APPENDIX B – UPDATED RESEACH TASK PLAN

Research Task Plan for ASSURE A46 – Validation of Visual Operation Standards for Small UAS (sUAS)

January 1, 2023

CONTRIBUTING AUTHORS

The authors of this report are:

Kansas State University (Salina)

Tom Haritos, Ph.D, UAS Research Program Manager, Applied Aviation Research Center, Kansas State University Salina

Kurt Carraway, UAS Executive Director, Applied Aviation Research Center, Kansas State University Salina

Tim Bruner, UAS Researcher, Applied Aviation Research Center, Kansas State University Salina

Katie Silas, Research Associate, Applied Aviation Research Center, Kansas State University Salina

Wichita State University

Gerardo Olivares, Ph.D., Senior Research Scientist and Director, Crash Dynamics and Virtual Engineering and Flight, Wichita State University

Luis Gomez, Virtual Engineering Lab Manager, National Institute for Aviation Research, Wichita State University

Harsh Shah, Research Engineer, National Institute for Aviation Research, Wichita State University

New Mexico State University

Henry Cathey, Aerospace Division Director, New Mexico State University

Justin MacDonald, Ph.D., Associate Professor, New Mexico State University

Mississippi State University

Michael Thompson, Raspet Flight Research Laboratory, Mississippi State University

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Acronym	Meaning
ASTM	American Society for Testing and Materials
CPA	Closest Point of Approach
EVLOS	Extended Visual Line-of-Sight
FTP	Flight Test Plan
KSU	Kansas State University
MSU	Mississippi State University
NMSU	New Mexico State University
PoP	Period of Performance
RP	Remote Pilot
RTP	Research Task Plan
SME	Subject Matter Expert
sUAS	Small Unmanned Aircraft System
TIM	Technical Interchange Meeting
VLOS	Visual Line-of-Sight
VO	Visual Observer
WSU	Wichita State University

1   Introduction

The purpose of this document is to provide a Research Task Plan (RTP) for execution of the research within the project titled A11L.UAS.88_A46 – Validation of Visual Operation Standards for Small Unmanned Aircraft Systems (sUAS). The primary tasks within this effort are:

1. Perform a literature review to identify relevant literature relating to industry standards for risk assessment as they relate to unmanned aircraft flight operations within or beyond line of sight. This literature review will serve as a foundational element of follow-on tasks, as it will serve to inform methods used for follow-on tasks.
2. Based on the findings from the literature review, the RTP and project scope will be evaluated and revised to reflect findings that steer the goals for the following tasks. Once the RTP has been modified, a stakeholder focus group will be conducted.
3. Initial test and analysis will consist of the development and execution of flight test plans that are guided by the findings in the literature review and based on best practices from other ASSURE efforts that have conducted research flight testing (e.g., A2, A18, etc.). Once the initial flight test plans have been developed, a data analysis plan will be developed to define the process for analysis of collected data to address knowledge gaps. After the initial flight test plans and data analysis plan are developed, a test and data analysis plan review will be conducted to ensure that the appropriate methods are being used. After the review of the test and data analysis plan, an initial flight test will be conducted to validate the methodology and further refine the plans to ensure useful, valid data collection.
4. Flight testing will be conducted with the finalized flight test and data analysis plans and will seek to answer the research questions through data collection.
5. Using the research results and developed recommendation, a draft waiver application will be submitted for an Extended Visual Line Of Sight (EVLOS) operation and the process will be documented. Outcomes of this case study will be captured in a task report.
6. Reporting will consist of a final report that captures outcomes of research tasks and makes recommendations based upon the outcomes of research tasks. The report generated for this research will inform industry training standards and regulations.
7. Complete a peer review of the final project report.

This RTP has been established by the task flow listed below. The following sections outline key research tasks, performers, timeline, and project deliverables.

2   Research Tasks

2.1   Task 0: Program Management

Performers

Primary Task Lead: Kansas State University (KSU)

Supporting: Wichita State University (WSU), New Mexico State University (NMSU), and Mississippi State University (MSU)

Timeline

1 Apr 2021 – 26 April 2024

Task Entrance Criteria

- Coordinate with FAA to establish consensus on the methodology/approach
- Coordinate with the FAA to designate agency stakeholders
- Schedule a kick-off meeting

Task Exit Criteria

- Approved RTP
- Successful kickoff meeting
- Technical Interchange Meeting (TIM) hosted with pertinent stakeholders; recurring schedule for TIMs established

Risks

- Delayed start for project
- Delays in RTP peer review
- Changes in scope following peer review of RTP
- Scheduling issues with TIMs

Task Description

This task outlines the required tasks to be performed and the duration of each task to ensure project completion as a component of this RTP. For the purposes of this RTP, Task 0 for program management is described per the following sub-tasks.

Task 0-1. Host a kickoff meeting to review sponsor needs, clarify any issues with scope, and discuss the technical approach and methodology.

Task 0-2. Research Task Plan - Develop a project schedule to include identification and tracking of critical paths. Draft an RTP for FAA review and comment. Adjudicate FAA sponsor comments prior to finalizing the RTP.

Task 0-3. Technical Interchange Meeting - Deliver project status to executive management and stakeholders via TIMs. Establish a schedule for reoccurring TIMs throughout the project's Period of Performance (PoP). The primary deliverable for this task will be meeting minutes for each recurring TIM and an updated action item list, provided within seven days after each meeting.

Task 0-4. Research Summary - Develop and maintain a research summary describing the research project and status. Updates to the research summary will be provided monthly in conjunction with the delivery of the monthly TIM notes.

Task 0-5. FAA Leadership Briefings - Provide FAA leadership briefings to the FAA lines of business as required and funded by the Program Manager, including final briefing delivered in person in Washington D.C. four weeks after the final report, if necessary.

Task 0-6. Project Closeout – Provide FAA Leadership with completed project deliverables to include the final report, completed peer review (if applicable), finalized financial reporting, final research report, and all documentation to close out the research project.

Task 0-7. ASTM engagement during the Visual Observer (VO) Training Working Group throughout this projects PoP.

Task 0-8. Government Furnished Information – FAA leadership will provide specific details of any ongoing or related research in the topic area within the Nextgen portfolio that may be related to this research that may inform or improve the conduct of the research during the PoP.

Tasks 0 - 1 and 0 – 2 will be completed within the first 120 days of the project PoP.

2.2   Task 1: Literature Review

Performers

Primary Task Lead: WSU

Supporting: KSU, NMSU, and MSU

Timeline

19 Apr 2021 – 1 Oct 2021

Task Entrance Criteria

- Completed RTP
- Completed kick-off meeting/TIM

Task Exit Criteria

- Completed literature review synthesis/narrative
- Peer reviewed literature report

Risks

- Delayed project start
- Changes in FAA guidance

Task Description

2.2.1   Task 1-1: Development of Literature Review

Lead Performer(s): WSU

Supporting Performer(s): KSU, NMSU, and MSU

Sub-task Timeline

19 Apr 2021 – 20 Aug 21

Sub-task Description

Identify the current state of research on visual observer / remote pilot visual acquisition and avoidance of potential collision hazards to include avoidance of other aircraft, terrain, and obstacles. There will be two drivers behind these considerations: 1) Operations in EVLOS and, 2) Operations in Visual Line Of Sight (VLOS) in which certain scenarios challenge visual conspicuity, to include certain types of illusions in which assured separation may be difficult. The literature review will include academic/industry sources, publicly available information online, and other available sources. This information will be used for planning simulations, tests, demonstrations, and/or analysis needed to assess VO/Remote Pilot (RP) performance and validate related learning outcomes and standards.

Exit Criteria: A literature review document outlining relevant literature that details EVLOS and VLOS operations as they relate to VO/RP performance.

2.2.2   Task 1-2: Peer Review of Literature Review

Lead Performer(s): KSU

Supporting Performer(s): WSU and NMSU

Sub-task Timeline

23 Aug 2021 – 1 Oct 2021

Sub-task Description

For this task, ASSURE and FAA-selected subject matter experts will review the literature report and will provide suggestions to guide the research.

Exit Criteria*:* A peer reviewed literature report that summarized findings of past research and provides recommendations for future studies based upon the lessons learned from prior research.

2.3   Task 2: Updated Research Task Plan

Performers

Lead: KSU

Supporting: WSU, NMSU, and MSU

Timeline

4 Oct 2021 – 12 Nov 2021

Task Entrance Criteria

- Completed literature review synthesis/narrative
- Completed peer review of literature review

Task Exit Criteria

- Task 2-1: An approved draft RTP
- Task 2-2: An approved, peer reviewed RTP

Risks

- Schedule slip due to delays with Tasks 0 and Task 1.

2.3.1 Task 2-1: Propose Additional Areas of Research

Lead Performer(s): KSU

Supporting Performer(s): WSU, NMSU, MSU

Sub-task Timeline

 4 Oct 2021 – 22 Oct 2021

Sub-Task Description

The performer and the FAA will propose other potential areas of research beyond what is outlined in the tasks. The performer and the FAA will coordinate and prioritize the research to be conducted, and the performer will then develop an updated RTP with potential increased/decreased scoping based on findings from the literature review and peer review.

Exit Criteria: A sponsor approved draft RTP for the execution of this research.

2.3.2 Task 2-2: Scoping Peer Review

Lead Performer(s): KSU

Supporting Performer(s): WSU, NMSU, and MSU

Sub-task Timeline

25 Oct 2021 – 12 Nov 2021

Sub-task Description

A scoping peer review will be held with the FAA and other parties determined by the FAA to discuss the RTP and determine the appropriate scope level.

Exit Criteria: An approved, peer reviewed RTP for the execution of this research.

2.4 Task 3: Initial Test and Analysis

Performers

Primary Task Lead: NMSU

Supporting: KSU, WSU, and MSU.

Timeline

15 Nov 2021 – 8 Apr 2022

Task Entrance Criteria

- Task 1 complete
- Task 2 complete with subtask reports

Task Exit Criteria

- Task 3-1: Experiment Plan
- Task 3-2: A draft Flight Test Plan
- Task 3-3: A draft data analysis plan
- Task 3-4: (1) Flight Test Plan Peer Review Meeting, (2) provide a final Flight Test Plan for flight test execution.
- Task 3-5: VO Training PowerPoints
- Task 3-6: Completed initial flight tests and data collection.

Risks

- Schedule slip in Task 2 causing delays in subsequent tasks

Task Description

This task consists of the development of test plans that are guided by research findings from the literature review in Task 1 and scoped in Task 2. As part of this task, the research team will develop, review, and execute a test plan that seeks to answer key research questions. For the peer review element(s) of this task, Subject Matter Experts (SMEs) with knowledge in testing, human factors, design of experiments, and visual detection will be used. A list of these SMEs will be included in project deliverables.

2.4.1 Task 3-1: Experimental Plan

Lead Performer(s): KSU

Supporting Performer(s): NMSU, WSU, MSU

Sub-task Timeline

15 Nov 2021 – 20 July 2022

Sub-task Description

This task consists of the development of the experimental plan guided by the findings of the literature review in Task 1 and will be used to scope the flight tests in Task 4. As part of the task, the research team will develop an experimental plan that details the purpose of the study, the research questions, evaluation procedures, instruments used, the validity and reliability, the testing environment, and the intended data analysis.

Exit Criteria: An experimental plan approved by the FAA.

2.4.2 Task 3-2: Initial Flight Test Plan Development Lead Performer(s): NMSU

Supporting Performer(s): KSU, WSU, and MSU

Sub-task Timeline

15 Nov 2021 – 20 July 2022

Sub-task Description

Develop Flight Test Plans (FTPs) for demonstrating visual limitations, environmental constraints, and potentially demonstrating visual illusions, to quantify the safety of VLOS and EVLOS operations.

Flight Test Plans may include:

1. Flight course design: Determine flight paths, altitudes, and timing. Develop safety mitigations that support safe flight testing.
2. Pilot Recruitment: Identify, recruit, and schedule manned and unmanned pilots with adequate qualifications, skills, and experience.
3. Encounters: Plan, schedule, and execute unmanned aircraft encounters with static obstacles and with other aircraft. Encounters will be evaluated to ensure proper safety margins and adequate vertical and/or horizontal separation. Encounters must be structured to facilitate the collection of data to address FAA knowledge gaps in VO/RP performance. Utilize the necessary aircraft, aircrews, and equipment for testing.
4. Data Collection: Identify the necessary tools and techniques to precisely capture at a minimum;
    a. Images and video that can be referenced for safety discussions about VLOS operations.
    b. The test conditions and measurements that are important for quantifying VLOS safety performance.
    c. The encounter parameters of the UA and aircraft for encounters. Examples include:
        i. The encounter geometries, altitudes, and the closing rate between UA and aircraft.
        ii. Vertical and lateral separation between UA and aircraft at Closest Point of Approach (CPA) during the encounter.
    d. The encounter parameters of unmanned aircraft with respect to static obstacles. Examples include:
        i. The encounter geometries, altitudes, and distances between the unmanned aircraft and the obstacle.
        ii. Vertical and lateral separation between the unmanned aircraft and the obstacle at CPA during the encounter.

Exit Criteria: Provide a draft FTP in preparation for the peer review meeting.

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2.4.3 Task 3-3: Data Analysis Plan Development

Lead Performer(s): WSU

Supporting Performer(s): NMSU, KSU, and MSU

Sub-task Timeline

7 Feb 2022 – 27 July 2022

Sub-task Description

The research team will design a plan to document the process for analysis of collected data to address FAA knowledge gaps. Analysis plans will be developed before testing is conducted to ensure that the correct data is collected during testing.

Exit Criteria: Provide a draft data analysis plan in preparation for the peer review meeting.

2.4.4 Task 3-4: Test and Data Analysis Plan Review

Lead Performer(s): WSU

Supporting Performer(s): NMSU and KSU

Sub-task Timeline

14 Feb 2022 – 10 Aug 2022

Sub-task Description

The performer will hold a scoping peer review with the FAA and other parties determined by the FAA to discuss the FTP and data analysis plan to determine the appropriate methods. The sponsor, based on other areas identified, will select components of the FTP and data analysis plan that meets the FAA immediate needs and is appropriate to the project scope. This task will consist of (1) a review of the draft flight test plan by the sponsor, performers, and select SMEs, and (2) a review of the data analysis plan. Following initial review, comments will be adjudicated prior to finalization.

Exit Criteria (1): Flight Test Plan Peer Review Meeting; conduct a Flight Test Plan peer review with the FAA and other parties determined by the FAA to review the FTP and data analysis plan.

Exit Criteria (2): Provide a final Flight Test Plan for flight test execution. Adjudicate the comments and feedback provided by the FAA in the peer review meeting of the draft final FTP.

2.4.5 Task 3-5: VO Training PowerPoints

Lead Performer(s): KSU

Supporting Performer(s): NMSU and WSU

Sub-Task Timeline

21 Feb 2022 – 10 Aug 2022

Sub-Task Description

The performer will generate two VO training PowerPoints. The first will be a condensed version to use during the initial flight testing in Task 3-6 and for flight testing in Task 4, this version is a shortened version

specific to the goals of the flight testing. The second version will be the extended version for FAA use, the extended version will have information that would be provided to an individual being trained as a VO.

Exit Criteria: Two VO Training PowerPoints, one for the flight testing and one for the FAA.

2.4.6 Task 3-6: Initial Flight Tests

Lead Performer(s): NMSU

Supporting Performer(s): WSU and KSU

Sub-task Timeline

28 Feb 2022 – 30 Sep 2022

Sub-task Description

The performer will implement the FTP to gather requisite data to answer research questions. These initial flight tests are precursors to follow-on testing that occurs in Task 4. As such, initial flight tests are aimed at validating methodology and further refinement of plans to ensure useful, valid data collection.

Exit Criteria: Completed initial flight tests and data collection.

2.5   Task 4: Flight Tests

Performers

Primary Task Lead: KSU

Supporting Performers: NMSU, WSU, and MSU

Timeline

 3 Oct 2022 – 26 May 2023

Task Entrance Criteria

- Task 1 complete
- Tasks 2-3 Reports complete

Task Exit Criteria

- Task 4-1: Finalize Test Plan
- Task 4-2: Conduct Flight Tests
- Task 4-3: Data Review and Analysis

Risks

- Schedule slip from Task 2 causing delays in subsequent tasks
- Delays in data collection

Task Description

Flight tests for data collection and analysis that is in alignment with finalized flight test and data analysis plans. Flight tests for this task seek to answer key research questions through data collection and analysis. Additional testing will be needed based on agreed priorities from the FAA and research team during Task 2 or based on the outcomes from Task 3. The performer will develop follow-on test and analysis plans and document findings in peer reviews reports.

2.5.1 Task 4-1: Finalize Flight Test Plan

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Lead Performer(s): KSU

Supporting Performer(s): WSU, NMSU, and MSU

Sub-task Timeline

 3 Oct 2022 – 21 Oct 2022

Sub-task Description

After the initial flight tests are conducted the research team will evaluate the FTP to ensure appropriate data will be collected via the FTP and adjust accordingly.

2.5.2. Task 4-2: Conduct Flight Tests

Lead Performer(s): KSU

Supporting Performer(s): WSU, NMSU, and MSU

Sub-task Timeline

24 Oct 2022 – 28 April 2023

Sub-task Description

Once the FTPs have been finalized the performers will conduct flight testing.

2.5.3 Task 4-3: Data Review and Analysis

Lead Performer(s): WSU

Supporting Performer(s): KSU, NMSU, and MSU

Sub-task Timeline

31 Oct 2022 – 26 May 2023

Sub-task Description

After the flight tests have been completed, the data will be reviewed and analyzed.

2.6   Task 5: Lessons Learned Document

Performers

Primary Task Lead: KSU

Supporting: WSU and NMSU

Timeline

 29 May 2023 – 8 Sept 2023

Task Entrance Criteria

- Task 1 complete
- Tasks 2 and 3 complete with applicable reports
- Task 4 complete
- Peer review complete

Task Exit Criteria

Documentation of the lessons learned from the KSU and NMSU flight testing as well as our processes and procedures during flight testing.

Risks

- Schedule slip from pervious tasks
- Incomplete Task reports due to delays in waiver submissions/approvals/feedback

Task Description

Using the research results and developed recommendations; the performer will submit a lessons learned document that will integrate into the final report. This document will detail the process and procedures followed by both KSU and NMSU towards flight testing. Limitations of the study will also be documented and recommendations for future research will be provided.

Exit Criteria (1): Submit lessons learned document.

2.7 Task 6: Final Report

Performers

Primary Task Lead: KSU

Supporting: WSU and NMSU

Timeline

 15 Sept 2023 – 30 Nov 2023

Task Entrance Criteria

- Task 1 complete
- Tasks 2 and 3 complete with applicable reports
- Peer review complete

Task Exit Criteria

- Completed final report
- Finalized financial reporting
- Completed supporting documentation and project closeout tasks

Risks

- Schedule slip from pervious tasks
- Incomplete Task reports due to delays in waiver submissions/approvals/feedback

Task Description

2.8 Task 7: Peer Review

Performers

Primary Task Lead: KSU

Supporting: WSU, NMSU, and MSU

Timeline

1 Dec 2023 – 29 Jan 2024

Task Entrance Criteria

- Task 1 complete
- Tasks 2 and 3 complete with applicable reports
- Peer review complete

Task Exit Criteria

- Completed final report
- Finalized financial reporting
- Completed supporting documentation and project closeout tasks

Risks

- Schedule slip from pervious tasks
- Incomplete Task reports due to delays in waiver submissions/approvals/feedback

Task Description

For Task 7, the performer will plan and budget for a peer review of the final report generated as a part of Task 6. This will include input form the FAA sponsor and select SMEs.

Exit Criteria: Plan and budget for a peer review to ensure public availability of the research within 30 days of final report delivery. Peer reviewed Final Report acceptable to the sponsor.

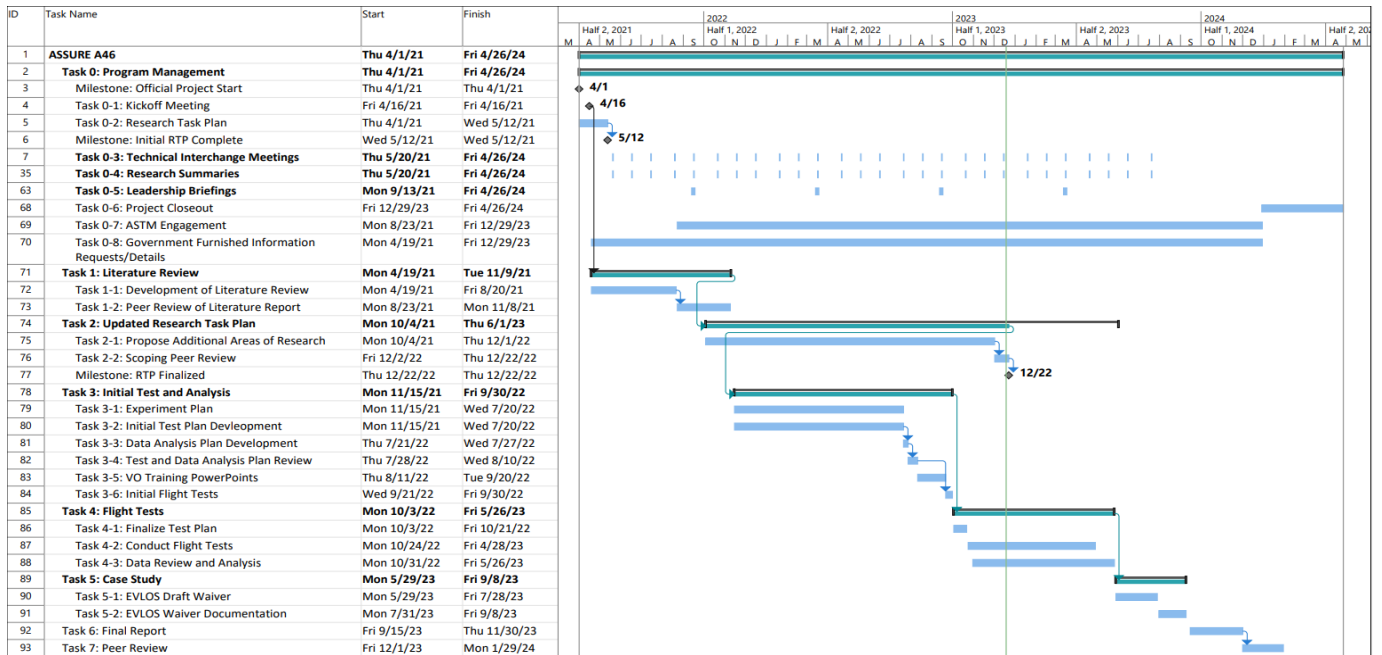| ID	Task Name	Start	Finish
1	**ASSURE A46**	**Thu 4/1/21**	**Fri 4/26/24**
2	**Task 0: Program Management**	**Thu 4/1/21**	**Fri 4/26/24**
3	Milestone: Official Project Start	Thu 4/1/21	Thu 4/1/21
4	Task 0-1: Kickoff Meeting	Fri 4/16/21	Fri 4/16/21
5	Task 0-2: Research Task Plan	Thu 4/1/21	Wed 5/12/21
6	Milestone: Initial RTP Complete	Wed 5/12/21	Wed 5/12/21
7	**Task 0-3: Technical Interchange Meetings**	**Thu 5/20/21**	**Fri 4/26/24**
35	**Task 0-4: Research Summaries**	**Thu 5/20/21**	**Fri 4/26/24**
63	**Task 0-5: Leadership Briefings**	**Mon 9/13/21**	**Fri 4/26/24**
68	Task 0-6: Project Closeout	Fri 12/29/23	Fri 4/26/24
69	Task 0-7: ASTM Engagement	Mon 8/23/21	Fri 12/29/23
70	Task 0-8: Government Furnished Information Requests/Details	Mon 4/19/21	Fri 12/29/23
71	**Task 1: Literature Review**	**Mon 4/19/21**	**Tue 11/9/21**
72	Task 1-1: Development of Literature Review	Mon 4/19/21	Fri 8/20/21
73	Task 1-2: Peer Review of Literature Report	Mon 8/23/21	Mon 11/8/21
74	**Task 2: Updated Research Task Plan**	**Mon 10/4/21**	**Thu 6/1/23**
75	Task 2-1: Propose Additional Areas of Research	Mon 10/4/21	Thu 12/1/22
76	Task 2-2: Scoping Peer Review	Fri 12/2/22	Thu 12/22/22
77	Milestone: RTP Finalized	Thu 12/22/22	Thu 12/22/22
78	**Task 3: Initial Test and Analysis**	**Mon 11/15/21**	**Fri 9/30/22**
79	Task 3-1: Experiment Plan	Mon 11/15/21	Wed 7/20/22
80	Task 3-2: Initial Test Plan Devleopment	Mon 11/15/21	Wed 7/20/22
81	Task 3-3: Data Analysis Plan Development	Thu 7/21/22	Wed 7/27/22
82	Task 3-4: Test and Data Analysis Plan Review	Thu 7/28/22	Wed 8/10/22
83	Task 3-5: VO Training PowerPoints	Thu 8/11/22	Tue 9/20/22
84	Task 3-6: Initial Flight Tests	Wed 9/21/22	Fri 9/30/22
85	**Task 4: Flight Tests**	**Mon 10/3/22**	**Fri 5/26/23**
86	Task 4-1: Finalize Test Plan	Mon 10/3/22	Fri 10/21/22
87	Task 4-2: Conduct Flight Tests	Mon 10/24/22	Fri 4/28/23
88	Task 4-3: Data Review and Analysis	Mon 10/31/22	Fri 5/26/23
89	**Task 5: Case Study**	**Mon 5/29/23**	**Fri 9/8/23**
90	Task 5-1: EVLOS Draft Waiver	Mon 5/29/23	Fri 7/28/23
91	Task 5-2: EVLOS Waiver Documentation	Mon 7/31/23	Fri 9/8/23
92	Task 6: Final Report	Fri 9/15/23	Thu 11/30/23
93	Task 7: Peer Review	Fri 12/1/23	Mon 1/29/24

Figure 1. ASSURE A46 Project Gantt Chart - Validation of Visual Operation Standards for sUAS.