法規名稱：(終)IMPLEMENTING ARRANGEMENT #10 CONTINUING DEVELOPMENT OF THE WFO-ADVANCED SYSTEM, DATA ASSIMILATION AND DEVELOPMENT OF SCALABLE MODELING SYSTEM AND WEB-BASED WORKSTATION TO THE AGREEMENT FOR TECHNICAL COOPERATION IN METEOROLOGICAL AND FORECAST SYSTEMS DEVE

終止日期：民國 87 年 06 月 30 日

ARTICLE I-SCOPE

This Implementing Arrangement describes the scientific and technical activities to be undertaken by the American Institute in Taiwan (AIT) and its representative, the Forecast Systems Laboratory (FSL) of the National Oceanic and Atmospheric Administration (NOAA). It provides for continuing development of the Forecast System being developed by the Joint Forecast Systems Project . This project is a cooperative effort between the Central Weather Bureau (CWB), the designated representative of the Taipei E-cono ic and Cultural Representative Office in the United States (TECRO), formerly known as the Coordination Council for North American Affairs, or CCNAA, and NOAA/FSL.

ARTICLE II-AUTHORIZATION

The activities described in this Implementing Arrangement will be carried out under the general terms and conditions established by the Agreement between CCNAA and AIT for Technical Cooperation in Meteorology and Forecast Systems Development. This Implementing Arrangement is hereby attached to that Agreement and becomes part of the Agreement.

ARTICLE III-SERVICES

The period of Implementing Arrangement #10 will be a transition year, during which several ongoing tasks will near completion and several new tasks will be started. For ongoing tasks, The FSL-CWB joint team will focus on customizing the FX-Advanced system into the CWB-Advanced system, developing three-dimensional variational data assimilation technique, and development of WSR-88D radar data ingest and diagnostic tools. Two new tasks are Scala-

ble Modeling System (SMS) development, and development of a Web-based forecast workstation based on Java technology. There will also be continuing interaction on earlier cooperative tasks, such as the open system central facility. These cooperative activities, described in more detail in the Statement of Work, will include the following six tasks:

Task #1-Implementation of operational FX-Advanced Forecast Workstation

The FX-Advanced Forecast Workstation project under development at FSL has been approved to be integrated into the AWIPS (Advanced Weather Interactive Processing System) baseline Build 3 for the U.S. National Weather Service. This AWIPS Build 3 will be deployed at 21 sites in 1997. FSL will continue develop Build #4, which is the first operational system that will replace the legacy NWS system, AFOS (Automation of Field Operations and Services). During the I.A. #10 period, CWB will adopt this oper ational system and customize it into their first prototype system, which will replace its current PC-based system when it is ready.

Task #2-Data Assimilation

CWB and FSL scientists continue to develop improved data assimilation techniques. FSL will complete a 3DVAR (three-dimensional variational) system for conventional observation data. CWB will apply this data assimilation technique to one of their operational models. For satellite radiance assimilation, FSL will provide consultation support to CWB in the area of initial testing on clear radiance data assimilation.

Task #3-Development of Scalable Modeling System for Spectral Model

FSL will develop the Scalable Modeling System in the area of Scalable Spectral Tool which can be used to parallelize CWB'S models for their future high performance computer. FSL will parallelize CWB'S second generation Global Forecast System (GFS) using

the SMS software. The performance of the parallelized GFS will then be tested using one or more case studies. FSL will also provide SMS documentation to potential users.

Task #4 - Development of Web-based Forecast Workstation
FSL and CWB scientists will develop an inexpensive and simple World Wide Web-based forecast workstation for use in variety of forecast, training, education, and research applications. The initial development will use Web and Java technology. The development phase will be short to allow the initial operational build to be tested and evaluated at an early date.

Task #5-Development of the WSR-88D Wideband Radar Data Ingest and Diagnostic Display System
FSL and CWB scientists will design and develop a simple real-time WSR-88D diagnostic display tool using a PC running on Windows NT and receiving broadcast data from an Ethernet connection. The user interface will be developed using Visual Basic.

Task #6-Continuing Interaction on earlier Cooperative Projects
Several earlier cooperative tasks have been completed. Technology has been transferred successfully and is beginning used operationally at CWB. FSL development in these areas continues, and further CWB/FSL interaction is important to keep CWB staff up-to-date on current developments. Cooperation on open system central facility and the forecast preparation system fit this task category. This task will allow continuing interaction at an appropriate level, including exchange of visits, copying papers and reports, and e-mail interaction.

ARTICLE IV-FINANCIAL PROVISIONS
In accordance with the Agreement, NOAA/FSL is undertaking this work on behalf of AIT for TECRO. TECRO will reimburse AIT, and its designated representative NOAA/FSL for all costs incurred in association with this Implementing Arrangement.

The total cost for activities described in this Implementing Arrangement is mutually agreed to be US $600,000. It is also agreed that fifty percent of the funds will be transferred in advance, with the remaining fifty percent transferred within 30 days of the acceptance of the final report by TECRO, and its designated representative, CWB.

ARTICLE V-INTELLECTUAL PROPERTY CONSIDERATIONS

No intellectual property considerations are expected to arise in conjunction with activities described in this Implementing Arrangement. Existing system designs and computer software of the F-SL Forecast System are in the public domain. Reports, specifications, and computer software prepared under this Implementing Arrangement will also be in the public domain once they have been approved in a final form by TECRO, CWB, AIT, and NOAA.

ARTICLE VI-EFFECTIVE DATE, AMENDMENT, AND TERMINATION

This Implementing Arrangement is effective on the date of the last signature hereafter. This Implementing Arrangement may be amended and/or terminated in accordance with the terms of the Agreement. The estimated completion date for the activities described in this Implementing Arrangement is June 30, 1998.

FOR THE TAIPEI ECONOMIC AND CULTURAL REPRESENTATIVE OFFICE IN THE UNITED STATES	FOR THE AMERICAN INSTITUTE IN TAIWAN
[Signed]	
Peter P.C. Cheng	Barbara J. Schrage
Deputy Representative	Managing Director ad interim
October 21, 1997	July 24, 1997
Date	Date

Statement of Work

For Implementing Arrangement #10
Continuing Development of the WFO-Advanced System, Data Assimilation and Development of Scalable Modeling System and Web-based Workstation

between The Taipei Economic and Cultural Representative Office in the United States and The American Institute in Taiwan

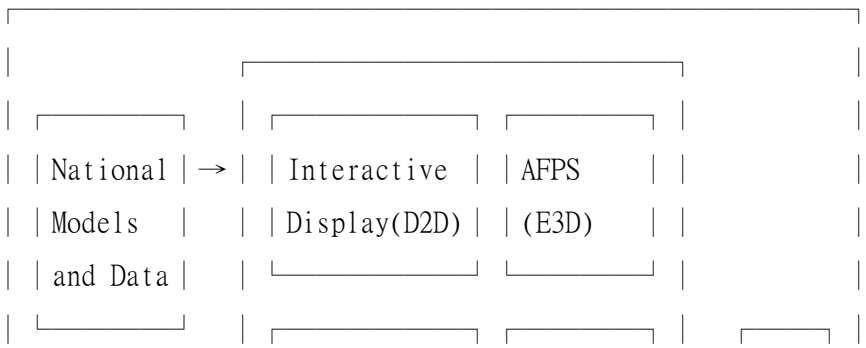
1.0 Background and Objectives

The agreement between the Coordination Council for North American Affairs (CCNAA) and the American Institute in Taiwan (AIT) provides for technical cooperation between the Taiwan Central Weather Bureau (CWB) and the U.S. National Oceanic and Atmospheric Administration'S Forecast Systems Laboratory (NOAA/FSL) . The two agencies cooperate on the development of meteorology and forecast systems. CCNAA has been renamed the Taipei Economic and Cultural Representative Office in the United States (TECRO).

The WFO-Advanced system currently under development at the Forecast Systems Laboratory (FSL) in Boulder has been approved to be part of AWIPS (Advanced Weather Interactive Processing System) for the U.S. National Weather Service (NWS). The WFO-Advanced system uses AWIPS dedicated hardware and communication links. FSL deployed WFO-Advanced (version DENVER96) at the Denver NWS Forecast Office for operational testing in May 1996. The AWIPS Build 3, which has a significant portion of WFO-Advanced capabilities, will be deployed at 21 Weather Forecast Offices (WFOs) for field testing during 1997. Among these WFOs, five sites will conduct Operational Test and Evaluation (OT&E). This AWIPS limited deployment decision was approved by the Secretary of the Commerce Department in February of 1997.

The WFO-Advanced system is a realization of the generic FX-Advanced (FSL X-window Advanced) system, which assimilates data and model information and disseminates forecast produc-

ts. Figure I illustrates the six components of the FX-Advanced system: interactive display, the AWIPS Forecast Preparation System (AFPS), 3-D visualization, 3-D editing, hydrometeorological applications, and a component that contains both GEMPAK (General Meteorological Package) and X applications. AFPS is a software package of for ecast visualization and graphical editing tools that is being developed at FSL. CWB-Advanced is a second realization of the generic FX-Advanced System, which has been customized by the CWB. CWB-Advanced has different geographic scales, different data ingest systems, different background maps, and some different products. The first version of the CWB-Advanced system will be released and tested at the Weather Forecast Center in 1997, and when it is ready, it will replace the current PC-based system. The PC-based system was installed during the spring of 1992. CWB will continue to main tain PC-based system for certain functions, such as replacing the VAX-based central facility and supporting their operation and outside users' needs. During I.A. #10, CWB will focus on the following tasks: (1) customizing the FX-Advanced interactive display component using CWB-specific raw data, (2) evaluating the operational version of the CWB-Advanced system, and (3) getting users' feedback. CWB will continue to evaluate some of the Interactive Forecast Preparation (IFP) tools such as AFPS and the hydrome teorological applications. Currently, CWB plans to integrate these capabilities into the CWB-Advanced system.



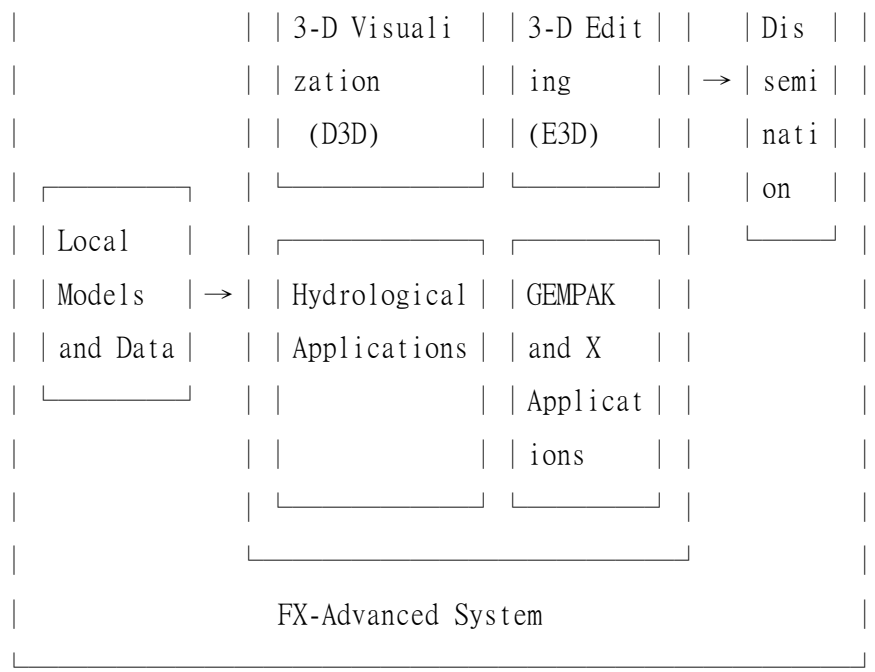


Figure 1. WFO-Advanced System

The I.A. #10 period will be a transition year during which several ongoing tasks will near completion, and several new tasks will be started. This Statement of Work addresses tasks that will be undertaken by the joint team of FSL and CWB personnel in accordance with the terms of I.A. #10. Six tasks are included in the Statement of Work. Three are related to ongoing projects: the FX-Advanced workstation, data assimilation, and the WSR-88D radar data ingest and diagnostic display. There are two new tasks Scalable Modeling System (SMS) development and applications and development of a Web-based Forecast Workstation based on Java technology. There will also be continuing interaction on earlier cooperative tasks, such as the open system central facility.

Tasks will be undertaken both by the FSL-CWB Joint Team working at the FSL facility in Boulder, Colorado and by CWB staff at the CWB facility in Taipei, Taiwan, as appropriate. This Statement of Work addresses only tasks that will be undertaken by the FSL-CWB Joint Team under the terms of I.A. #10. It describes the performance schedule, deliverables, and resource requirements.

2.Task Descriptions

In terms of the overall program schedule, the following five tasks have been identified as being critical during the July 1, 1997 to June 30, 1998 time period. These are listed below, along with the proportion of resources that is to be allocated to each task.

- Task #1-Implementation of the operational FX-Advanced Forecast Workstation (20%)
- Task #2-Data Assimilation (20%)
- Task #3-Development of Scalable Modeling System for spectral model (30%)
- Task #4-Development of Web-based Workstation (20%)
- Task #5-Development of the WSR-88D Wideband Radar Data Ingest and Diagnostic Display System (5%)
- Task #6-Continuing interaction on earlier cooperative projects (5%)

These six tasks are described in more detail below.

Task #1-Implementaijon of the Operational FX-Advanced Forecast Workstation

During the I.A.#10 period, FSL's schedule for AWIPS development is:

1.AWIPS Build 3

FSL delivered FXA-3.0 to NWS in April of 1997 as an AWIPS Build 3. FSL will help NWS with the AWIPS limited deployment effort. NOAA will procure and install 21 systems and has an option to procure an additional 18 systems during 1997. A decision on the remaining AWIPS systems (about 1 13) will be made after the operational test and evaluation of AWIPS Build 3. FSL will provide operational support during the deployment, including trouble-shooting assistance. FSL will also provide NWS with more technical design documents for the WFO-Advanced system, including a user's guide and a site manager's guide.

2.AWIPS Build 4

AWIPS Build 4 is the first operational system that will replace AFOS (Automation of Field Operations and Services), the cu-

rrent NWS communication and display system, and other legacy systems. Build 4 will have full PUP (Principal User Processor) functions, and it will support the initial IFPS (Interactive Forecast Preparation System) capability and LDAD (Local Data Acquisition and Dissemination) functions. FSL will complete B-uild 4 during the I.A. #10 period.

3.AWIPS Operational support

FSL will maintain the current FX-Advanced workstation capabil-ities and focus on operational requirements such as system pe-rformance optimization, site localization, redundancy and fai-lover, wide area networking, software improvement such as Com-mercial off-the-shelf software(COTS) replacement (e.g., DEC M-essage Queue-DMQ and Object Interface-01), configuration mana-gement, and documentation. FSL will also participate in the s-ystem operational test and evaluation.

FSL will release software from each upgrade build to CWB after completing each development cycle. FSL will also provide avai-lable documentation for the FX-Advanced system. If necessary, FSL will provide an on-site, deep knowledge, short training c-ourse to CWB workstation staff, so CWB staff can learn the de-tails of the FX-Advanced system. The training would target CWB ,s meteorological application developers. This training would cover workstation design and software architecture. The goal of the training would be to allow CWB staff to perform in-hou-se software modification efficiently so that the system can i-ngest CWB's data sources and satisfy CWB's operational needs. Currently, two visiting scientists from CWB are participating in the FX-Advanced system development. During the next phase, which involves mainly testing and delivering the whole workst-ation system, it would be impossible to integrate a new CWB v-isiting scientist into the development team, although one CWB visiting scientist will continue to participate in this task. The following summarizes the schedule and resources required for Task #1:

Performance Period:

1.Development and operational test of the FX-Advanced software	7/1/97-6/30/98
2.Preparation of FX-Advanced documentation	7/1/97-6/30/98
3.FX-Advanced software training	(time flexible)

Resources Required: 20% FSL-CWB Joint Team

Deliverables:

1.Software releases of FX-Advanced	12/97,4/98
2.Documentation of the FX-Advanced	12/97,5/98
3.Training materials	5/98

Task #2-Data Assimilation

During 1.A. #9, FSL/CWB collaboration on this task focused on the development of an inversion procedure for satellite radiance data. A regression-based inversion technique was developed to translate differences between forecast and observed satellite radiances into increments of temperature and moisture. No sensitivity experiments have yet been conducted, due to a significant data ingest problem now being solved. FSL has also developed a I-D variational analysis method for use with satellite radiance data, soon to be available for CWB experimental use.

During 1.A. #10, FSL will concentrate on the following area:

Development of three-dimensional variational (3DVAR) analysis software for conventional observations

FSL will complete the development of nonproprietary software for 3DVAR analysis using conventional observations (radiosonde, aircraft, satellite temperature, synoptic surface observations (SYNOP), buoy, and ship). The software will include modules for organizing observations and metadata into the arrays needed for 3DVAR analysis, calculating the penalty function, calculating the gradient of the penalty function, determining the step size for each iteration, performing iterative solutions to 3DVAR analysis, and establishing constraints for hydrostatic and mass/wind balances. The software will also include dummy routines for an input/output interface for observations and background grids on input and analyzed grid on output. Du-

mmy routines will identify expected formats to be used by the analysis software.

Performance Period:

1.Development of 3DVAR analysis software for conventional observations 7/1/97-3/31/98

Resources Required: 20% FSL-CWB Joint Team

Deliverables:

1.3DVAR analysis software for conventional observations 4/98

Task #3-Development of Scalable Modeling System for spectral model

Massively Parallel processing (MPP) technology provides attractive opportunities for achieving affordable computing that fulfills the requirements of high-resolution models requirements such as speed, memory, and price/performance. FSL High Performance Computing scientists have developed a high-level library, the Scalable Modeling System (SMS), and they have ported many Numerical Weather Prediction (NWP) models to MPP computers using SMS. SMS has four components: the Nearest Neighbor Tool (NNT), the Scalable Runtime System (SRS), the Paralleling Preprocessor (PPP), and the Scalable Spectral Tool (SST). NNT is used to transform a grid-point model code to the original code with minimum impact; SRS is used to provide efficient I/O for NWP applications. NNT and SRS have already been completed and tested. PPP will enhance the preprocessing capability for grid-point models, and SST will be used to handle spectral models.

CWB is currently planning procurement of its next generation high performance computer (HPC) in order to satisfy its operational responsibilities. The tentative schedule for the procurement is for CWB to issue a Request for Proposal (RFP) by the end of June of 1998 and to begin the HPC installation in June of 1999. CWB will expect to spend some effort porting their models to their future HPC. FSL plans to work with CWB in the area of SMS development, especially the SST components. CWB and FSL will also collaborate on specific SMS applications such

as porting CWB's Global Forecast System (GFS) to the future H-PC.

The GFS is a global primitive equation model with a resolution of 18 sigma levels in the vertical dimension and 79 waves of triangular truncation in the horizontal dimension (T79L18). T-he data assimilation model uses multivariate optimum interpol-ation (01) analysis. The forecast dynamic model uses a primit-ive equation model on spherical coordinates. The physical par-ameterization for GFS includes surface flux, vertical turbule-nce mixing, short-wave and long-wave radiative transfer, cumu-lus convection, grid-scale condensation, and gravity wave drag . The GFS is running with six-hour intermittent data assimila-tion cycles to produce two forecasts a day. The forecast model is initialized by incremental, nonlinear, normal-mode initial-ization.

During 1.A. #10, FSL will support CWB in the following three areas:

1.FSL will parallelize CWB's second generation Global Forecast System (GFS) using the SMS software.

2.FSL will test the parallelized GFS on a target machine sele-cted by CWB and will compare the results with that of CWB's current CRAY YMP run on the same case study.

3.FSL will provide SMS documentation to potential users, so t-hat vendors can perform benchmark evaluations as part of th-eir proposal submission to CWB.

The following summarizes the schedule and resources required for Task #3:

Performance Period:

1.Survey CWB second generation GFS model	7/1/97-9/30/97
2.Parallelize GFS physical parameterization model	7/1/97-12/30/97
3.Develop Scalable Spectral Tool for SMS	10/1/97-3/30/98
4.Parallelize GFS dynamic model	12/1/97-4/30/98
5.Test paralleled GFS model on a selected target machine	10/1/97-5/30/98

6.Complete SMS document 5/30/98

Resources Required: 30% FSL-CWB Joint Team

Deliverables:

1.SMS software and document 5/30/98

2.Parallelized GFS model to CWB 5/30/98

Task #4 -Development of Web-based Forecast Workstation

The idea of a World Wide Web-based Forecast Workstation to be run from a PC was initially raised by Dr. Sandy MacDonald, the Director of FSL, almost two years ago when he visited CWB. The minimum hardware configuration of the current FX-Advanced system (assuming Hewlett-Packard hardware) will cost about $IOOK (US) in Taiwan. For many university and research users in Taiwan, this cost is prohibitive. The development of the FX-Advanced at FSL has reached the final deployment test and evaluation stage, and FSL has decided to initiate a new project called FX/net (Web-based workstation) in the Spring of 1997.

The objective of the FX/net project is to provide the meteorological community with an inexpensive and simple forecast workstation for use in variety of forecast, training, education, and research applications in which the full capabilities of the FX-Advanced system are not required. FX/net may also be able to meet the needs of the Taiwan CWB for a system to support their local field offices. The initial development phase will be kept short to allow the initial operational build to be tested and evaluated at an early date.

The following summarizes the schedule and resources required for Task #4:

Performance Period:

1.System requirements analysis 7/1/97-10/30/97

2.System Design 11/1/97-3/31/98

3.System development (feasibility evaluation, hardware configuration, and Prototype Build 1 software development) 4/1/98-6/30/98

Resources Required: 20% FSL-CWB Joint Team

Deliverables:

1.System design document 4/30/98

2.Prototype Build 1 software 5/30/98

Task #5-Development of the WSR-88D Wideband Radar Data Ingest and Diagnostic Display System

During I.A. #9, the FSL data ingest team completed the narrowband data communication task using a multichannel, high-speed synchronous communications server, which successfully received data from the Radar Product Generator (RPG). The FX-Advanced workstation is able to receive data from either a leased line or a dial-up service via the Simpact Freeway communication server. The use of Simpact Freeway for the NEXRAD Product Interface (NPI) subsystem has been adopted by AWIPS system. The original AWIPS candidate for NPI is a HP workstation (HP 9000 model 747i and SBE BC3X communication controller). Basically, the NPI task was completed for associated PUP and nonassociated PUP for narrowband data during I.A. #9.

During I.A. #10, FSL will work with the NWS Office of Hydrology (OH) staff to integrate their hydrological applications software. These applications software include sending raingauge data back to the RPG for calibration. Wideband data, which can be obtained from either the RPG or the Radar Data Acquisition (RDA) communication interface ports, are extremely useful for development of applications software later.

During I.A. #10, FSL will carry out the following task with C-WB:

Design and test a tool for a real-time WSR-88D diagnostic display of wideband radar data

This display tool will provide meteorologists a simple display of radar diagnostic status through an Ethernet connection. Initially, FSL will ingest WSR-88D wideband data that were broadcast from the National Severe Storms Laboratory (NSSL)-developed Radar Interface and Data Distribution System (RIDDS) via the SPARC station 5 workstation. If the Windows NT ingest is reliabel, FSL will design and implement an 8-mm WSR-88D tape-reading function as a C-language DLL (Dynamic Link Library).

The user interface will be developed using Visual Basic and W-indows Sockets.

The following summarizes the schedule and resources required for Task #5:

Performance Period:

1.Develop and test a real-time WSR-88D diagnostic display system		7/1/97-6/30/98
Resources Required:	5%	FSL-CWB Joint Team

Deliverables:

1.Real-time WSR-88D diagnostic display system (initial version)	5/98

Task #6-Continuing interaction on earlier cooperative projects

During the I.A. #9 period, several earlier cooperative projec-ts have been completed, and technology has been transferred s-uccessfully and is being used operationally at CWB. One examp-le is development of the open system central facility. FSL has provided the updated central facility software (called NIMBUS) to CWB as it became available during I.A. #9. CWB continues to develop its own central facility software, called NICE (Netwo-rk Information exChange Environment), which is similar to NIM-BUS. The NICE system will become operational during I.A. #10. FSL development in this area continues and further CWB/FSL in-teraction is important to keep CWB staff up-to-date on current developments in NIMBUS. Cooperation on the open system softwa-re and the forecast preparation system fit this task category. This task will allow continuing interaction at an ”appropria-te” Elevel, including exchange of visits, copying papers and reports, and e-mail interaction.

Performance Period:

1.Continuing interaction on earlier cooperative projects		7/1/97-6/30/98
Resources Required:	5%	FSL-CWB Joint Team

Deliverables:

1.Relevant documents, reports, and electronic information as needed	

3.Schedule

The following milestones are consistent with the overall program requirements:

Functions	Milestones
1.Provide FX-Advanced software	12/97, 4/98
2.Provide FX-Advanced documentation	12/97, 5/98
3.Provide forecaster workstation training material	5/98
4.Provide 3DVAR analysis software for conventional observations	4/98
5.Provide evaluation report on using satellite radiance data	3/98
6.Provide Scalable Model System software and documentation	5/98
7.Provide parallelized Global Forecast System model	5/98
8.Provide Web-based forecast workstation system design document	4/98
9.Provide Web-based forecast workstation Build 1 software	5/98
10.Provide real-time WSR-88D diagnostic diplay software	5/98
11.Provide relevant documents, reports on earlier cooperative projects	as needed

Schedule by Month

TASKS	7/1	8/1	9/1	10/1	11/1	12/1	1/1	2/1	3/1	4/1	5/1	6/1	6/30
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Web-based forecast workstation)

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2.Prototype Build 1 software ——————→

Task 5 (WSR-88D)

1.Real-time diagnostic display system ——————————————————→

Task 6 (interaction on earlier projects)

4.0 Budget

The following are the estimated costs for I.A. #10

Tasks	Personnel	Travel/Training	Total
Task #1	$ 90K	$ 30K	$120K
Task #2	$ 90K	$ 30K	$120K
Task #3	$150K	$ 30K	$180K

Task #4	$ 90K	$ 30K	$120K
Task #5	$ 20K	$ 10K	$ 30K
Task #6	$ 20K	$ 10K	$ 30K
Total	$460K	$140K	$600K

As stated in I.A. #10, funds available for the tasks, traveling and meeting expenses described in this Statement of Work will be US $600,000. All budget figures are estimates. Actual amounts will be accrued for purposes of fulfilling the financial arrangements described in the Implementing Arrangement, in accordance with the terms of the Agreement.

All programs within the Forecast Systems Laboratory use the same budget procedures, whether they are base-funded programs or externally-funded programs. Beginning in FY91, a facility charge has been applied to all programs to cover management and administrative costs as well as the use of the FSL facility and all associated equipment and data.

FSL staff time is charged at the employee's salary plus the normal NOAA benefit, leave, and overhead charges. FSL professional staff are primarily in the civil service grade scales of GS-11 to GS-14. Contract staff are in equivalent categories.

5.0 CWB Joint Team Assignments at FSL

Several tasks require CWB staff in residence at FSL. The primary effort of CWB staff at FSL during this period will be directed toward developing an operational forecast workstation, data assimilation techniques, the Web-based workstation, and radar data acquisition software.

Assignments for the CWB staff will be as follows:

- Development of the FX-Advanced system (one CWB staff)
- Development of 3DVAR software (one CWB staff)

- Development of Web-based workstation (one CWB staff)
- Development of the NEXRAD data acquisition (one CWB staff)