STATEMENT OF WORK ASSOCIATED WITH IMPLEMENTING ARRANGEMENT NUMBER 14 TECHNICAL ENHANCEMENTS FOR THE ADVANCED OPERATIONAL AVIATION WEATHER SYSTEM SUBJECT TO THE AGREEMENT BETWEEN THE TAIPEI ECONOMIC AND CULTURAL REPRESENTATIVE OFFICE IN THE UNITED STATES AND THE AMERICAN INSTITUTE IN TAIWAN FOR TECHNICAL COOPERATION ASSOCIATED WITH ESTABLISHMENT OF ADVANCED OPERATIONAL AVIATION WEATHER SYSTEMS

1.0 Background and Objectives

The Agreement between the Taipei Economic and Cultural Representative Office in the United States (TECRO) and the American Institute in Taiwan (AIT) provides for technical cooperation between the Civil Aeronautics Administration (CAA), as TECRO's designated representative, and the University Corporation for Atmospheric Research (UCAR), as AIT's designated representative. CAA and UCAR will cooperate on the development and establishment of operational aviation weather systems.

The Advanced Operational Aviation Weather System (AOAWS) developed by TECRO's designated representative, CAA, requires up-to-date scientific and technical components in order to provide a high level of service to the aviation community on Taiwan. Most of this aviation weather science and technology has been developed by AIT's designated representative, UCAR, over the past two and a half decades and has been validated in operational environments both in the United States and in other countries.

The AOAWS consists of advanced meteorological sensor systems (at airports and within the Taiwan airspace), a communications infrastructure, a product generation component, a system server component that distributes products, and product displays that present the advanced aviation weather information to end users. The AOAWS system components have been integrated to form an operational, turn-key system that serves the aviation community.

TECRO and its designated representative, CAA, will be provided with the necessary technology required to develop and implement enhancements to the AOAWS system, from AIT's designated representative, UCAR, as defined herein.

2.0 Task Descriptions

Task #1: AOAWS-TE Display System Enhancements

Minor enhancements or refinements to the Java-based Multi-dimensional Display System (JMDS), Web-based Multi-dimensional Display System (WMDS), Automated Weather Observing System (AWOS) Display and/or System Monitor Display (SMD) will be developed and implemented based on user feedback and resources available during 2011.

The display system enhancement task includes: (a) supporting the JMDS software system; (b) recording user feedback; (c) adding new functionality to the JMDS/WMDS based on user feedback and as resources permit; (d) providing annual software releases for this new code; and (e) updating user manuals to reflect the new capabilities.

Additional minor enhancements to the JMDS and WMDS will be developed during the project period if resources permit based on user feedback and TECRO's designated representative, CAA,

prioritization. If new enhancements make it necessary, updates will be made to the JMDS, AWOS Display, WMDS and SMD manuals.

To ensure that the AOAWS display systems can be efficiently supported and enhanced in the future, an evaluation of the underlying technology will be performed. The technology and software designs of the major display components (JMDS, WMDS and AWOS displays) will be reviewed to assess their supportability during future years. This evaluation will be documented in a report and delivered to TECRO's designated representative, CAA.

Required tasks and subtasks

The following tasks and subtask will be performed:

1. Support the operational version of the JMDS.
2. Support the operational version of the WMDS.
3. Support the operational version of the AWOS Display.
4. Support the operational version of the SMD.
5. Respond to user feedback and as appropriate, provide and develop minor enhancements to address issues raised by the users.
6. Ensure the displays (JMDS, WMDS and SMD handle Weather Research and Forecasting (WRF) model configuration changes when they occur.
7. Evaluate display technologies.

Cost Estimate[1]:

Software Engineering (4 person-weeks)	US$ 20,000
Total	US$ 20,000

[1]All manpower values are given as person-weeks. Costs reflect UCAR's full loading (for 2011: overhead @ 0.498, benefits @ 0.510, the UCAR fee @ 0.03, and computer service charge of US$ 7.14 per UCAR manpower hour) and the fully loaded costs of approved subcontractors.]

Task #2: Wind Shear Detection System Evaluation

Under the AOAWS program, TECRO's designated representative, CAA, implemented two Low-Level Wind Shear Alert Systems (LLWAS) manufactured by Almos Systems Pty. Ltd. in the year 2000. These were implemented at Songshan Airport (SS) and Taoyuan International Airport (TIA). The remote wind sensors that make up the wind shear detection network are sensitive to the local environment including wind obstructions such as trees, buildings, roadways, etc. It is important that the remote sensor sites be periodically reviewed to ensure that they are free of obstructions. Scientific staff from AIT's designated representative, UCAR, will visit each remote sensor site and evaluate its surroundings to ensure that they are free of obstructions that could impact the overall performance of the wind shear system.

A wind shear detection system evaluation will also be performed for Kaohsiung International Airport (KH). An evaluation was performed by UCAR in 1996-1997, when it was determined that a remote sensor solution was the only practical solution due to the lack of appropriate ground sensor

sites and the airport's proximity to the sea. Since 1997, other wind shear detection technologies have emerged and their applicability for KH will be evaluated in this study.

AIT's designated representative, UCAR, will perform a geographic analysis of the KH layout and surrounding environment to assess the opportunities and constraints (e.g., coastal proximity, runway layout, urban environment, etc.) that may have an impact on the applicability of various wind shear detection technologies. UCAR will evaluate currently available weather sensing systems and their locations at and around KH to assess the applicability of using the existing sensors to detect wind shear and/or to use data from those sensors to support the implementation and evaluation of candidate wind shear detection systems.

Required tasks and subtasks

AIT's designated representative, UCAR, with assistance from TECRO's designated representative, CAA, will perform the following tasks and subtasks:

1. Visit each LLWAS remote sensor site at both SS and TIA.
2. Perform a survey of the local conditions and environment surrounding each remote sensor site.
3. Prepare and deliver a report describing the findings and make recommendations where necessary to ensure the ongoing proper function of the LLWAS.
4. Visit KH and perform a site assessment of current meteorological sensors that could contribute to a wind shear detection solution. Potential sites of new wind shear sensors will also be evaluated.
5. Prepare and deliver a report that discusses options, issues, and concerns that may have an impact on the applicability of various wind shear detection technologies based on the local geography around KH. The report will also discuss the applicability of utilizing existing weather sensor systems in the wind shear detection solution.

Cost Estimate:

Scientists (4 person-weeks)	US$	20,000
Travel:		
1 trip for 1 person@ 10-days	US$	15,000
Total	US$	35,000

Task #3: AOAWS Data System Upgrades, Testing, and Integration
This task focuses on ensuring that the AOAWS data system infrastructure and processing system is able to incorporate data and product enhancements developed and implemented during this phase of the AOAWS program.
Modifications to the AOAWS will be tested by UCAR in 2010 and readied for the anticipated WRF model configuration change, which is scheduled to occur between October 2010 and January 2011. Because no additional major data system changes are anticipated in 2011, only limited resources will be applied to this task in 2011.
If and when necessary, system enhancements include incorporating data from the WRF modeling

system as it is upgraded and/or its configuration changes, and incorporating refinements to AOAWS products and data types. It also includes enhancements to the system monitoring capability, where applicable. In addition, AIT's designated representative, UCAR, will monitor and correct any problems that arise from system upgrades during the project period.

Required tasks and subtasks

The Data and System Testing and Integration tasks and sub-tasks include:

1. Installing an upgraded AOAWS version to handle changes to the WRF modeling system.
2. Supporting TECRO's designated representative, CAA, in troubleshooting any problems associated with the AOAWS data system.
3. Providing assistance to the CAA to ensure that the necessary data links and network capacity are identified and available, if upgrades are made.

<u>**Cost Estimate:**</u>

<u>Engineering (4 person-weeks)</u>	US$	20,000
Total	US$	20,000

Task #4: AOAWS System Implementation, Support and Maintenance

System administration and software engineering support and maintenance will be provided for the installed AOAWS system and for system upgrades. AOAWS components are located at the Taipei Aeronautical Meteorological Center (TAMC), the SS Weather Station and Flight Information Service (FIS), TIA Weather Station and Radar Facility, and FIS, KH Weather Station and FIS, and the Taipei Area Control Center (TACC).

Defects in the AOAWS system software that arise or develop during this project period (2011) will be addressed and resolved by AIT's designated representative, UCAR. Support and maintenance services cover only software components of the AOAWS. Support and maintenance services for hardware, communication network links, and network components used by the AOAWS that are operated by local telecommunication companies and/or TECRO's designated representative, CAA, are not covered under this Implementing Arrangement. However, UCAR will assist the CAA in troubleshooting hardware and network problems.

TECRO's designated representative, CAA, is responsible for running the AOAWS system. AIT's designated representative, UCAR, will respond as appropriate to help the CAA ensure that the AOAWS system serviceability level remains consistently high. In addition to the support and maintenance work referred to above, UCAR will install the system upgrades (AOAWS Version 10.x), which will include the functionality of the operational AOAWS plus any new capabilities developed in 2011.

To ensure the efficient introduction of new algorithms and technology in the future, a review of the AOAWS architecture, source code base, build process and install process will be performed. The intent of the review is to: 1) identify and remove unused components such as configurations files, scripts and data directories; 2) correct deficiencies in the build and install processes; and 3) correct

errors or enhance the SysView diagrams when necessary. The results of this review will be summarized in a report that will be delivered to TECRO's designated representative, CAA.

Required tasks and subtasks

The following tasks and subtask will be performed during the project period:

1. Provide general assistance to TECRO's designated representative, CAA, in supporting and operating the AOAWS including assisting the CAA with any AOAWS related new hardware installation and network configuration changes. Note: there will be no Debian Operating System (OS) upgrades in 2011.
2. Provide assistance to the CAA in troubleshooting problems with various versions of the AOAWS, if and when they occur.
3. Support and maintain the installed operational version of the AOAWS.
4. Install, test and support upgraded versions of the AOAWS.
5. Correct AOAWS defects that arise from the upgrades.
6. Perform a review of AOAWS architecture.

Cost Estimate:

Engineering (32 person-weeks)	US$ 160,000
Travel Estimate:	
1 trip @ 1-week	US$ 12,000
Total	US$ 172,000

Task #5: Project Management, Administration and Document Preparation

All technical aspects of the AOAWS project will be managed by AIT's designated representative, UCAR, in cooperation with the project management team from TECRO's designated representative, CAA.

Required tasks and subtasks

The following sub-tasks will be carried out by the project management team:

1. Carry out general project management, such as planning, budgeting, technical consultations with team members, and tracking progress.
2. Prepare monthly and quarterly progress reports.
3. Obtain and review user feedback on the AOAWS-TE.
4. Response to routine technical and information requests from TECRO's designated representative, CAA.
5. Participate in AOAWS-TE related meetings.

Cost Estimate:

General Project Management (13 person-weeks)	US$ 64,000
Travel:	
1 trip @ 1-week	US$ 12,000
Total	US$ 76,000

3.0 Deliverables

AOAWS-TE Quarterly Report #1   15 April 2011

AOAWS-TE Quarterly Report #2	15 July 2011
AOAWS-TE Quarterly Report #3	15 October 2011
AOAWS-TE Quarterly Report #4	2 December 2011
Draft IA#14 Acceptance Plan	15 July 2011
LLWAS Evaluation Report	2 December 2011
Display Technology Evaluation Report	2 December 2011
AOAWS-TE Architecture Review Report	2 December 2011
AOAWS-TE Version 10.x Software Release	2 December 2011
JMDS Version 10.x Release (source code)	2 December 2011
WMDS Version 10.x Release (source code)	2 December 2011
AWOS Display Version 10.x Release (source code)	2 December 2011
Year-End Acceptance Meeting	5 December 2011

4.0 Budget Summary

Task #1 – AOAWS-TE Display System Enhancements	$ 20,000
Task #2 – Wind Shear Detection System Evaluation	$ 35,000
Task #3 – Data System Upgrades, Testing, and Integration	$ 20,000
Task #4 – System Implementation, Support, and Maintenance	$ 172,000
Task #5 – Project Management	$ 76,000
Total	US$323,000