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Instrument Systems Analysis and Verification Facility (ISAVF) Users Guide

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Greenbelt, Maryland*

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Instrument Systems Branch

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PREFACE

This material is intended to be the basic users overview for the Instrument Systems Analysis and Verification Facility (ISAVF) currently starting operation by the Instrument Systems Branch. It is intended as an outline to give the user some basic background on their present or future instrument integration within the ISAVF facility.

The ISAVF facility is primarily an interconnected system of computers, special purpose real-time hardware, and associated generalized software systems, which will permit the Instrument System Analysts, Design Engineers and Instrument Scientists, to perform trade off studies, specification development, instrument modeling, and verification of the instrument, hardware performance. It is not the intent of the ISAVF to duplicate or replace existing special purpose facilities such as the Code 710 Optical Laboratories or the Code 750 Test and Evaluation facilities. The ISAVF will provide data acquisition and control services for these facilities, as needed, using remote computer stations attached to the main ISAVF computers via dedicated communication lines.

A minimal amount of special purpose stimuli and test equipment will be provided in the ISAVF to permit cost effective validation of instrument systems/subsystems.

Basically the ISAVF will be an easily reconfigurable combination of computers and their associated electronic interconnection and control equipment. The primary facility space, which has been acquired, is located in Building 11 (Code 720 VAX 11/780 computer facility) and in Building 20 (Code 725 VAX 11/750 and H/P 1000 computer facility and its associated instrument verification laboratory). These two facilities are interconnected with a 50 Mega-bit optical link for machine-to-machine communication. Computers are currently installed in these facilities which will perform the functions of central computation, instrument control and data acquisition. While these machines are not currently in the optimum configuration, they are certainly capable of supporting the initial facility development. We plan to augment the configuration of these computer systems as the need arises.

We are currently developing testing software systems for use in all Code 720 organizations and it is the intent of the ISAVF facility to be the focal point of Code 720's instrument integration, calibration and validation capabilities.

INSTRUMENT SYSTEMS ANALYSIS AND VERIFICATION FACILITY USERS GUIDE (ISAVF)

INTRODUCTION

The Instrument Systems Branch is charged with providing:

- Instrument system analysts and engineers as well as analytical task team discipline support to GSFC managed instruments.
- Leadership, coordination, and analytical support for the development of instrument system and subsystem design.
- Supporting instrument systems analyses, trade-off, and evaluation studies to aid in the development, monitoring, and verification of instrument systems.
- A focal point for design, development, validation, and delivery of instrument ground support equipment (IGSE) and bench test equipment (BTE) for use in instrument system design verification, calibration, and performance evaluation programs.
- Operation, planning, scheduling, and management of general purpose computer facilities to satisfy the digital computation, data handling, and display needs of the Instrument Division.
- Multidisciplinary research, development, and maintenance of advanced computational capabilities for accurate and efficient systems synthesis, analysis, and simulation of present and planned instruments.

This defines the Instrument Systems Analysis and Verification Facility (ISAVF) presently starting operation by the Instrument Systems Analysis Branch to support the charter outlined above. The purpose of the ISAVF facility is to provide a laboratory which can be used to perform both analytical studies and instrument performance validation.



ISAVF MISSION

The Instrument Systems Analysis and Verification Facilities Cadre (Systems Integration and Test Section) develops, maintains, and provides the Instrument Systems Analysis and Verification Facility (ISAVF) for the integration/test of selected flight instruments and for ground system component (such as detector arrays, control actuators, etc.) testing for the purpose of detailed performance characterization. Responsible for detailed planning for system integration and all test activities, including Instrument Ground Support Equipment (IGSE), in support of the branch's system engineering function. Also responsible for planning and executing, with support from other branch elements, the branch's program to develop advanced instrumentation techniques in the area of smart sensors, robotics, and automation.

ISAVF Facility/Personnel Requirement Assumptions

In order to accomplish the assigned mission statement for the ISAVF Facility, it is assumed that space flight instruments and subsystems of the following types must be capable of being handled within the section.

- Solid state detectors for scientific and application instruments - such as visible and infrared detectors, xray detectors, scintillating detectors, etc.
- Data collection, control and processing of electronic flight subsystems with data rates from 1Khz to 100 mhz.
- Electrical, optical and mechanical integration of flight instruments, either free flyer, Shuttle borne or for Space Station applications.
- Instrument ground support equipment to support the integration, testing and calibration of the above types of instrument systems and subsystems.
- Research facility support for computer applications and mechanisms for AI and space flight robotic systems.
- Quick turn around evaluation testing of contractor supplied subsystems.

In addition to the above areas of instrument technology, the ISAVF Cadre must provide the management, scheduling, development and maintenance of its support facilities. Also the Cadre must provide consultation and guidance in the development of integration, test and validation plans and procedures for flight instruments and for selected instrument perform the day-to-day instrument integration, testing and calibration.

ISAVF Facility Requirement

Support for the type of flight instruments indicated in the ISAVF mission will require facilities capable of providing support in the following areas:

- Optical bench and associated sources to characterize and calibrate visible, and infrared detector systems. This table could also be used to perform mechanism tests in a minimum vibration environment.
- IGSE development laboratory for fabrication and testing of IGSE. This area should double as a flight data subsystem test area.
- Clean room capable of handling a Shuttle class scientific or application instrument.
- Computer facilities to house the systems and the associated computer systems required to support IGSE, system integration, facility health and safety, and to provide computational support for the Branch and Division.
- Software and material storage areas.
- Section personnel office space.
- Work areas for visiting technical personnel during instrument integration.
- Data links to other testing areas on the Center and to development laboratories within the Division.
- Electronic, mechanical and optical test equipment to support flight instrument integration, testing and calibration.

ISAVF Personnel Requirements

For support to be provided in the areas given in the ISAVF Cadre mission statement the following types of technical talent must be maintained within the facility.

- Facility development, management, scheduling, operation and maintenance. (electronic engineer, physicist, electronic technician and mechanical technician, facility manager, computer systems manager(s)).
- Instrument ground support equipment development engineering (electronic engineer(s), physicist, electronic technician and mechanical technician, software development engineer).
- Instrument Integration and test (electronic engineer(s), physicist, electronic technician, mechanical technician, software engineer)
- AI and Robotics Research (electronic engineer, physicist, electronic technician, mechanical technician).

Present ISAVF Facilities

The present capabilities of the organization features are indicated in this section.

Overview

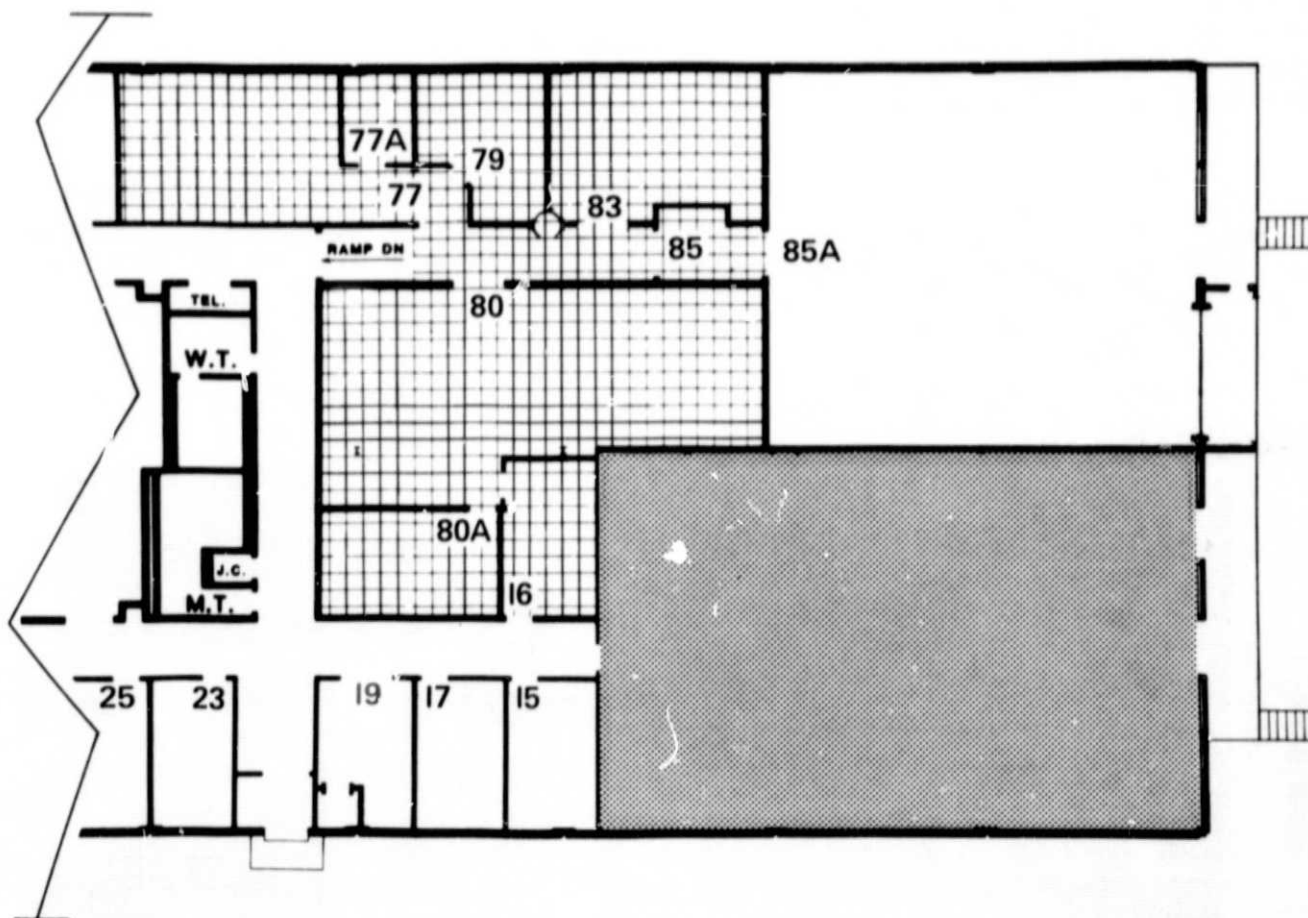
The facilities are collectively identified as the Instrument Systems Analysis and Verification Facility (ISAVF).

The key components of the ISAVF currently in place are:

- VAX 11/780 Computer Laboratory located in Building 11 Rooms S1, S1A and S3.
- Computer laboratory located in Building 20 Rooms 79, and 80 which contains VAX 11/750,

HP 1000 and associated personal computers and DEC LSi 11 work stations.

- Class 100,000 clean room for integration, testing and calibrating space flight instruments located in Building 20 Room 85 and 85A.
- Detector validation and characterization laboratory located in Building 20 Room 83.
- IGSE Development laboratory located in Building 20 Room 77/77A.
- Computer software library and associated archival storage room located in Building 20 Rooms 80A and 16.
- Personnel offices located in Building 20 Rooms 15, 17, 23 and 25.



Facility Capabilities

Data Collection and Control Computer Facility

Use: Central computation analysis and display, facility safety monitoring and Instrument Ground System Equipment (IGSE) control.

Features:

Computer Room (Rm. 80)

Area - (24' x 53' 6") with access doors of 6' x 6' 6".
Temperature and humidity control - (18-24 degrees C, 40-60% non-condensing Relative Humidity (RH) separately zoned.

Power - Three 225 Amp service cabinets of 208/120 Volt, 3 phase, 4 wire, isolated ground bus, 104 circuits, Emergency power shutoff, underfloor distribution, quiet electric ground.

Lighting - Zoned lighting control.

Floor - (2' x 2') Tile on a raised pedestal system.

Fire/Safety - In ceiling and under floor monitors to central zone. RP-1 rated exterior walls.

Communication - Telephone distribution for all data and voice transmission, fiber optic links to other computer

facilities, cable ducts/troughs to all areas of the ISAVF Facility.

Security - Cypher lock system for access control.

Data Analysis Lab (Room 16)

Use: See Data Collection and Control Computer Facility.

Features: Same as Computer Room (Rm 80) except as follows:

Area - (12' x 20'). Same as Computer Room.

Graphics Room (Room 79)

Use: See Data Collection and Control Computer Facility.

Features: Same as Computer Room (Rm 80) except as follows:

Area - (15' x 18')

Lighting - Dimmer Controls for ease of CRT monitoring. Same as computer room.



Computer Library (Rm. 80A)

Use: Central facility software and media storage.

Features: Same as Computer Room (Rm 80) except as follows:

Area - (14' x 23') under floor/above ceiling.

Fire - Complete room isolated from entire facility per

RP-1 specifications. Fire Dampers under floor/above ceiling.

Temperature/Humidity - (18-24 degrees C), 40-60% non-condensing RH.

Security - Cypher lock system coded separately from main facility for access control.



Instrument Subsystem Testing & Integration

Use: Subsystem validation, calibration and integration.

Features:

Electronics Laboratory (Rm. 77/77A)

Area - (17' 10" x 37' 6") with 6' x 6' 6" Access door.

Temperature/Humidity - (18-24 degree C), non-condensing RH, separately zoned.

Power - Two 100 Amp, service cabinets 208/120 Volt 3 ph., 4 wire isolated ground, 45 circuits, emergency power shutoff, underfloor distribution, quiet electrical ground.

Lighting - Zoned lighting control.

Floor - (2' x 2') tile on a raised pedestal system.

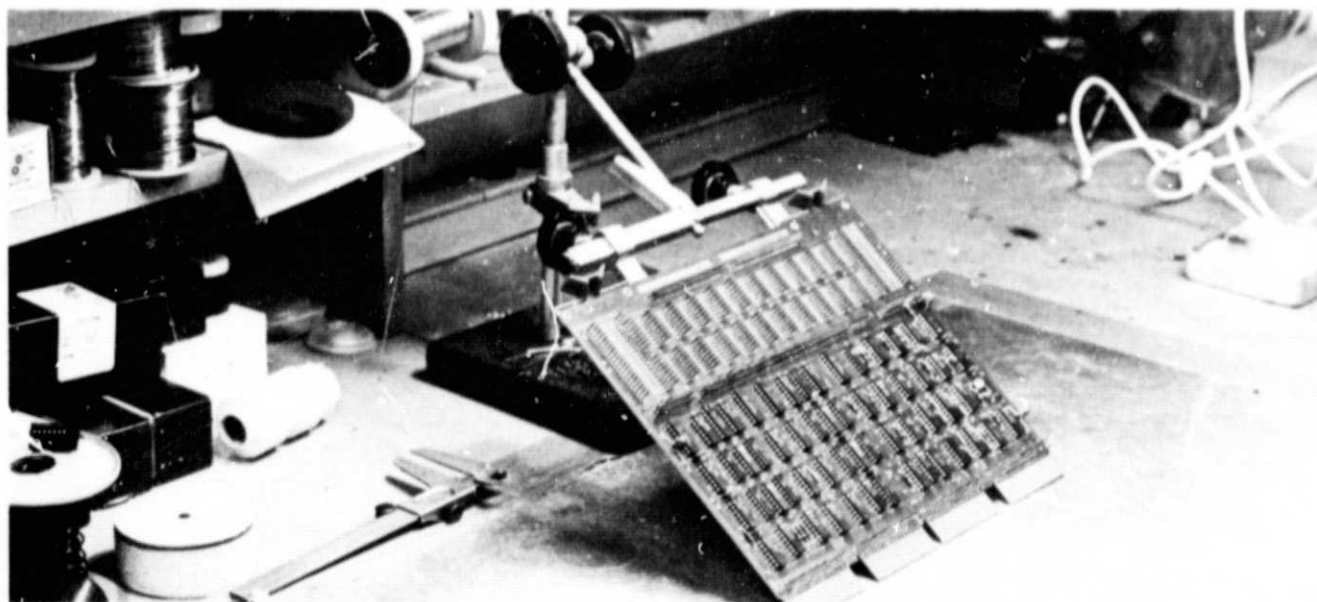
Fire/Safety - In ceiling and under floor monitors, to central zone, RP-1 exterior walls.

Communication - Fiber optic links to other facility areas, cable ducts/trough to other areas of the facility for data collection and control.

Security - Cypher lock system for limited access control.

Special Purpose:

Regulated air (20-50 lbs.) with dryer, Air tent for class 100,000 or 10,000 control, Portable lifting crane (1/2 ton).



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Detector Laboratory (Room 83)

Use: Detector system evaluation and integration

Features:

Area - (24' 11" x 17' 10" x 10') with equipment access door (6' x 6' 8"). Personnel access is accomplished by light tight revolving door.

Temperature/Humidity - (18-24 degree C), 40-60% non-condensing RH separately zoned with an electronic air cleaner for particle control.

Power - Two 100 Amp service cabinets 208/120 Volt 3 ph., 4 wire, with isolated ground bus, 45 circuits, emergency power shutoff, underfloor distribution, quiet electric ground.

Lighting - Zoned lighting control with dimmers & RFI Suppression.

Fire/Safety - In ceiling and under floor monitors to central zone.

Communication - Fiber optic links to other facility areas, cable duct/trough to other areas of the facility for data collection and control.

Security - Key lock on personnel revolving door for access control.

Special Purpose:

Optical table - (4' x 10') on air damped bags.

Vibration Isolator - Concrete slab isolated from main building structure (optical table rests on this slab).

Crane (1 Ton) - Electric hoist bridged structure with travel to each end of the room.

Air - Regulated (20-50 lbs.) with dryer.

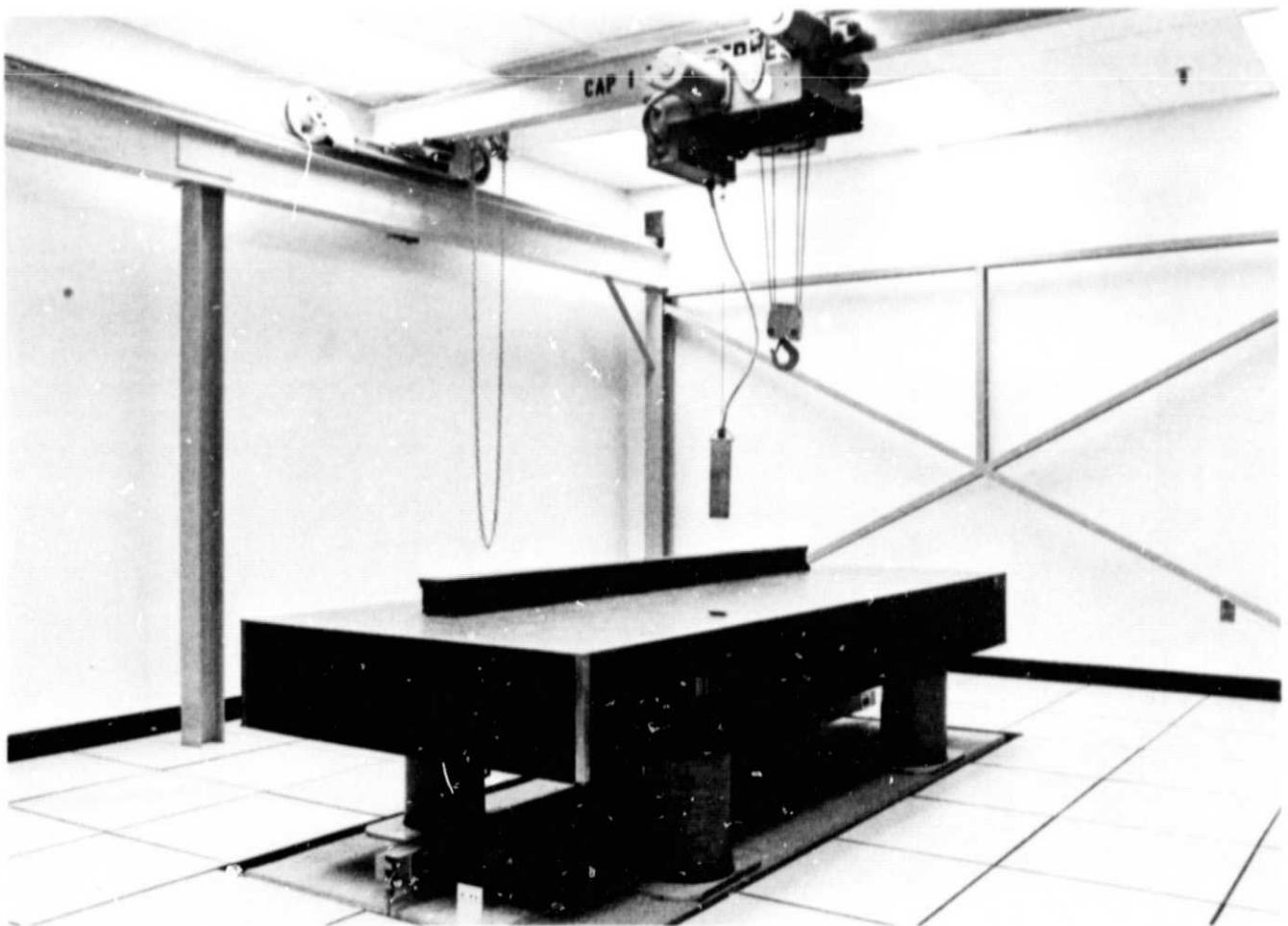
Dryer - Electric air dryer for compressed air for table air dampers.

Cooling Water - Regulated system for proper control of light sources.

Monitors - Temperature, pressure and humidity.

Cryogenic - Portable Dewars.

Air Tent - For class 10,000 or 1,000 (Future).



Instrument Integration and Validation Clean Room (Rm. 85/85A)

Use: Instrument system integration, calibration and validation.

Features:

Area - (45' x 51' x 16') with personnel access doors (6' x 6' 8"), A change room area (12' x 7'), and a truck lock (18' x 10') with double roll up doors for environmental control.

Temperature/Humidity - Two Liebert microprocessor controlled Liebert Air Handlers with HEPA filters. Temperature/humidity can be set into microprocessor for room control.

Power - Three 225 Amp service cabinets, 208/120 Volt 3 ph., 4 wire, isolated ground bus, 71 circuits, emergency power shutoff, wall mounted distribution, quiet electric ground.

Lighting - Zoned lighting control with RFI Suppression and a master off/on switch to aid instrument integration.

Fire Safety - On and above ceiling monitors to an independent zone monitor. Air Handler microprocessor interface to shut down air flow in the event of smoke/fire.

Communication - Fiber optic links to other facility areas, cable/duct troughs to other areas of the facility for data collection and control.

Security - Cypher lock system for access control and key lock systems on truck lock area to preclude environmental problems.

Special Purpose:

Crane (5 Ton) - Gantry type to support 5 tons but with a 3' air hoist to give maximum hook to hook height.

Vacuum System - portable units with HEPA filters.

Monitors - Internal to Liebert air handlers temperature and humidity. Pressure and contamination to be added.

Air Tent - For class 10,000 or 1,000 as required (Future).

Lighting - RFI shielded lights.

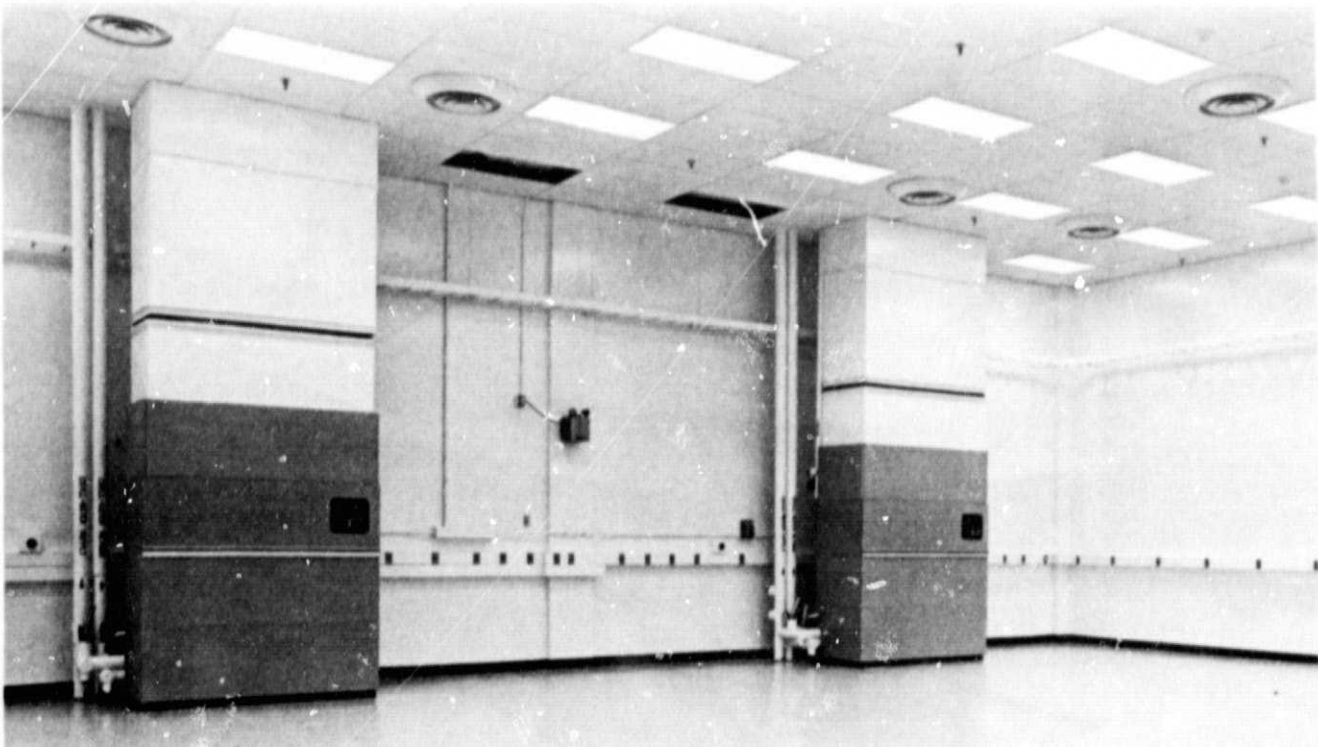
Cryogenic - Portable Dewars.

Compressed Gas - Bottle manifold exterior of room on loading platform. Covered roof for protection from elements.

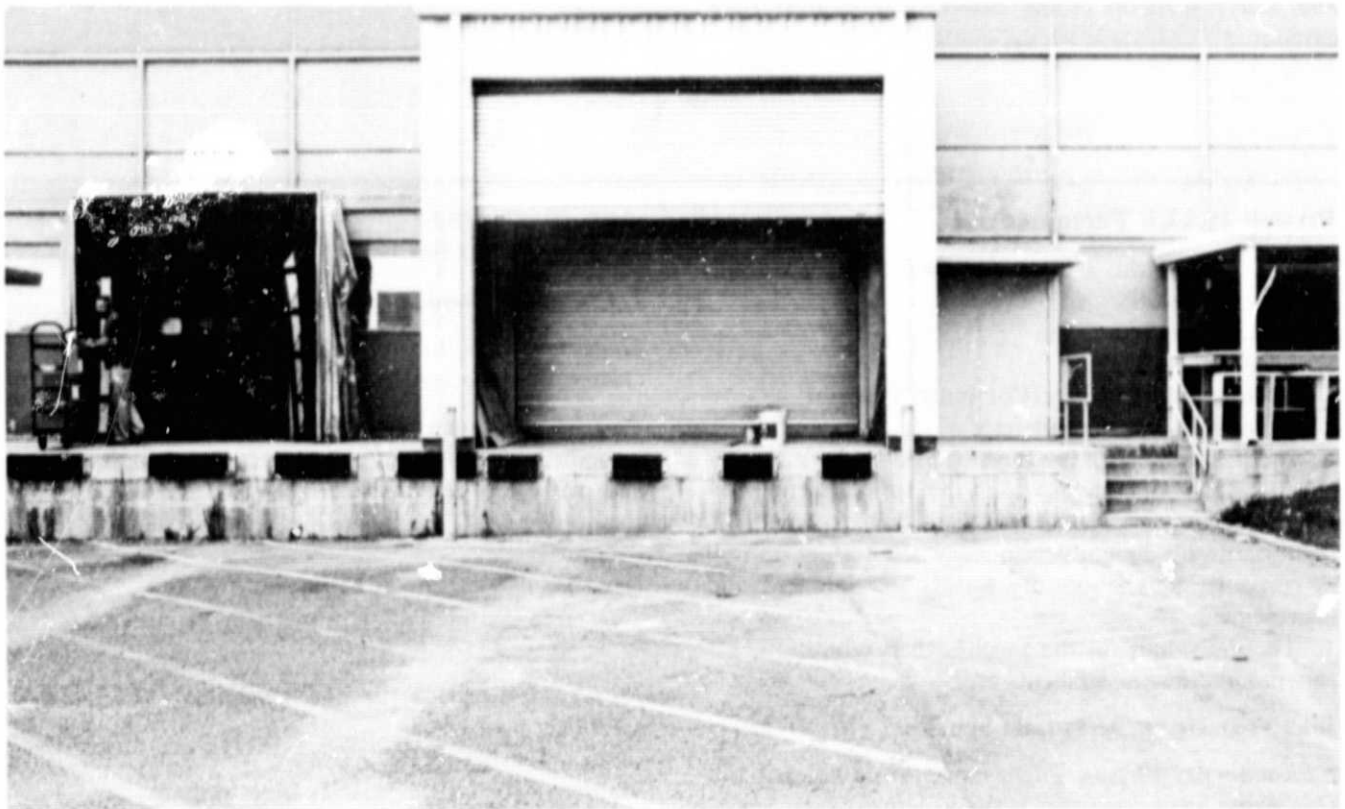
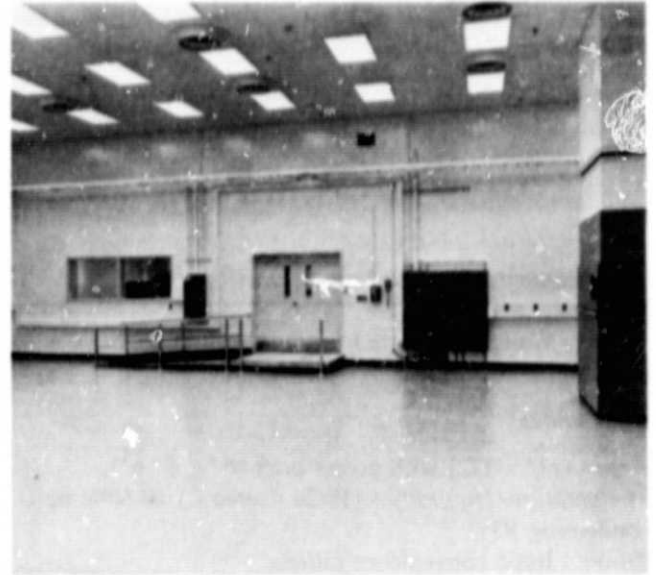
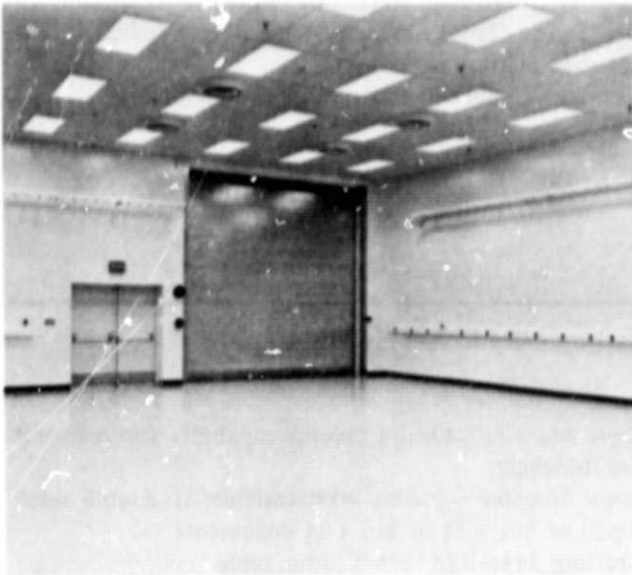
Cooling Water - Exists in ceiling, to be installed as required.

Air - Regulated (20-50 lbs.) with dryer.

Isolation Pad - (future)



Instrument Integration and Validation Clean Room (Rm. 85/85A) - Continued



Bonded Storage (2nd Floor - not shown)

Use: Limited access storage of critical flight hardware and test instruments.

Features:

Area - (43' x 24').

Temperature/Humidity - (18-24 degree C) 40-60% non-condensing RH.

Power - Basic convenience outlets.

Lighting - Overhead fluorescent lamps.

Fire/Safety - Smoke detectors on ceiling attached to central zone monitor.

Security - Cypher lock to limit personnel access.

Documentation/Drafting Room (Rm. 19)

Use: Well lighted area for drawing revision and copying (ozalid) capability.

Features:

Area - (13' x 17') with access door (6' x 6' 6").

Temperature/Humidity - (18-24 degree C) 40-60% non-condensing RH.

Power - Basic convenience outlets.

Lighting - Overhead fluorescent lamps.

Fire/Safety - In/on ceiling detectors to central zone monitor.

Security - Key locked main door.

Special Purpose:

Copy Machine - Ozalid process capability for A thru J size drawings.

Copy Machine - Xerox 4000 capable of double sided copies of 8½ x 11 or 8½ x 14 documents.

Drafting Table - (4' x 6') tilting table.

Files - 12 drawers of A thru F size filing capabilities.

Present ISAVF Personnel

The Staff of this Facility include the following skill mix and personnel:

1 Electronic Technician

1 Computer Scientist

1 Mechanical Engineer/Computer Specialist

4 Electrical Engineers

All of the engineers are cross trained in computer applications and software as well as their primary engineering training. This staff of individuals has experience in flight hardware design, development and testing, as well as computer and laboratory facility development and management.

The individuals in the facility, their education, experience and key assignments are:

John F. Davis AST, Data Systems

Education: BS Physics/Engineering, Washington & Lee University, 1955

Profile: 30 years experience in the development, installation, operation and scheduling of testing and qualification facilities in the areas of power systems, data systems, electro-optical systems and ground support equipment for

same. 20 years experience in computer systems management. (Currently day to day facility manager)

J. Cassandra Goodell AST, Data Systems

Education: BES John Hopkins University, 1980; MSE George Washington University, 1984

Profile: 5 years experience in instrument ground support equipment development and computer system hardware and software design. (Currently IGSE development engineer and I&T engineer COBE and BBXRT)

Gerard Kaiser AST, Flight Systems Test

Education: BS Engineering, Loyola College, 1984

Profile: Experience in the reliability and quality assurance field.

Maureen Mingarelli AST, Data Systems

Education: BSCS University of Tennessee, 1982

Profile: 5 years experience in development of software systems for instrument integration and testing and for data analysis. (Currently software analyst)

Reginald S. Mitchell AST, Data Analysis

Education: BSME George Washington University, 1965; MSE George Washington University, 1967

Profile: 13 years experience in scientific computing, including software design, production and testing, both batch and realtime applications. Extensive experience with the NASTRAN structural analysis program, including documentation review, program trouble shooting, maintenance and enhancement. 7 years experience with medium scale, multi-user, time shared computer system management and maintenance. (Currently VAX 11/780 system manager)

Dr. Hongwoo Park AST, Space Optics, Physicist

Education: BS and MS Physics, Seoul National University, 1965 and 1967; Ph.D. Physics, Johns Hopkins University

Profile: 12 years experience in optical instrumentation, radiometric calibration, instrument performance analysis, detector characterization, and satellite and rocket data analysis.

John Rogers AST, Integration and Test Manager

Education: BS Engineering, Northeastern University, 1960; MS Engineering, Catholic University, 1966

Profile: 25 years experience involved in testing and evaluation, advanced research for facilities development, advanced instrumentation for measurement of the environment of the facilities (i.e., solar simulator spectrum, vacuum, contamination monitoring) and project manager of aircraft flights for solar irradiance. Managed development of contamination monitor for flight of ATS-F, instrument engineer for missions on SMM (for instruments), concurrently instruments and test engineer for instruments, integration and test manager for major ST testing at GSFC and integration and test manager for EGRET.

John O. Thomason Electronics Technician

Education: Army Service School; CREI Extension Courses

Profile: 25 years in layout, fabrication, troubleshooting and testing ground support equipment and space flight data systems. (Currently mechanical/electronic/optical technician for facility)

John L. Wolfgang AST, Data Systems

Education: BSEE George Washington University, 1962; MSE George Washington University, 1967

Profile: 27 years experience in the design, development, integration and testing of space flight data systems and instruments. 20 years experience in facility planning, scheduling, operation, development and maintenance. 10 years experience in instrument systems engineering. 14 years supervisory experience in facility management, instrument development, integration and testing. (Currently Head of Section)

Lois G. Workman AST, Data Systems

Education: BSEE University of Tennessee, 1975

Profile: 10 years experience in the design, development, integration and testing of space flight data systems and associated ground support equipment. 8 years experience in instrument integration and testing. (Key technical experience areas are digital data systems design and testing). (Currently IGSE development and I&T engineer - COBE instruments)

Proposed ISAVF Facilities/Personnel Additions

In order to more effectively/efficiently support the mission of the ISAVF Facility the following additions or changes in the facility and personnel are anticipated.

ISAVF Facility Additions

The facility should not need major additions in the next fiscal year to support its mission. We will, however, need to provide additional test equipment and computational resource. We propose to handle short term requirements for equipment via an open ended equipment rental contract. This would permit the facility to handle short term usage requirements without expenditure of equivalent purchase costs for the test equipment.

In the next three to five years the facility will be improving its graphics and detector hardware.

ISAVF Personnel Additions

The facility is planning to add the following personnel to keep its staff adequately sized for the anticipated workload. The following are listed in order of priority.

1. A Mechanical/Optical Technician
2. Software Engineer
3. Electronic Engineer

ACKNOWLEDGEMENT

The authors would like to thank Maureen Mingarelli, Reg Mitchell, Cassandra Goodell and Lois Workman for their assistance in defining the requirements of facility to integrate, calibrate and validate instruments.

The authors of this document would appreciate your response to its content as it relates to the users interface to the Instrument Systems Analysis and Verification Facility (ISAVF). Please address your recommendations and suggestions to:

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