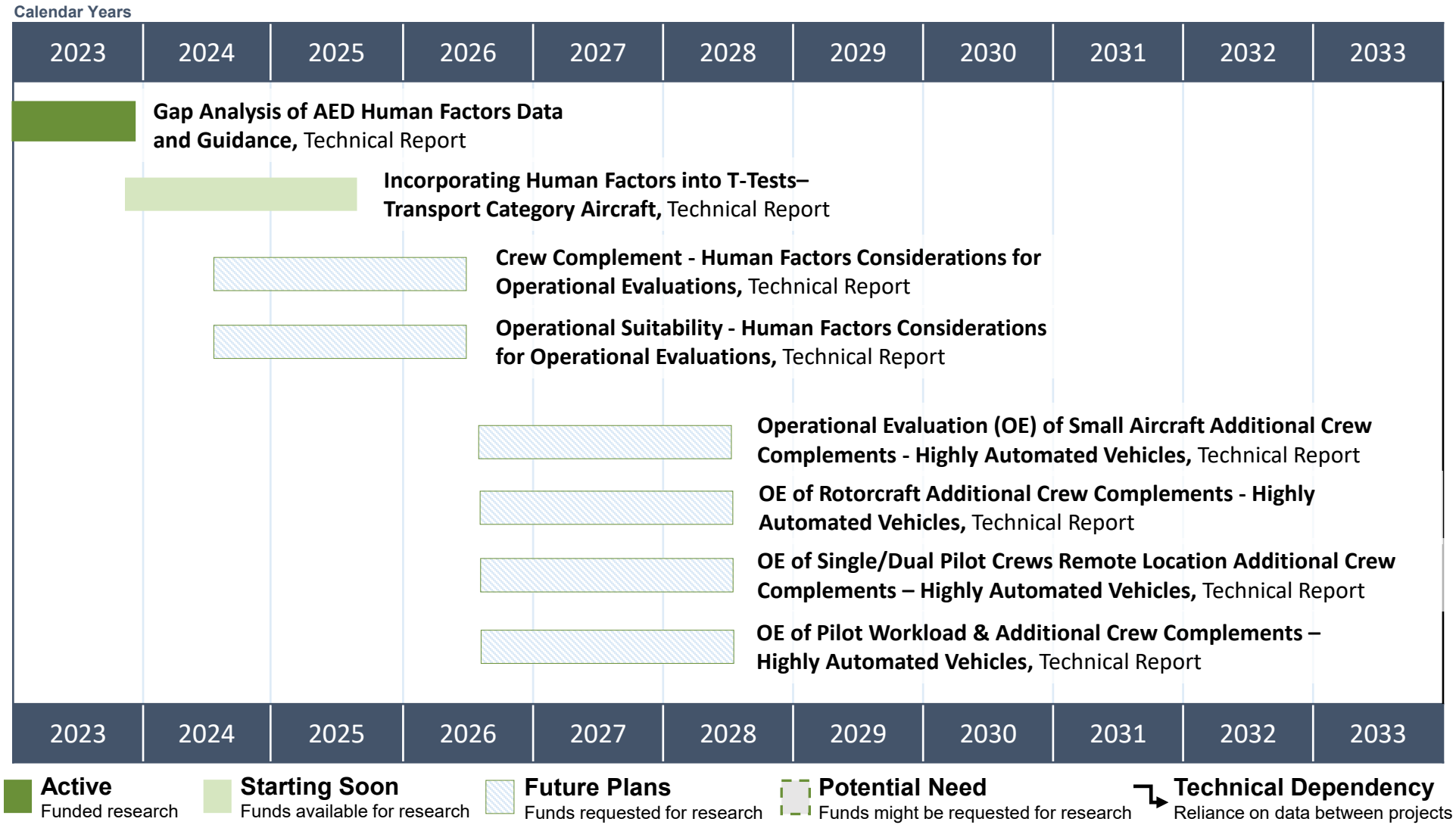
FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Integration of Human factors into the Aircraft Evaluation Division (AED) processes and criteria

Research Question: What human factors data, processes, and procedures can support operational suitability evaluations and in the Flight Standardization Board (FSB) process?

***ACSAA related research**



OC 9: Integrating Human Factors into Aircraft Certification & Flight Standards Methods & Processes

FY2023 Research and Potential Project Plans

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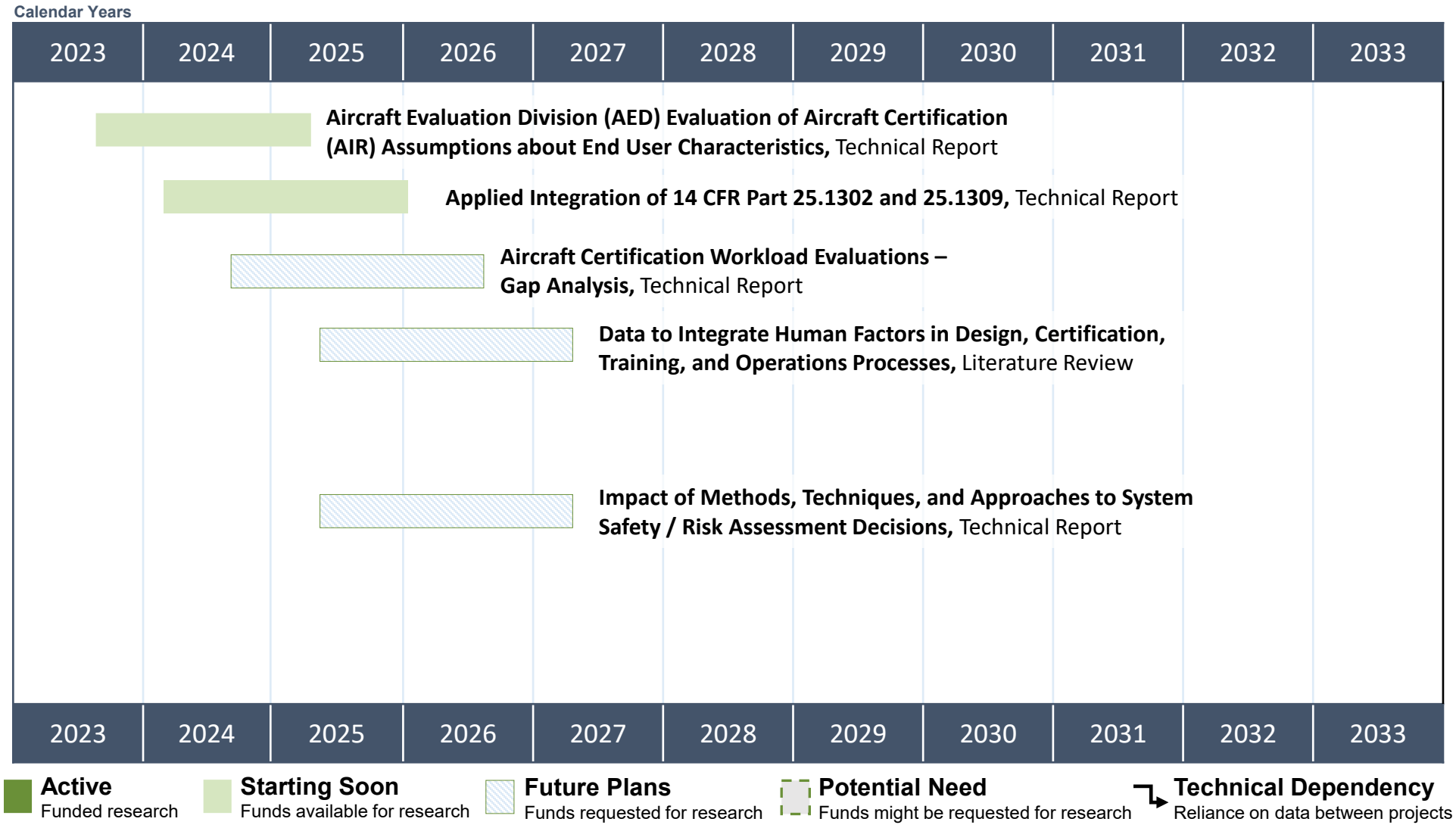
Design, certification, training, and operations

Research Question: What human factors data, processes, and procedures can support Aircraft Certification in human factors evaluations of aircraft design and certification?
ACSAA related research

Research Question: What human factors methods, techniques, and approaches are available to integrate human error considerations into system safety assessments, and what factors need to be considered when using these new methods in an aircraft certification application / context?
ACSAA related research



OC 10: Pilot Physiological State Monitoring Technologies and Mitigations

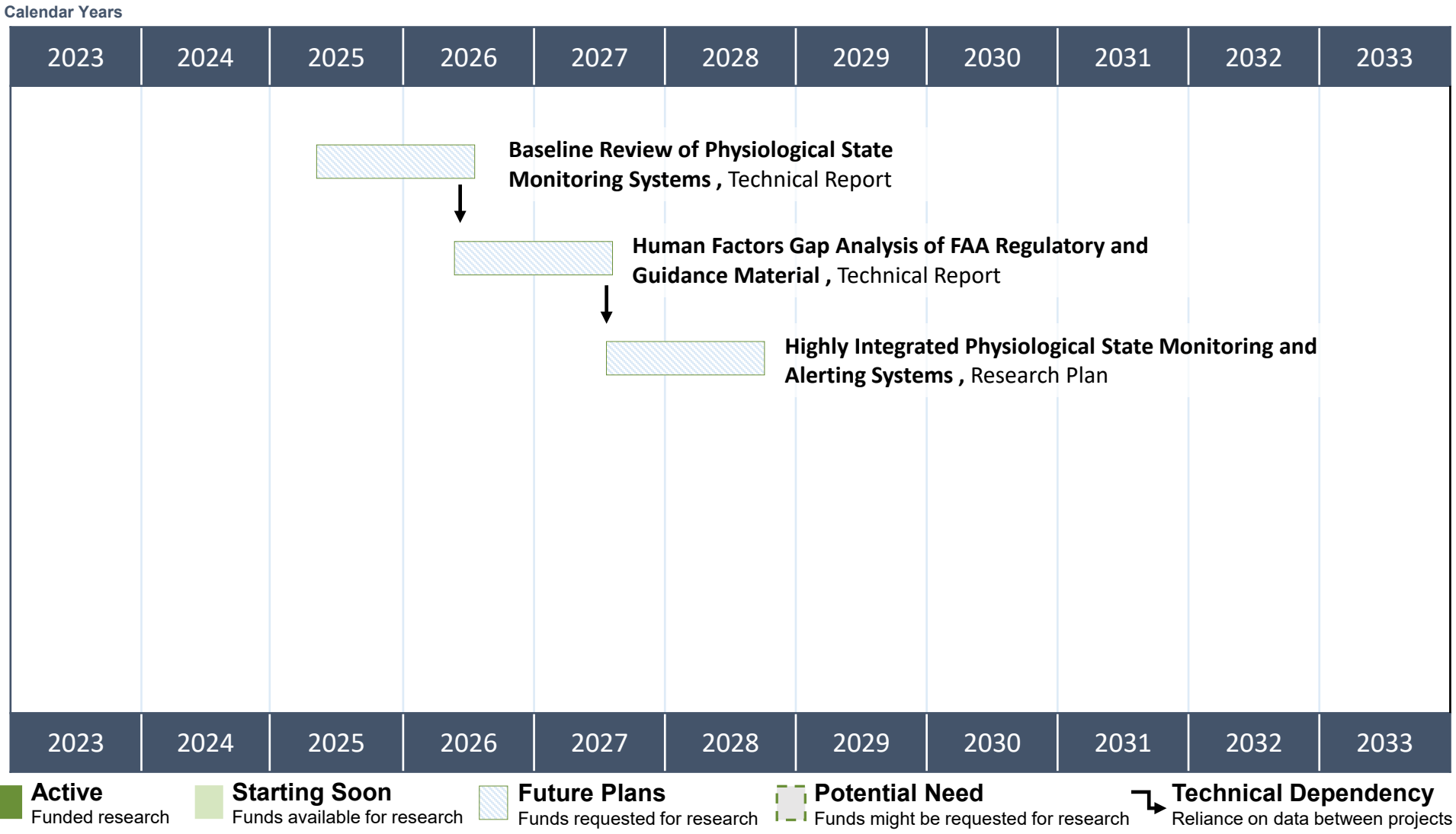
FY2023 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Design and operational evaluation considerations

Research Question: What is the state of the art for pilot physiological state monitoring technologies and mitigations?

Research Question: What are the minimum standards/requirements for pilot physiological state monitoring and mitigations?



OC 11: Current Flight Deck Operations and Pilot Procedures: Arrival, Approach, Departure

FY2023 Research and Potential Project Plans

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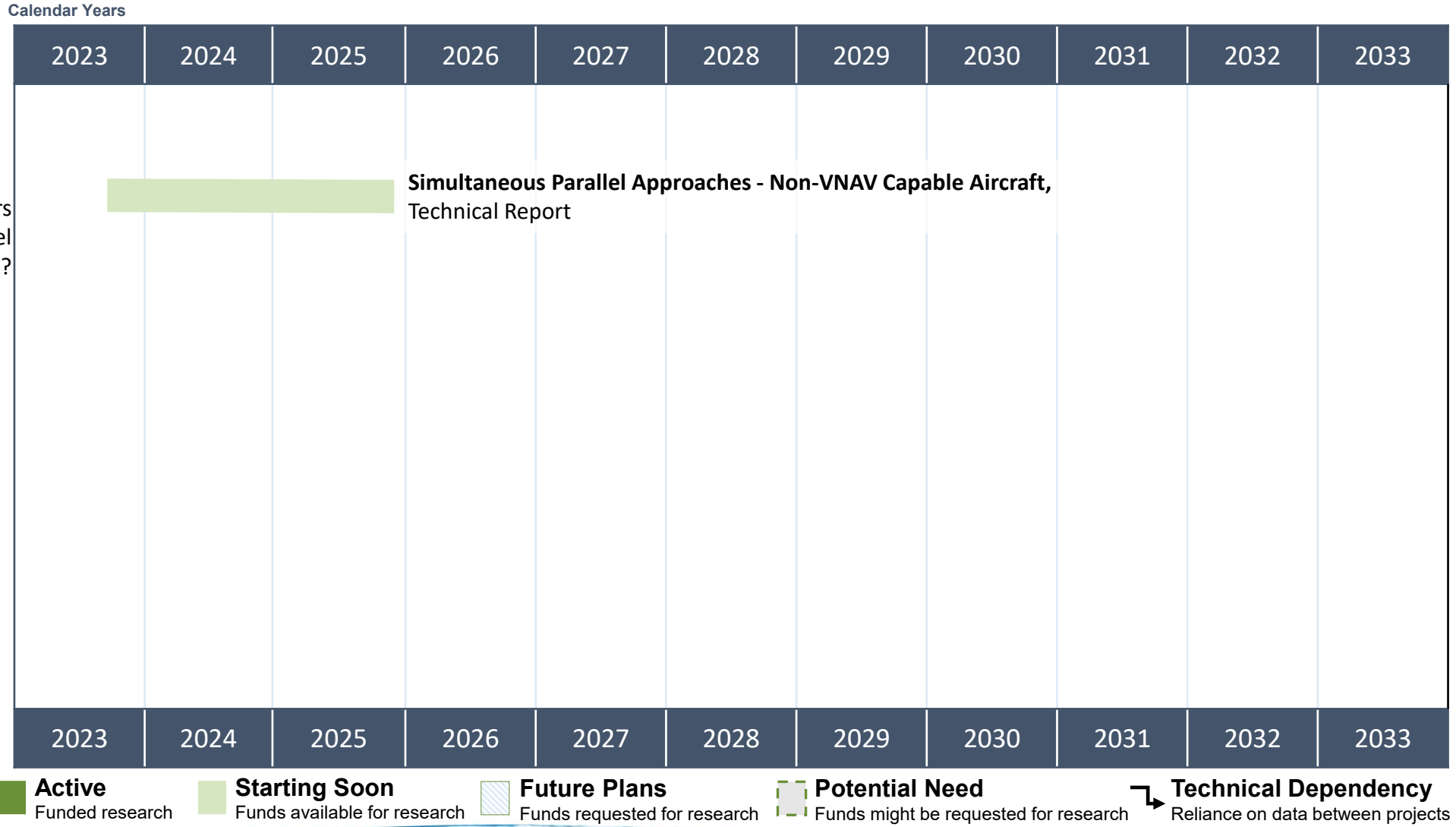
Simultaneous parallel approaches

Research Question: What are human factors considerations for simultaneous parallel approaches and non-VNAV capable aircraft?



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