Summary Narrative for Site Visit Team (SVT)

University of Wyoming King Air as a National Facility

1. Introduction

The University of Wyoming King Air (UWKA) together with the Wyoming Cloud Radar (WCR), Wyoming Cloud Lidar (WCL), and associated in situ instrumentation is an NSF Lower Atmospheric Observing facility (LAOF), initially supported through the LAOF Program and more recently through the Facilities for Atmospheric Research and Education (FARE) Program and has operated in this role since 1987. A series of 5-year Cooperative Agreements (CAs) between the University of Wyoming (UW) and NSF support this effort. The UWKA is one of three aircraft supported through the FARE program and is the only aircraft that is both owned and operated by a university, the other two aircraft are owned by NSF and operated by the National Center for Atmospheric Research (NCAR). The CA provides support for a group of scientists, engineers, technicians, pilots, and an aircraft mechanic, along with base support to maintain the aircraft, instrumentation, and infrastructure required to ensure the UWKA is available to support research and education deployments requested through the NSF AGS (Atmospheric and Geospace Sciences) programs.

The CA provides funding support for the UWKA and associated instruments, including the WCR and WCL. Funding for deployments of the UWKA and its instrumentation are funded through supplemental awards to the CA and are determined through a competitive solicitation process as part of the Facility and Instrumentation Request Program (FIRP) in NSF. As stipulated in the CA, the UWKA, WCR, and WCL are available for request, on priority basis to NSF users up to 75% per year. In addition to deployments of the WCR and WCL on the UWKA, they may also be deployed on other NSF-supported such as the NSF/NCAR C130 as part of the CA.

The following sections summarize how the UWKA facility team is meeting the core expectations of the CA and address specific concerns/questions/suggestions raised during the last site visit, reviews from proposal for the current CA, performance during the last and most recent CA, and plans for the future development of the UWKA facility.

2. Objectives

The principal goal of the UW-NSF CA is to *provide the NSF-funded community with a world-class, mission-ready airborne atmospheric research facility that enables new discoveries*. The intellectual merit of this work has its basis within the scientific contributions that are enabled by the UWKA/WCR/WCL to the NSF geoscience community through its support of the FARE program. To achieve this goal, the facility has five specific objectives, listed below and expanded upon within the UWKA Strategic Plan 2022-2027 (link to the SP can be found in section 7).

Specific Objectives of the UWKA facility:

- Provide an airborne platform that fills the well-defined 'niche' of the UWKA within the LAOF fleet and remains nimble and flexible enough to continue to accelerate atmospheric research for decades to come.
- Advance a suite of in situ and remote airborne instruments that enable new perspectives and discoveries.
- Ensure superb user support and the collection of high-quality scientific data sets.
- Become the premier facility for educating and training airborne-measurement-focused atmospheric scientists.
- Ensure the facility's accessibility to the scientific community, its relevance to cutting-edge atmospheric science, and positive visibility to the public.

3. History of UWKA as a LAOF

The UWKA is presently funded through a CA between NSF and UW that began in September 2019 and is set to run through August 2024, this is 8th (CA8, AGS-1917369) in a series, dating back to 1987. Previous agreements and their respective dates are: CA7, AGS-1441831 (June 14 – Aug 19); CA6, AGS-0832637 (Jan 09 – May 14); CA5 ATM-0334908 (Jan 04 – Dec 08); CA4 ATM-9906463 (Jan 99 - Dec 03); CA3 ATM-9319141 (Dec 94 – Dec 98); CA2 ATM-9019603 (Mar 91 – Dec 94); and CA1 ATM-8700514 (Dec 87 – Mar 91). The principal scope and goals of the CAs have remained remarkably consistent over the years with the addition of the WCR in CA5 and the WCL in CA6. The model has been and remains that the aircraft and associated instrumentation are available to NSF on a priority basis for deployments up to a roughly 75% effort and availability level.

Since 1987, the UWKA has flown more than 6500 hours, an average of ~190 hr/year. Of those, roughly 75% of the hours (an average of ~140 hr/year) were flown in direct support of NSF LAOF/FARE allocations. For the most recent history, during CA7 the UWKA flew 155 hr/yr and in the first 3 years of CA8 (including projected hours through August of 2022) the UWKA will have flown 86 hr/yr. The number of hours flown during CA8 has been impacted significantly by COVID and subsequent postponement and/or cancellation field campaigns.

Another metric for measuring demand is the number of requests received and allocated through LAOF/FARE. Figure 1 illustrates that the demand through CA7 and during the first half of CA8 has remained relatively consistent. Through the first 3 years of CA8, the UWKA facility has received 15 requests through LAOF/FARE, on par with the 22 requests during the five years of CA7. Only 3 requests have been allocated during CA8. However, of the 12 declinations for the UWKA/WCR/WCL, 2 were moved to other aircraft due to scheduling conflicts arising from COVID. Also, there are no requests for the UWKA for the period summer 2022 through end of 2023 due to unavailability as the facility retires its current aircraft and brings the next generation UWKA (UWKA-2) online. Additional information on this development is provided in Section 6.

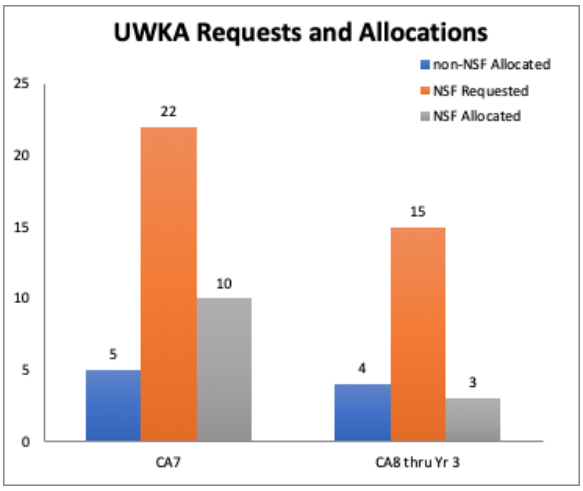

Figure 1: Requests and Allocations for the five years of CA7 and the first 2 ½ years of CA8

4. UWKA Management Team, Support Personnel, and Relationship to Dept. Of Atmospheric Science

The UWKA facility team consists of 20 individuals, 17 of whom receive their primary funding support through the CA. These 17 individuals are responsible for the operation and maintenance of the facility, including all aspects aircraft operations and maintenance, instrument support and development, data collection, processing, quality control, and dissemination, web development, and documentation. Duties are broken into three main support groups (Fig 2) consisting of the Project Science, Operations, and Engineering and Technical Support Groups. The following describes the personnel make-up (when fully staffed) and the primary responsibilities associated with each group.

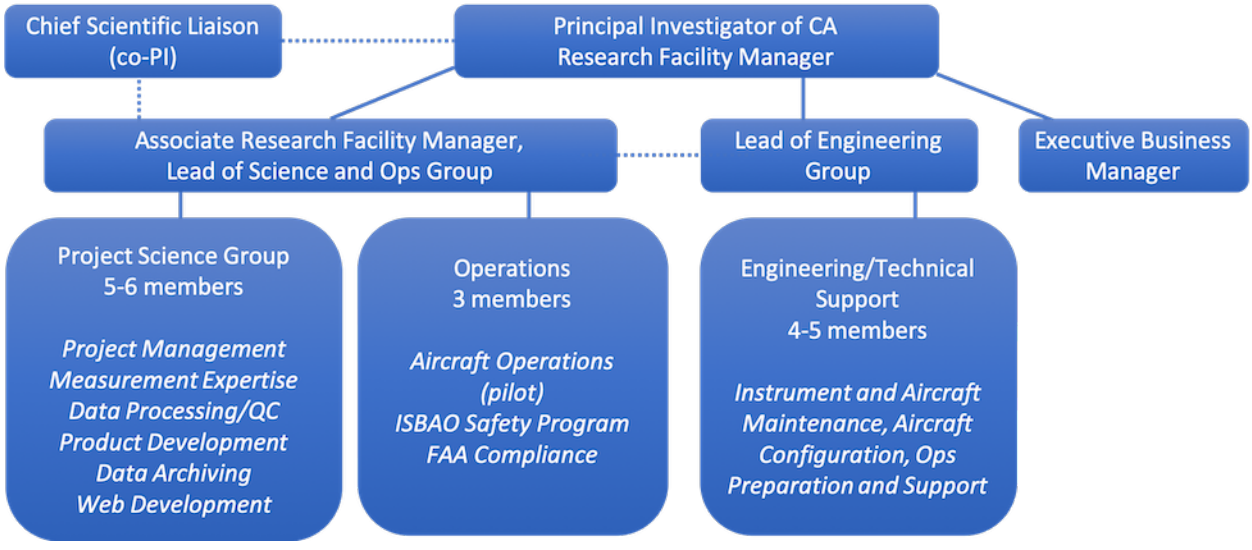

Figure 2: Organizational chart for the UWKA/WCR/WCL Facility. Solid lines indicate direct reports, dotted lines indicate lines of enhanced communication

- Operations Group – This group consists of 3 research pilots, each of whom holds a type rating for a B200. Members of the Operations group are responsible for all aspects of aircraft operations, maintaining the Flight Operations Manual (FOM), directing the safety program, maintaining our ISBAO Level-3 certification, ensuring Compliance with all FAA regulations, and assessing the feasibility of projects from a safety and operations perspective *(ie* flight patterns, base of operations, etc.).
- Project Science Group – The science group consists of 6 PhD-level scientists who are responsible for managing interaction between facility personnel and users of the UWKA/WCR/WCL facility. Members of this group are the primary contact for the facility when deployed and manage the facility team when in the field. Individuals in this group have expertise with various instruments that are part of the facility, including the WCR, WCL, in situ cloud physics, aerosol and trace gas, and basic atmospheric and aircraft state. Members of the group are also responsible for all aspects of data handling including initial data processing, quality control, archiving, dissemination to facility users and the broader community. Group members also work to develop higher-level (user) data products and are often involved in data analysis in collaboration with facility users. Members of this group are responsible for the development of documentation for users including the Facility Users Guide *(under development, see Section 7 for link)*, maintaining the list of publications resulting from the UWKA/WCR/WCL, and web development and maintenance.
- Engineering and Technical Support Group – The engineering and technical support group consists of 6 members who are electrical technicians and engineers, mechanical technicians, and an aircraft maintenance technician (AMT). The AMT holds an Airframe and Powerplant (A&P) License with Inspection Authorization (IA) and is responsible for maintaining the aircraft, signing off on all instrument installations, and coordinating with our company Designated Engineering Representatives (DERs) regarding aircraft modifications and new instrument installations. The remainder of the team is responsible for all instrument maintenance and calibration, configuring the aircraft (ie installing and de-installing instruments), and preparation and support of aircraft operations. Within the group, the facility maintains its own machine shop which includes a CNC milling machine for manufacturing parts for instrument installations. Also, relevant to, but outside of the group itself, two facility personnel (the Lead of the Engineering and Technical Support group and the Associate Facility Manager) each hold a FAA-DER company certification. The individuals are responsible for showing compliance to FAA regulations in the areas of electrical and structural modifications and installations.

Consistent with the expectations set forth in the CA, primary funding is provided at a level of 75% for most of the CA-supported individuals, including the members and leaders of the three groups with some minor exceptions. The Chief Scientific Liaison and the Research Facility Manager, who both hold faculty appointments, and the Executive Business Manager who is responsible for managing the finances associated with the Department of Atmospheric Science are funded for one to three months through the CA, consistent with their effort level. For those who are funded at 75%, the remaining 25% of funding/effort comes through other (outside of the CA) duties in the department and/or university. For example, pilots receive support directly through the university for duties associated with operating the university's transportation aircraft. Members of the engineering and support group receive funding through other research grants for supporting the development, maintenance, and operation, of

instruments and other departmental facilities. Members of the project science group are often involved in other scientific research beyond the scope of the CA and also support departmental activities.

The management team consists of the Research Facility Manager, the Associate Research Facility Manager, and the Chief Scientific Liaison. Together, these individuals are responsible for ensuring the principal goal is met (Section 2) and for developing and implementing strategies to continue to meet the specific objectives defined within the facility's strategic plan. Specifically, the Associate Facility Manager is responsible for all day-to-day activities within the facility, including the development of feasibility assessments and deployment budgets, working directly with the lead of the Engineering Group and members within the Science and Operations Groups to ensure tasks within those groups are accomplished, including making recommendations regarding needs of the facility (personnel and equipment). The Chief Scientific Liaison is responsible for interacting with and promoting the facility to the broader scientific community. Such activities include coordinating within the facility for the participation of the facility personnel at conferences and workshops to promote its capabilities for scientific and educational purposes. The Scientific Liaison is also responsible for working with the scientific community to ensure the measurement capabilities of the facility remain scientifically relevant and for organizing semi-annual meetings with the King Air Advisory Panel (KAAP) described in Section 5. The Research Facility Manager is the PI of the Cooperative Agreement and is ultimately responsible for all deliverables to the NSF FARE Program. These include submission and management of budgets, all reporting functions (ie annual and any interim reports), SVT document preparation, and supervisory responsibility of group leads.

Not directly part of the UWKA facility, but critical to its success, are faculty within the Department of Atmospheric Science (DAS). Faculty members often play a critical role in driving instrument development within the facility. Historical examples of this include the development of the WCR in the 1990's and the WCL in the early 2000's, both of which were initiated by DAS faculty outside of any support through the CA. These instruments proved to provide unique measurement capabilities and were later brought into the facility due to community demand. More recent examples include development of aerosol and trace gas chemistry measurements. Current DAS faculty provide expert guidance to the facility in identifying, acquiring, and integrating these new capabilities into the facility.

5. Performance Since 2016 Site Visit

In the following sub-sections, we describe performance of the UWKA/WCR/WCL facility since the 2016 SVT site visit that occurred midway through CA7. In Section A, we focus on general performance during the first half of CA8, including projects supported and requested, the development of new capabilities, the facility safety program, and graduate student support. Section B addresses specific items discussed in the 2016 SVT report. And Section C describes the formation and role of the King Air Advisory panel and summarizes their reports from the last two years.

A. Summary of Performance in CA8

The following summary is taken from year 1 and 2 annual reports for CA8 submitted in summer 2020 and 2021, respectively. Links to the full annual reports are in Section 7.

During the first two years of CA8, the UWKA/WCR/WCL facility participated in planning and/or operations for 10 projects, 6 of which were funded through NSF and 4 through outside sources. The projects and the source of support are summarized in Table 1. Of the 6 NSF-funded projects, one was funded internally through the CA for instrument/system developments and improvement (DILBERT) and the remaining 5 were requested/allocated through the LAOF/FARE Program, these include CHEESEHEAD (spanned CA7 and CA8), SPICULE (initially allocated and tested the WCR on NSF/NCAR 130 and later transferred to the NSF/NCAR GV due to COVID), SWEX (initially allocated and tested on the UWKA, later transferred to the WCL on the Naval Postgraduate School Twin Otter due to COVID), TRANS2AM, and CHACHA. Details for these projects can be found in the annual reports that are linked in Section 7.

Table 1: Projects supported during the first two years of CA8, including funding source and hours flown on UWKA.

Non-NSF Funded Project	NSF-Funded through Cooperative Agreement	NSF-Funded through Request and Deployment Pool Process	Hours Flown on UWKA
		CHEESEHEAD (in CA7, project completed in CA8)	31.7 (during CA8)
APART-Lite			10.7
MONARK			22.1
FLUX			5.4
		SWEX (originally scheduled for 2020, test hours flown on UWKA; moved to WCL on Twin Otter in 2022 due to COVID)	1.8 for testing in 2020; WCL on other aircraft in 2022
		SPICULE (WCR on C130 tested in 2020, moved to GV in 2021 due to COVID)	
	DILBERT		20.7
HCPI			9.9
		TRANS2AM (begun in summer 2021, will be completed in summer 2022)	53, 53 remain
		CHACHA (currently underway)	120 (allocated)

Because deployment activities were reduced in years 1 and 2 due to COVID, more effort was placed on the development of new capabilities. Several new instruments and infrastructure were acquired/developed, tested, and brought online, all of which are now operational on the UWKA. Table 2 summarizes the new capabilities; details are provided annual reports linked in Section 7. The development and testing of these capabilities were supported through the DILBERT (Deployable Instruments, Laramie-Based, Engineering Research Test) Program which includes flight hours programmed directly through the CA.

The safety program for UWKA Flight Facility has been certified as Stage 3 (the highest level of certification) through the International Standard for Business Aircraft Operations (ISBAO) since 2012. At that time, UW was the first university to receive this level of certification. At Stage 3, external audits are

required every three years as part of re-certification. In January 2021, the UW flight facility underwent an audit performed by Chris Chop, a certified ISBAO auditor. The outcome of the audit was a re-certification of UW's Stage 3 compliance, with the summary stating: "*The University of Wyoming Flight Center has an extremely well-functioning SMS that is sustained by continuous improvement. The University of Wyoming Safety Risks are effectively managed and safety management activities are fully integrated into the operation; positive safety culture is clearly sustained. Safety cultural attributes of the highest order were observed in practice during the audit."*

Table 2: System Upgrades that have been acquired/developed, tested, installed, and ready for deployment on the UWKA during the first two years of CA8.

New Science Displays	Ultra-High Sensitivity Aerosol Spectrometer (UHSAS)	Single Particle Soot Photometer (SP2)
Upgraded Power Inverters	High Volume Particle Sampler (HVPS)	Mensor Static Pressure System
Upgraded Network Time Server	Hot Wire Liquid Water Content (LWC-301)	

Three MS-level graduate students have been supported through the first 2.5 years of CA8. Direct graduate student support is a new initiative in CA8 (none of the earlier CAs contained funding for students) and provides students a unique opportunity to work hands-on with instruments in close collaboration with experts in airborne instrumentation and measurements. The projects chosen for the students are relevant to the facility, such as development of processing code, testing/evaluation of new instruments, etc. One student project is the development of the new Wyoming OAP PRocessing Software (WOPRS). The current software package is more than 20 years old and is incompatible with many of the new OAPs. WOPRS will be complete this spring and will become operational for the facility while being maintained by the Project Science Group. Another project is the laboratory and flight testing and performance evaluation of the UHSAS on the UWKA. That project will be complete this spring, and the instrument is now fully deployable as a facility-supported instrument. A third project, just underway, is the re-design of the department-owned cloud droplet generator. The droplet generator is used by the facility to calibrate and characterize cloud probes in a controlled laboratory environment. The re-design will allow for a greater number of facility instruments that could utilize the droplet generator for calibration.

B. Responding to 2016 Site Visit Report

In 2016 an external review team was assembled by NSF and charged with assessing the quality and effectiveness of the University of Wyoming's performance as a provider of a national lower atmosphere observing facility. A link to the final report is provided in Section 7. The tone of the report was overall very positive, but here we briefly summarize steps to address 'opportunities for improvement detailed in the report.

- Assessment of Scientific and Educational Impact – the SVT noted that the best way to assess scientific impact is through peer-reviewed publications and citations. An up-to-date list of publications utilizing data from the UWKA/WCR/WCL is available on the UWKA website (linked in Section 7). The list is updated semi-annually using a combination of web-based tools.

- Entraining New Investigators – A new management structure has been established for the facility that includes a Chief Scientific Liaison. As described in Section 4, this person is responsible for interacting with and promoting the facility to the broader scientific community, including coordinating within the facility for the participation of the facility personnel at conferences and workshops to promote its capabilities for scientific and educational purposes. In addition to presenting talks at recent conferences (AMS Annual 2020 and 2021, ICCP 2021), we are presently working with NCAR/EOL personnel to develop a FARE Program workshop. Additional opportunities to participate in more conferences and visit universities are expected in the coming years as COVID concerns decline.
- Data Availability – The UWKA webpage underwent a major overhaul during the first two years of CA8; as part of this, we upgraded UWKA/WCR/WCL data request pages. Also, we are working with NCAR EOL and implementing standard procedures for issuing DOIs for all NSF FARE-funded projects (internally and externally non-NSF funded projects and Testing projects (DILBERT), will not typically be issued DOIs). At present, projects dating back to SNOWIE 2017 have DOIs issued through EOL Data Management.
- Outreach and Education – Education and Outreach opportunities often occur in the form of open houses and educational deployments. In 2019 the UWKA participated in TECPEC (Terrain Effect on Clouds and Precipitation – an Educational Campaign) that included participation of more than three dozen students from the Universities of Utah and Wyoming. Two years before that, the UWKA participated in SEAR-MAR which included 5 universities in the mid-Atlantic and opportunities for more than 35 undergraduate students to participate in research/education flights on the UWKA. The new FIRP solicitation provides exciting opportunities for education-focused deployments in the future. The FIRP delineates a specific track for education and outreach activities using LAOF instruments and platforms. The $50K cost cap is waived for aircraft requests, facilitating the use of the UWKA-2 for these activities. One limitation for UWKA's engagement in education and training is its small size. Therefore, we are developing a high-speed (~1 Mbps) satcom system and air-to-ground telemetry system supporting 5G speeds are designed for the UWKA-2, funded by the MSRI-1 Award (see Section 6). This will allow a superior, more informed flight experience from the ground with integrated data displays, live on-board camera footage, low-latency instrument control and flight track maps plotted on top of situational data. Aside from other benefits, the high-speed data link will enable an immersive, virtual environment on the ground, and a captivating educational experience for student participants.
- Work to Obtain/Upgrade Aircraft – Significant progress has been made towards this. A summary is provided in Section 6.

C. King Air Advisory Panel and Reports Summary

The King Air Advisory Panel (KAAP) was formed in spring of 2019 as the faculty of DAS were developing a proposal for the Next Generation King Air (see Section 6). The panel consists of 5 members with experience ranging from airborne atmospheric scientists to research aircraft facility managers. Members serve a 5-year term and meet with the UWKA facility management team semi-annually. The KAAP is charged with providing the facility with expertise and perspective from users and operators outside of UW about the operation and future direction of the UWKA facility, including support of NSF-funded projects, instrumentation and measurements capabilities, education and training activities,

and non-NSF deployments. Once a year (at the spring meeting), the KAAP provides a summary report to the facility management team which is in turn provided to NSF. Links to the KAAP summary reports from spring 2020 and 2021 are provided in Section 7. During the last two years, KAAP meetings have focused mostly on the development of the new aircraft, accounting for the area of greatest opportunity and risk currently associated with the facility.

6. Development of Next Generation King Air (UWKA-2)

One of the major recommendations from the 2016 SVT Report and a bullet point in the CA8 agreement between UW and NSF is to develop a replacement aircraft facility. The current UWKA has been in service for 45 years and logged more than 8500 flight hours. Given the unique nature of its mission and the infrastructure needed to support its continued operation, it is nearing the end of its useful life. In 2019, the faculty of DAS and management team of the UWKA/WCR/WCL facility submitted a proposal to the NSF Mid-Scale Research Infrastructure I (MSRI) Program for the development of the Next Generation University of Wyoming King Air Research Aircraft (UWKA-2). The proposal was awarded in October of 2019 and included funds for the development of a mission-capable research aircraft with similar characteristics to the current aircraft and additional measurement capabilities and enhanced mission performance. The proposed path forward was for the University of Wyoming to purchase a baseline aircraft, after which, funds from the MSRI award would be used to transition the aircraft into an airborne atmospheric research facility. We are now 2.5 years into the MSRI effort, here we summarize the objectives and expected outcomes for this award.

The MSRI supports the development of UWKA-2. The new aircraft is a 2013 King Air 350i with increased gross-weight and more capable engines. This provides the baseline aircraft upon which the new mission-capable aircraft is being constructed. The UWKA-2 will be more capable than the current aircraft in three regards:

- UWKA-2 will have additional ports (2 nadir ports vs. 1, and 2 zenith ports vs. none), additional inlets (7 vs. 6), ~15% more interior space, greater scientific payload capacity (~15%), more electrical power (400A vs. 280A), higher ceiling (35,000 ft vs. 28,000 ft), longer endurance (4.5-5.5 hrs vs. 4 hrs), and greater overall flexibility. In the current aircraft, the instrument payload often needs to be curtailed because of space, weight, and/or power limitations. As such, the *UWKA-2 platform can be more responsive to the evolving atmospheric technology and the evolving research needs and interests of the NSF-funded community*.
- UWKA-2 lowers the barriers of access to advanced airborne atmospheric measurements, through advanced communication systems that will enable real-time immersive flight experience, instrument control, and flight management from the ground. This should make *UWKA-2 a platform of choice for the training of the next generation of airborne atmospheric scientists*.
- With two nadir and two zenith ports and additional payload capacity for power, weight and size, UWKA-2 will be even more capable for lower-tropospheric profiling compared to the current aircraft. The synergy between profiling measurements above and below flight level and in situ measurements makes the UWKA-2 especially attractive. For instance, the two zenith ports allow WCR dual-Doppler synthesis above flight level, not just below flight level (as in the current aircraft). This enables the aircraft to maintain a low flight level for in situ cloud measurements,

while simultaneously measuring two-dimensional along-track winds from the surface to cloud top.

Much of major design work and installation of large modifications has been accomplished. In Section 7, there is a link to the University of Wyoming Next Generation King Air Web page which provides monthly updates on the progress of the aircraft.

In addition to the development and certification of the aircraft and associated research infrastructure on the airframe, the MSRI also supports additional measurement and instrument developments, including:

- the upgrade of the WCR (WCR-4), with a new data acquisition system and four fixed antennas, two pointing up (zenith and slant-zenith) and two pointing down (nadir and slant-nadir);
- the upgrade of the Ka-band Profiling Radar (KPR-2), to be more sensitive and narrower-beam, in both zenith and nadir directions;
- the upgrade of the Multi-Aspect Raman Lidar (MARLi-2) to improve humidity and temperature retrieval, over a greater range below flight level;
- the development of the 5-antenna ADL (Airborne Doppler Lidar) for the retrieval of 3D winds below flight level;
- the acquisition of new probes for measuring trace gases (CO_2, CO, CH_4, C_2H_6, H_2O, N_2O, O_3 and NO_x) and inlets for measuring size-resolved aerosol concentrations; and
- the development of an advanced aircraft-to-ground data communication system to provide scientists and students an immersive an high-informed flight experience from the ground.

Annual reports for year 1 and 2 are linked in Section 7 and provide details of the MSRI development over the last 2.5 years. Figure 3 shows the schedule for the development of UWKA-2. Modifications of UWKA-2 are set to be complete in early summer, 2022 and modifications of UWKA-2 will be completed later in the summer. Roughly one year is scheduled for completing certification of the research configuration with an additional ~9 months for integrating and testing standard facility instrumentation. We are targeting late 2023/early2024 for UWKA-2 to be deployable for NSF-funded projects, depending on complexity of requested payload.

Figure 3: Timeline for development of UWKA-2

7. Additional Information with Relevant Links

Below are links that provide additional resources for the Site Visit Team. Contained within the link are publicly accessible webpages maintained by the UWKA/WCR/WCL facility and documents and reports referenced in this narrative.

Publicly Accessible Webpages

UWKA King Air Webpage: https://www.uwyo.edu/atsc/uwka/index.html

Next Generation King Air (UWKA-2) Webpage:
https://www.uwyo.edu/atsc/uwka/next-gen-king-air.html

Facility User's Guide (work in progress): https://www.uwyo.edu/atsc/uwka/facility-users-guide.html

List of Publications (since 2004) resulting from UWKA/WCR/WCL:
https://www.uwyo.edu/atsc/uwka/publications.html

Project Descriptions and Data Access/Requests:
https://www.uwyo.edu/atsc/uwka/facility-data-requests.html

Non-Public Webpages and Reports

UWKA Planning Calendar through 2025:
https://docs.google.com/spreadsheets/d/10XW91GUZddk5fiJATdvoklg2AORoEZy3Bq8XdpXCv0c/edit#gid=1716593319

UWKA/WCR/WCL Facility Strategic Plan:
https://www.uwyo.edu/atsc/uwka/_files/2022_svt/uwka_sp_2022-27.pdf

2016 SVT Final Report: https://www.uwyo.edu/atsc/uwka/_files/2022_svt/svt2016_report.pdf

CA8 Yr 1 Annual Report (2020):
https://www.uwyo.edu/atsc/uwka/_files/2022_svt/annreport_ca8_yr1.pdf

CA8 Yr 2 Annual Report (2021):
https://www.uwyo.edu/atsc/uwka/_files/2022_svt/annreport_ca8_yr2.pdf

KAAP Report (2020): https://www.uwyo.edu/atsc/uwka/_files/2022_svt/kaap_report_spring2020.pdf

KAAP Report (2022): https://www.uwyo.edu/atsc/uwka/_files/2022_svt/kaap_report_spring2021.pdf

MSRI Yr 1 Annual Report (2020):
https://www.uwyo.edu/atsc/uwka/_files/2022_svt/annreport_msri_yr1.pdf

MSRI Yr 2 Annual Report (2021):
https://www.uwyo.edu/atsc/uwka/_files/2022_svt/annreport_msri_yr2.pdf