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SECTION E. ENVIRONMENTAL SCIENCES

3.0 Mission:

- Research and development in remote sensing physics leading to remote sensing systems for:
  - atmosphere, earth and celestial observations and data;
  - understanding environmental processes and their interactions.

- Research and development on astronomical and astrophysical reference frames, properties and processes for understanding and establishing environmental bounds limiting precise time and navigation.

- Research and development relating to novel sensors, materials, and data and signal processing technology for high spectral and spatial resolution studies of the earth, the atmosphere, the sun and celestial bodies.

- Research & development of numerical weather analysis and prediction systems for:

  - Study of atmospheric processes and interactions that impact naval operations on tactical to global scales;
  - Establishing operational prediction systems at Navy Meteorology and Oceanography Centers worldwide;
  - Developing capable shipboard atmospheric modules for tactical analysis and prediction.

- Development of automated weather modeling and interpretation systems for:

  - Studying and evaluating the impact of the atmosphere on weapon, sensor, and platform performance;
  - Creating atmospheric modules useful for mission planning decision aids aboard ship.

- Research and development to satisfy the requirements of the Project Reliance Joint Service Program Plan and the Navy-Air Force Cooperative Agreement (NAVAF) to:

  - Provide DoD leadership in atmospheric global and regional modeling and prediction;
  - Develop and implement DoD operational global weather analysis and prediction systems.

- Research and development on atmospheric, solar, and celestial processes for:

  - Providing physically realistic models of the space environment;
  - Providing global middle and upper atmospheric models for predicting communication disruptions;
  - Understanding and determining the interactions between space hardware and the environment (e.g. high energy radiation effects);
  - Understanding how targets modulate observable properties of the atmospheric and space environment.

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  - Understanding and determining the interactions between space hardware and the environment (e.g. high energy radiation effects);
  - Understanding how targets modulate observable properties of the atmospheric and space environment.

- Interconnectivity with other Common Support Functions

  - Atmospheric and space environment data and modeling and simulation modules are used by the Weapons development community. Most particularly for S&T demonstration and validation, engineering development and to support employment of cruise missiles, ICBMs/SLBMs and guided projectiles.

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E. ENVIRONMENTAL SCIENCES

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  - Understanding how targets modulate observable properties of the atmospheric and space environment.

- Interconnectivity with other Common Support Functions
  - Atmospheric and space environment data and modeling and simulation modules are used by the **Weapons** development community
  - Atmospheric and solar data management, fusion, modeling, and prediction are utilized to improve **C4I** capability.

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- Interconnectivity with other Common Support Functions

  - Atmospheric and space environment data and modeling and simulation modules are used by the **Weapons** development community. Most particularly for S&T demonstration and validation, engineering development and to support employment of cruise missiles, ICBMs/SLBMs and guided projectiles. R

  - Atmospheric and solar data management, fusion, modeling, and prediction are utilized to improve **C4I** capability. Most particularly for S&T demonstration and validation, engineering development and to support employment of airborne, fixed and mobile C4I systems related data fusion, decision aids, distributed information systems and forecast communications disruptions. R

  - Technology emerging from the space sensor development effort is used in **Space** hardware. Most particularly support S&T, demonstration and validation, engineering development and to support employment of satellites for space-based surveillance. R

  - Space radiation and modeling effort and the development of operational databases and validated algorithms are used to improve performance of **Space** hardware. Most particularly support S&T, demonstration and validation, engineering development and to support employment of satellites for surveillance and computer hardening affecting C4I. R

  - Develop atmospheric environmental modules for modeling and simulation capabilities to support **Training** of personnel. Most particularly support devices and simulators and computer aided intelligent tutoring systems. R

  - Upper and lower atmospheric and earth sensors and models detecting pollutants and other properties important in **Environment Quality.** Most particularly support technologies to identify hazardous materials, ensure DoD compliance and DoD stewardship (conservation) of natural resources. R

- Interconnectivity with other Navy-unique programs and/or multidisciplinary efforts.

  - Development of massively parallel implementation of atmospheric prediction systems in coordination with the NRL Connection Machine Facility. R

  - Development of innovative artificial intelligence applications for atmospheric data assimilation and interpretation in coordination with the Naval Center for Applied Research in Artificial Intelligence. R

  - Development of coupled air-ocean-ice analysis and prediction systems in coordination with the Navy Ocean Modeling Program and NRL Oceanography and Remote Sensing Divisions. R

  - Development of simulation and visualization tools for creation of synthetic environments in coordination with the DMSO program and the NRL Remote Sensing Division. R

  - Development of methodology for incorporating environmental effects into distributed interactive simulations in conjunction with NRL, Monterey. R

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- Atmospheric and solar data management, fusion, modeling, and prediction are utilized to improve **C4I** capability. Most particularly for S&T demonstration and validation, engineering development and to support employment of airborne, fixed and mobile C4I systems related data fusion, decision aids, distributed information systems and forecast communications disruptions.

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  - Development of simulation and visualization tools for creation of synthetic environments in coordination with the DMSO program and the NRL Remote Sensing Division.

  - Development of methodology for incorporating environmental effects into distributed interactive simulations in conjunction with NRL, Monterey.

  - Use of Navy Center for Space Technology for hardware development and environmental testing.

  - LITTORAL WARFARE MODELING - Existing algorithms and data bases developed for projects within Oceanography, Marine Geoscience, Sensor application, and Acoustics areas are being modified and adapted to modeling efforts being developed to support the Navy's shift in warfare interest from the deep water to the littoral warfare zone.

  - OCEAN OPTICS - Algorithms, data bases and experiments in Oceanography, Marine Geoscience, Sensor application, Optical Science, and Space Science are being utilized in the programs to investigate ocean optical properties, color and their associate impact upon Navy.

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- OCEAN OPTICS - Algorithms, data bases and experiments in Oceanography, Marine Geoscience, Sensor application, Optical Science, and Space Science are being utilized in the programs to investigate ocean optical properties, color and their associate impact upon Navy. R

- GLOBAL GRID - Remote Sensing Division has a program for the distribution, processing and utilization of environmental data and products in a high speed near real time manner to support fleet operations. These techniques are coordinated with the Optical Science group who is doing similar efforts in surveillance and the Space Systems group who is working the tactical communication link. R

- OPTICAL INTERFEROMETER - The ground based optical interferometer is investigating and demonstrating interferometric techniques and their application to such items as precise measurements and potential surveillance efforts. As such Remote Sensing Division works closely with the Space Systems and Spacecraft Engineering groups in investigating the feasibility of adapting this technology into space platforms. R

- RASTER J - This is a program to develop an airborne testbed for environmental measurements. As such the NRL flight detachment at Pax river provides air platforms in their P3's, interdisciplinary expertise and sensors developed for other programs in Chemistry, Plasma Physics, Optical Science and Condensed Matter are being applied to the detection problem. Experience, algorithms, and data bases from these groups are being combined with the expertise of the Information Technology Division to provide the synergistic fusion of data from such a platform for generation of an end product. R

- HYDRODYNAMICS - Expertise, data and experiments within the Oceanography, Marine Geoscience, Acoustics, Space Systems, and general sensor applications are being utilized in the Remote Sensing Division research efforts associated with hydrodynamics and its potential impact upon Navy operations. R

3.1 Location

3.1.1 Geographic/Climatological Features:

Maryland Point Observatory
Maryland Point Observatory is situated in southern Maryland in an area which is relatively radio quiet for millimeter-wave radioastronomy. Millimeter waves travel line-of-sight so that its location, just over the horizon from major interference sources and in a heavily wooded area, is effectively shielded.

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- GLOBAL GRID - RSD has a program for the distribution, processing and utilization of environmental data and products in a high speed near real time manner to support fleet operations. These techniques are coordinated with the Optical Science group who is doing similar efforts in surveillance and the Space Systems group who is working the tactical communication link.

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Chesapeake Bay Detachment (CBD)
The location of CBD is ideal for environmental studies of coastal estuary processes and, because of the high cliffs and frequent ship and air traffic, an ideal test site for R & D on advanced LIDAR technologies.

Monterey, CA
NRL Marine Meteorology Division is located in Monterey, CA. The variability of atmospheric conditions around Monterey Bay have made it a useful site for field R&D efforts. For example, Monterey Bay has been selected as the site for a number of upcoming marine environment field experiments, including the Monterey Area Ship Track (MAST) experiment, and the Real-time Environmental Integrated Analysis System (REINA) experiment.

3.1.2 Licenses & permits:

NONE

3.1.3 Environmental constraints:

NONE

3.1.4 Special Support Infrastructure:

Washington, DC
As NRL's principal site the Environmental Sciences community can draw upon the infrastructure developed by the entire NRL community located in DC which includes items such as: massively parallel supercomputer, fiber optic data links, and a wide array of scientific and technical capabilities and services. The site's location in the DC area is an aid in hiring and retaining internationally recognized professional scientists and engineers.

Monterey, CA
Monterey is rapidly becoming a center of environmental research, due to substantial programs at the Naval Postgraduate School (NPS), Fleet Numerical Meteorology and Oceanography Center (FNMOC), the Monterey Bay Aquarium, several nearby academic institutions, and plans by NOAA to collocate its Western Regional Forecast Center and new Coastal Ocean Modelling Program in a building adjacent to NRL. This clustering enhances recruitment and retention of scientific personnel, and encourages a variety of environmental related professional activities. In addition, the NRL environmental community has access to the FNMOC supercomputer, high speed communication lines, data sources and bases, and the general infrastructure support of FNMOC and the NPS (NRL-MRY is tenant of NPS).

3.1.5. Proximity to Mission-Related organizations:

Common Support Functions	Name	Type of Organization	Distance	Workyears Performed by Your Activity	Workyears Funded by Your Activity
Environ. Sci (MRY)	FNMOC	Operational Weather & Ocean Prediction	0	4.6	0
Environ. Sci (DC)	USNO	Research Facility	10	2	0

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- Technology emerging from the space sensor development effort is used in **Space** hardware.
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- Develop atmospheric environmental modules for modeling and simulation capabilities to support **Training** of personnel.
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Environ. Sci (DC)	Air Force Space	Operational	40	4	0
Environ. Sci (MRY)	NOAA OAB & Forecast Office	Operational Weather Prediction & Data Distribution	0	.5	0
Environ. Sci (DC)	CBD	Test Area	25	2	0

Washington, DC
NRL D.C. is in close proximity to Navy, DoD and other agency (e.g. NOAA, Mineral Management Service, etc.) operational headquarters. This proximity to operational activities/facilities (e.g. USNO, FNMOC) and to facilities with special environmental characteristic, and/or capabilities (e.g. CBD and Air Force Space) adds a benefit to the S&T effort.

Monterey, CA
NRL Monterey is co-located with Fleet Numerical Meteorology and Oceanography Center (FNMOC) and the NOAA Oceans Application Branch (COAB). This collocation provides NRL with access to state-of-the-art mainframe computer and operational global telecommunications feeding the world's most comprehensive ocean and atmosphere operational data base. FNMOC provides the target operational infrastructure for global and regional numerical weather prediction systems developed at NRL and transitioned to FNMOC for operational use. FNMOC data bases provide a comprehensive global data environment for NRL's development of data quality control and data fusion systems, as well as the investigation of atmospheric processes that impact military operations on global to regional scales. The data collection and distribution infrastructure allows NRL to provide real-time data analysis and prediction in support of R&D field experiments.

3.2 Personnel:

3.2.1 Total Personnel:

	Number of Personnel			
Types of personnel	Government		On-Site FFRDC	On-Site SETA
Environmental Sciences	Civilian	Military	0	
Technical	182	8	0	126
Management (Supv)	38	1	0	0
Other	5	0	0	0

3.2.2 Education:

Type of	Number of Government Personnel by Type of Position		
Degree/ Diploma	Technical	Management (Supv)	Other
High School or Less	26	0	3
Associates	2	0	0
Bachelor	26	2	1
Masters	40	6	1

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Environ. Sci (DC)	USNO	Research Facility	10	2	0
Environ. Sci (DC)	Air Force Space	Operational	40	4	0
Environ. Sci (MRY)	NOAA OAB & Forecast Office	Operational Weather Prediction & Data Distribution	0	.5	0
Environ. Sci (DC)	CBD	Test Area	25	2	0

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Doctorate (include Med/Vet/etc.)	96	31	0

3.2.3 Experience:

	Years of Government and/or Military Service				
Type of Position	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	39	53	32	17	49
Management (Supv)	1	4	5	5	24
Total	40	57	37	22	73

* This Table does not include 5 persons listed as "Other" in Table 3.2.1.

3.2.4 Accomplishments During FY91-93:

3.2.4.1 Number of Patents:

CSF	Disclosures	Awarded	Patent Titles (List)
Environmental Sciences	7	3	See Attachment A

3.2.4.2 Number of Papers:

CSF	Number Published	Paper Titles (List)
Environmental Sciences	385	See Attachment A

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3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle:

"LAB"	Fiscal Year 1993 Actual			
Environ. Sci	Civilian	Military	FFRDC	SETA
Science & Technology	204	8	0	126
Engineering Development	0	0	0	0
In-Service Engineering	0	0	0	0

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Doctorate (include Med/Vet/etc.)	96	31	0

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3.2.4.2 Number of Papers:

CSF	Number Published	Paper Titles (List)
Environmental Sciences	412	See Attachment A

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle:

"LAB"	Fiscal Year 1993 Actual			
Environ. Sci	Civilian	Military	FFRDC	SETA
Science & Technology	204	8	0	126
Engineering Development	0	0	0	0
In-Service Engineering	0	0	0	0

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3.2 Personnel

3.2.1 Total Personnel.

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
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Technical	182	8	0	126
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Management (Supv)	1	4	5	5	24
Total	40	57	37	22	73

* This Table does not include 5 persons listed as "Other" in Table 3.2.1.

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3.3.1.2 Engineering Development By ACAT:

NONE

3.3.1.3 In-Service Engineering:

NONE

3.3.2 Projected Funding

3.3.2.1 Direct Funding:

NONE

3.3.2.2 Other Obligation Authority:

CSF	FY94	FY95	FY96	FY97
Environ. Sci.	71.1M	70.9M	72.0M	73.3M

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities:

The percentage of shared usage is indicated with each facilities description. R

Common Support Function	Major Facility or Equipment Description	DOD	Federal Gov't	U.S.	Replacement Cost ($K)
Environmental Sciences	Background Data Center	X			16,464
	Scene Generation Facility	X			21,337
	ARGOS (under development)			X	14,000
	RAIDS			X	10,000
	MAHRSI (under development)			X	8,128
	SSULI (under development)			X	17,000
	OSSE			X	56,767
	SUSIM			X	31,300
	LASCO (Under development)			X	42,061
	BCS			X	2,000
	HRTS			X	13,000
	Mechanical Design and Fabrication Facility				700
	UV Sensor Calibration Facility	X			1,000
	Information Processing and Visualization Facility				1,970
	Clean Rooms				225
	Ultraclean Mirror Test Facility			X	2,300
	Plastic Track Etching and Analysis Facility			X	414

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3.2.4 Accomplishments During FY91-93

3.2.4.1 Number of Patents

CSF	Disclosures	Awarded	Patent Titles (List)
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3.2.4.2 Number of Papers

CSF	Number Published	Paper Titles (List)
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3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle

"LAB"	Fiscal Year 1993 Actual			
Environ. Sci	**Civilian**	**Military**	**FFRDC**	**SETA**
Science & Technology	204	8	0	126
Engineering Development	0	0	0	0
In-Service Engineering	0	0	0	0

3.3.1.2 Engineering Development By ACAT. NONE

3.3.1.3 In-Service Engineering. NONE

3.3.2 Projected Funding

3.3.2.1 Direct Funding. NONE

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	Radiation Sensor Development Facility	X			1,300
	Visualization Center				700
	RIRA				250
	Data Networking				2800
	Laser Facilities	X			1000
	MARV	X			175
	Towed Sensor System-Surface Tension	X			80
	Towed Sensor System-Density	X			150
	Towed Sensor System-Velocity	X			100
	Mark III Optical Interferometer	X			5000
	Navy Prototype Optical Interferometer	X			20,000 (estimate) still in construction
	Millimeter Wave Radiometry	X			1000
	Water Vapor Millimeter-wave Spectrometer		X		600 (each,all systems2.6M)
	Millimeter-wave Atmospheric Sounder		X		2000 (total system 15M)
	Littoral Remote Sensing Modeling & Simulation System	X			500
	Airship Suspended Platform	X			750
	Windwave Channels		X		800
	Maryland Point		X		3000
	Polar Ozone & Aerosol Monitor		X		5000
	VLBI Correlator (Joint with USNO)	X			1500
	Multi-Sensor Suite for P3 Aircraft	X			1500
	TESS(3) Laboratory	X			405
	Visualization Lab	X			810
	GOES Antenna				270
	Computer Facility		X		2160
	DIPL				1175

Background Data Center: The Center has expertise for terrestrial and celestial background phenomenology and provides the science and engineering communities with data archival, management and analysis services for using and preserving both classified and unclassified data from rocket and satellite collection programs, especially as they relate to missile defense. Specialized and standard software packages are available to users for accessing, selecting and analyzing data. A bulletin board is available. A variety of work stations are available for users. The Center was established and is operated under DoD/BMDO directive # 3240.

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3.3.2.2 Other Obligation Authority.

CSF	FY94	FY95	FY96	FY97
Environ. Sci.	71.1M	70.9M	72.0M	73.3M

3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities.

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	Clean Rooms				225
	Ultraclean Mirror Test Facility			X	2,300
	Plastic Track Etching and Analysis Facility			X	414
	Radiation Sensor Development Facility	X			1,300
	Visualization Center				700
	RIRA				250
	Data Networking				2800
	Laser Facilities	X			1000
	MARV	X			175
	Towed Sensor System-Surface Tension	X			80
	Towed Sensor System-Density	X			150
	Towed Sensor System-Velocity	X			100
	Mark III Optical Interferometer	X			5000

	Navy Prototype Optical Interferometer	X			20,000 (estimate) still in construction
	Millimeter Wave Radiometry	X			1000
	Water Vapor Millimeter-wave Spectrometer		X		600 (each,all systems2.6M)
	Millimeter-wave Atmospheric Sounder		X		2000 (total system 15M)
	Littoral Remote Sensing Modeling & Simulation System	X			500
	Airship Suspended Platform	X			750
	Windwave Channels		X		800
	Maryland Point		X		3000
	Polar Ozone & Aerosol Monitor		X		5000
	VLBI Correlator (Joint with USNO)	X			1500
	Multi-Sensor Suite for P3 Aircraft	X			1500
	TESS(3) Laboratory	X			405
	Visualization Lab	X			810
	GOES Antenna				270
	Computer Facility		X		2160
	DIPL				1175

Background Data Center: The Center has expertise for terrestrial and celestial background phenomenology and provides the science and engineering communities with data archival, management and analysis services for using and preserving both classified and unclassified data from rocket and satellite collection programs, especially as they relate to missile defense. Specialized and standard software packages are available to users for accessing, selecting and analyzing data. A bulletin board is available. A variety of work stations are available for users. The Center was established and is operated under DoD/BMDO directive # 3240.

No other facility exists within DoD to collect and distribute data relating to natural and artificial backgrounds of direct interest to the DoD missile defense community.

Scene Generation Facility: Using the Strategic Scene Generation Module (SSGM) and other tools, radiometric scenes can be generated for missile defense scenarios that are used for digital simulations, hardware demonstrations and validation and system design. Scenes comprise sensor-perspective radiance maps derived from government standard models and authenticated data bases and are generated on high performance, parallel processing workstations. The SSGM is distributed to users for use on a local workstation and is being upgraded and supported by NRL with BMDO support on an ongoing basis.

No other capability exists within DoD for generating high fidelity, radiometric scenes routinely for ballistic missile engagements using government standard codes and validated data bases.

ARGOS (under development): ARGOS is a 6000 pound spacecraft under development by the Air Force Space Test Program. The NRL developed instruments on

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The Scene Generation Facility works hand in hand with the Background Data Center where it uses and develops common data bases for the purpose of verification, validation, and understanding phenomenology. 100% on this CSF. R

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There will be no other instruments like these available in the world for scientific investigation when they begin their space observations in low earth orbit during calendar 1996. 100% on this CSF. R

RAIDS (Remote Atmospheric and Ionospheric Diagnostic Spectrometer): The RAIDS instrument is awaiting launch on an Air Force satellite. The instrument is an observatory with seven independent spectrometers that will conduct UV measurements of the upper atmosphere for the purpose of establishing the basis for global modeling of the ionosphere. Joint ground-space observations will be conducted in order to validate and extend the data set. Data will be available to scientist for analysis from NRL's Background Data Center.

The RAIDS data will represent a unique data set in the world not available from any other instruments carrying out space observations. 100% on this CSF. R

MAHRSI (Middle Atmosphere High Resolution Spectrometer Instrument) (under development): MAHRSI is under development at NRL for flight on an instrumented pallet launched from the space shuttle for five days operation in space. The pallet is recovered by the shuttle for reflight. Two flights are not scheduled; the first one during Fall, 1995. The instrument is a high resolution visible-UV spectrometer that will record trace molecules in the middle atmosphere essential to obtain information on the chemistry and dynamics of the region. Data will be available for analysis through NRL's Background Data Center.

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SSULI (Special Sensor, Ultraviolet Limb Imaging) (under development): SSULI is a limb scanning spectrometer being provided to the Defense Meteorological Satellite Program that will provide the information for generating global models of the ionospheric electron density. Five instruments are being developed for flight on successive satellites. A facility and personnel will be sited at NRL for reducing and analyzing mission data. Data will be archived and distributed using the facilities of the Background Data Center.

The flight of these instruments and the corresponding algorithm development and data analysis will be the first time that DoD will apply the principal of UV limb scanning to develop global models of ionospheric parameters. In addition the data base developed from the observations will be unique. 100% on this CSF. R

OSSE (Oriented Scintillation Spectrometer Experiment): OSSE is a gamma ray spectrometer measuring radiation in the 50 KeV to 10 MeV energy range from the sun, astronomical and natural emitters. It is part of NASA's Gamma Ray Observatory and has been operating in space since April 1991. Data can be used to determine total flux, emission processes and chemical abundances in observed objects. Observations of solar flares are of special interest.

The instrument is the most sensitive of its kind ever to have been developed and flown in space for these purposes. No other significant capability exists elsewhere in the world to make these observations. 100% on this CSF. R

SUSIM (Solar Ultraviolet Spectral Radiance Monitor): SUSIM provides for high accuracy measurements of solar UV radiation between 110 and 410 nm with moderate spectral resolution allowing for the determination of short-term and long-term variability of the radiation and its correlation with atmospheric and geophysical effects. The instrument has been operating in space as part of NASA's Upper Atmospheric Research Satellite (UARS). A second version of the instrument flies yearly on the space shuttle for calibration purposes.

This instrument is the most accurate and best calibrated of its kind ever developed. It is the only one in the world that is capable of these measurements. The data are supplied to NOAA's Geophysical Data Center for use by the scientific community. 100% on this CSF. R

BCS (Bragg Crystal Spectrometer): The instrument consists of 4 curved crystal spectrometer covering the narrow x-ray wavelength ranges that allow high spectral resolution measurements of common elements presents in the hot plasmas occurring solar flares. BCS is part of the instrument complement on the Japanese solar observatory, Yohkoh, that has operating in space since August 1991. Scientists at NRL have available all the data from the mission for analysis, not just those from the BCS, including full disk x-ray images. Analysis software and workstations are available for users.

There is no other instrument like BCS operating in orbit available in the world at the present time. 100% on this CSF. R

LASCO (Large Area Solar Coronagraph) (Under development): The instrument consists of three independent coronagraphs and a high resolution coronal spectrometer in a common instrument that is being prepared for the joint NASA-ESA mission, Solar and Heliospheric Observatory (SOHO), for flight in 1995. SOHO will be placed at an earth-moon liberation point and will continuously observe the sun. Measurements will be made of the sun's corona from about 1.1 to 40 solar radii, along with correlated spectral measurements that will allow

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No other space-based coronagraph will be available during 1995 and following years. The instrument will be the most sensitive of its kind ever flown and the first coronagraph that will utilize CCD imaging detectors.

HRTS (High Resolution Telescope Spectrometer): HRTS is a rocket-borne high resolution imaging spectrometer with sub arcsecond spatial resolution for observing the solar atmosphere. It has also flown on the space shuttle. It provides fundamental information of basic physical processes in sunspots, active regions, filaments and other fine solar structures. It has been used as a test bed to perform specific observations of high interest to the solar physics community, usually in conjunction with other space and ground based observations.

No other instrument of this capability exists in the world for performing observations of solar phenomena from above the earth's atmosphere.

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UV Sensor Calibration Facility: The facility is utilized by NRL personnel for the calibration of rocket and satellite instrument in the UV and soft x-ray spectral ranges. Facilities include a number of UV sources of radiation extending to the soft x-ray range and vacuum systems to allow both imaging and spectroscopic calibrations. Certain of the vacuum chamber are colocated with clean room facilities to allow their use with space instruments with high cleanliness requirements.

No where else in DoD is there available the array of calibration facilities for space instruments. 100% on this CSF. R

Information Processing and Visualization Facility: This facility provides the technical and administrative staff the capability to process scientific data, control experimental hardware and facilities, develop new technical capabilities, implement MIS functions and provide routine administrative support. The facility comprises several networks of computers that themselves are networked to allow total communicability. Computers include VAX mainframes, PCs and high-end workstations. 100% on this CSF. R

Clean Rooms: Assembly of space hardware and other specialized equipment that have extreme requirements for being free of dust and other contaminants are carried out in these facilities. Six different clean rooms exist in the Division, ranging in capability from Class 10 to 10,000. These facilities contain specialized equipment to assist the staff in the assembly and test of space hardware. 100% on this CSF. R

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There is no other facility in the DoD that provides for such capability for space optical systems, specifically the high rejection of scattered light. 100% on this CSF.

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Radiation Sensor Development Facility: Several laboratory areas are set aside to provide for the development of special purposes imaging and spectroscopic sensors to be used with space experiments. Instruments sensitive in the range from optical through gamma rays and including particles can be developed in these facilities. Specific developments ongoing at the present time include the use of Josephson junctions at liquid He temperature for x-ray detection, the development of diamond as a photodiode array and the germanium strips as gamma ray detectors. Auxiliary equipment available to researchers include radiation sources, vacuum systems for space simulation and clean rooms for assembly. 100% on this CSF. R

Visualization Center: The Remote Sensing Visualization Center is a Silcon Graphics Computing System. This center analyzes and processes remotely sensed and modeled data associated with scientific and technical thrusts in the environmental science area. The system is not unique, only its application. 100% on this CSF. R

RIRA: The Radio Infrared Astrometry System is an alliance computer that supports research analysis associated with astrometric research and analysis. The hardware can be replaced with general purpose equipment necessitating only software conversion. 100% on this CSF. R

Data Networking: The Remote Sensing Division Data Networking system consists of computer work stations, communication nets, data storage and retrieval systems, and individual PC systems. These systems are networked together to support research functions. 100% on this CSF. R

Laser Facilities: Several Laser systems are utilized in research functions associated with aerosol measurements (air/sea interface), altimetry, and non-acoustic ASW. Shown is the laser test site at the Chesapeake Bay Site. These systems have been developed for specific research and are unique in their application. 90% on this CSF, and 10% for Environmental Quality CSF. R

Mobile Autonomous Research Vehicle: This vessel is a self-propelled research platform (24' x 8') for measurement of near-surface and surface oceanographic variables of relevance to the remote sensing problem. Sensors on the forward instrument mount are: a Ku-band scatterometer, video wave imagers, and a wide-angle video camera. On the forward deck is a surface tension

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Radiation Sensor Development Facility: Several laboratory areas are set aside to provide for the development of special purposes imaging and spectroscopic sensors to be used with space experiments. Instruments sensitive in the range from optical through gamma rays and including particles can be developed in these facilities. Specific developments ongoing at the present time include the use of Josephson junctions at liquid He temperature for x-ray detection, the development of diamond as a photodiode array and the germanium strips as gamma ray detectors. Auxiliary equipment available to researchers include radiation sources, vacuum systems for space simulation and clean rooms for assembly. 100% on this CSF.

Visualization Center: The Remote Sensing Visualization Center is a Silcon Graphics Computing System. This center analyzes and processes remotely sensed and modeled data associated with scientific and technical thrusts in the environmental science area. The system is n unique, only its application. 100% on this CSF.

RIRA: The Radio Infrared Astrometry System is an alliance computer that supports research analysis associated with astrometric research and analysis. The hardware can be replaced with general purpose equipment necessitating only software conversion. 100% on this CSF.

Data Networking: The Remote Sensing Division Data Networking system consists of compute work stations, communication nets, data storage and retrieval systems, and individual PC system These systems are networked together to support research functions. 100% on this CSF.

Laser Facilities: Several Laser systems are utilized in research functions associated with aeros measurements (air/sea interface), altimetry, and non-acoustic ASW. Shown is the laser test site a the Chesapeake Bay Site. These systems have been developed for specific research and are uniqu in their application.

Mobile Autonomous Research Vehicle: This vessel is a self-propelled research platform (24' x 8') for measurement of near-surface and surface oceanographic variables of relevance to th remote sensing problem. Sensors on the forward instrument mount are: a Ku-band scatteromete video wave imagers, and a wide-angle video camera. On the forward deck is a surface tension measuring system and wave slope gauge. Meteorological sensors are mounted on the mast. Navigation instrumentation, AC/DC power sources, and a depth profiler are included.

This platform is being used in conjunction with the Radar Division (Code 5300) and has been use in ASW research. Facility is shared approximately 50% of the time with Navy unique efforts.

Towed Sensor System - Surface Tension: This system measures the ocean surface tensic well away from the contaminating influence of the ship's wake. Surface tension variations reflect modulations in the concentration of surface active (slick-forming) chemicals which in turn reflect underlying ongoing processes. Resolution is better than 1m, and no other system exists to give this measurement with such high spatial resolution.

This system has been used in the ONR (6.1-6.2) Ship Wake Detection Program, the U.S.-U.K

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TOWED Sensor System - Surface Tension: This system measures the ocean surface tension well away from the contaminating influence of the ship's wake. Results are used to interpret and model remotely sensed data fields. The system is specialized and unique in its application.

TOWED Sensor System - Density: This towed sensor system is used to obtain the temperature and salinity in the uppermost 10m of the ocean well away from the contaminating influence of the ship's wake. The system consists of a tow cable, an otter/depressor, and a temperature/salinity sensor array suspended from a surface float. These data are used in support of modeling and experiments in remote sensing realizations. The system is unique as to design, function and application.

TOWED Sensor System - Velocity: This system consists of a broad band acoustic doppler current profiler deployed in a specially designed body which sails off to the side of the ship to obtain velocity profiles in the upper lOOm of the ocean for use in modeling and experiments of remotely sensed fields. The system is unique as to design, function and application.

MARK III OPtical Interferometer:

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This system has been or will be used to interpret synthetic, real aperture, and interferometric radar images for in-house and cooperative university and NASA programs. 50% on this CSF, and 50% for Space CSF. R

MARK III Optical Interferometer: FUNCTIONS: Makes very high angular resolution optical observations of stars for astrometry and astrophysics. High resolution measurement of stellar positions provides essential data for earth rotation and celestial reference frame determinations. These measurements are required by the U. S. Naval Observatory to meet its unique, Congressionally mandated function to provide precise navigation, time, and time interval information. In addition, such position data provides basic astrophysical data; e.g., for binary stars, it enables determination of stellar masses. It was built as a prototype to demonstrate the basic concepts later implemented in the Navy Prototype Optical Interferometer. 100% on this CSF. R

DESCRIPTION: The Mark III Optical Interferometer is the most advanced Michelson interferometer operating in the world today. It combines light from pairs of telescopes spaced over baselines from 3 to 31 m. The visible light from these telescopes is combined in a central optics laboratory, where interference fringes are detected and tracked. The facility can determine stellar positions with an accuracy as fine as 10 milliarcseconds (mas), more than 50 times better than normal ground based telescopes (and better than the Hubble Space Telescope). Built to test some

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INSTRUMENTATION: The facility includes 5 telescopes of 10" diameter that can be used two at a time. Two delay lines (movable mirrors on a cart within an evacuated tube) are used to equalize the path length from the source through the telescopes. Three computers are used to control the operation of the system.

LOCATION: Mount Wilson, CA

Navy Prototype Optical Interferometer:

FUNCTIONS: Makes very high angular resolution optical observations of stars for astrometry and astrophysics. High resolution measurement of stellar positions provides essential data for earth

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LOCATION: Anderson Mesa Flagstaff, AZ

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FUNCTIONS: Makes very high angular resolution optical observations of stars for astrometry and astrophysics. High resolution measurement of stellar positions provides essential data for earth rotation and celestial reference frame determinations; such position data for binary stars enables determination of stellar masses. High resolution imaging of stellar surfaces and near-surface structures provides basic data on stellar structure and activity.

DESCRIPTION: The NPOI facility is a joint project with the U. S. Naval Observatory and Lowell University, and is currently under construction on Anderson Mesa, outside Flagstaff, AZ. When complete, it will consist of 4 fixed and 6 portable telescopes. The visible (450-800 nm) light from these telescopes is combined in a central optics laboratory, where interference fringes are detected and tracked. The facility can be operated in two modes. In the astrometric mode, the interference fringe positions from the 4 fixed telescopes are used to determine stellar positions with an accuracy of 1 to 3 milliarcseconds (mas). In the imaging mode, the fringe contrast and phase data from the 6 movable telescopes are used to build up an image of stellar surfaces. In its initial configuration, with telescope separations up to 60 m, it should be capable of detecting 1 mas structures; enhancements over the next few years (including baselines as long as 470m) should increase the resolution to 0.1 mas.

INSTRUMENTATION: In addition to the telescopes, the facility is equipped with delay lines (movable mirrors on carts within evacuated tubes) that are used to equalize the path length from the source through the telescopes to the point of beam combination. The delays can be moved at speeds of up to 1 cm/sec with position errors < 10 nm (rms). The beams are combined with unique optical assemblies that enable simultaneous observation of several pairs of baselines (telescope separations). The facility uses 3-, 4-, and 6-way beam combiners. Precise astrometry also requires a complex laser metrology system, using 50 laser path-length measurements, to monitor the positions of the telescopes and delay lines during

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LOCATION: Anderson Mesa, Flagstaff, AZ

Multimeter Wave Radiometer: The Special Sensor Microwave Imager (SSM/I) is a multichannel passive microwave radiometer that supports the joint Air Force/Navy/Army Defense Meterological Satellite Program (DMSP) in providing critical atmospheric, oceanographic and land

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Airship Suspended Platform: The airship suspended platform (ASP) is a unique instrument platform designed to be suspended from an airship for near surface measurements over ocean or land. Over the ocean undisturbed measurements of wind speed, wind stress and air-sea interactions and standard oceanographic and meteorological parameters can be made within the marine boundary layer from the ASP. The ASP dimensions are 8.4 m in length, 1.4 m high, and 2.5 m wide. When empty, it weighs 135 kg and can carry up to 230 kg of equipment. It is aerodynamically designed for stability and for minimum air flow distortion. The ASP was custom designed and built by AeroVironment Inc.

The ASP has been used for two major field experiments in 1992 and 1993 for the Air-Sea

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LOCATION: Anderson Mesa Flagstaff, AZ

Millimeter Wave Radiometry: The Special Sensor Microwave Imager prototype is a test unit to support analysis and research for the sensor which is operationally deployed on the Defense Meteorological Satellite. The system is a millimeter wave radiometer and associated test equipment. It is usually utilized on a P3 research aircraft or on an access tower. Fixtures and antenna mounts for these applications are not shown. The system is unique.

Water Vapor Millimeter-Wave Spectrometer: The Water Vapor Millimeter-wave Spectrometer (WVMS) project uses ground based radiometry to measure the 22.2 GHz water vapor transition in the middle atmosphere (40-70 km). The radiometers are a key element in the international Network for Stratospheric Change (NDSC) and as such are used as a check on space-based measurements. At present the radiometers are operating in Table Mountain, California and at the NDSC site in Lauder, New Zealand. The instruments are operated remotely from the Naval Research Laboratory, where the data is analyzed daily. The measurements are unique in that they provide the first nearly continuous record of water vapor in the middle atmosphere from a fixed site.

A third sensor is under construction. A similar sensor to measure Ozone is also under construction.

Millimeter-Wave Atmospheric Sounder: The Millimeter-wave Atmospheric Sounder (MAS) is an integral part of NRL's space-based research in support of SERDP. MAS is designed to study the formation and destruction of Ozone by measuring emission lines of Ozone, Water Vapor, and Chlorine Monoxide from the Space Shuttle. During an 8-day shuttle flight, MAS scans the limb of the Earth to produce maps of the global distribution of these trace molecules as a function of altitude. MAS, which first flew in March 1992 and had a second flight in April 1993, is scheduled to fly once a year to provide a database for the study of changes in the middle atmosphere.
The replacement cost for NRL's part of the MAS space hardware is $2M. Total system cost includes elements built by European co-investigators and ground support equipment is $15M.

Littoral Remote Sensing Modeling & Simulation System: The Littoral Modeling And Simulation System (LRS-MASS) is an integrated software system for Non Acoustic Surface Effects (NASE) simulations of the ocean environment. The integrated system has been designed according to industry standards and its development and implementation satisfies specific Navy requirements. The system includes a large number of software components that have been developed during the last fifteen years under Navy R & D funds. Most of the existing software components of the integrated system have been developed independently of each other and this is the first time that such an integration effort has been attempted successfully. The major modeling blocks of the integrated system are shown in the attached diagram and each of these blocks represents the area of physics that it is modeled within the system. Each of the modeling blocks is composed of the required software components necessary to perform the corresponding simulations for that block.

parameters on a global scale. NRL has conducted the calibration/validation of each of the SSM/I instruments for the DMSP and supports the development of new satellite microwave sensors such as the advanced Special Sensor Microwave Imager/Sounder (SSMIS) to fly on the DMSP satellites in late 1996. NRL will conduct a calibration/validation of this sensor as well by underflying the SSMIS with a prototype aircraft SSM/I instrument. The SSM/I provides unique capability to DoD in Numerical Weather Prediction forecast modeling as well as to the deployment of troops and trafficability information to the armed forces such as in Desert Storm. NRL was instrumental in the design, development, performance testing and validation of the SSM/I. 50% on this CSF, and 50% for Space CSF. R

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The ASP has been used for two major field experiments in 1992 and 1993 for the Air-Sea Interactions Program conducted by NRL, ONR and the University of Washington Applied Physics Laboratory.

Since the ASP is a near ideal platform for monitoring forms of pollution and certain nuclear wastes it is under consideration for use by the EPA and DOE.

The airship itself as a remote sensing platform has also been used for two major field experiments in 1992 and 1993 for the NRL, ONR and SPAWAR programs for Transformation Dynamics of Marine Aerosols and for MAST (Monterrey Area Ship Tracks). 100% on this CSF. R

Windwave Channels [Tanks]: The NRL Remote Sensing Division (Code 7200) operates two wave-wind channels which are housed in a high-bay laboratory in Building A59. These channels and the laboratory in which they are housed were constructed between 1977 and 1982. Both channels are 30m in length and are equipped with hydraulically-actuated surface wave generators and fan-driven wind generators which can produce waves under varying conditions of wind velocity and fetch. One channel is 1.1m depth x 1.2m width, and the other is 0.5m depth x 2.4m width. Both wind channels extend 0.5m in height above the water surface. This laboratory is unique because of the high bay which allows the deployment of a variety of radar sensors at distances well above the water surface with a minimum of interference from the surroundings.

The hydraulically-actuated wave generators permit the generation of complex unsteady wave packets under computer control. This capability is especially useful in focusing the wave energy at a prescribed location in the channel in order to study the fluid dynamics of wave breaking and the related radar scattering mechanisms under precisely controlled conditions. A typical sequence of breaking waves with increasing intensities is shown in the accompanying set of video frame images. The waves range vary in intensity from a symmetric, round wave that is not breaking, to an incipient breaker, and to a fully plunging or overturning breaker. When wind is blown over the water surface, the changes in the mechanisms of breaking due to the presence of the wind can be studied with great precision. The laboratory is equipped with a full suite of wave measuring probes, wind flow measuring anemometers, and radar probes to support experiments such as these. Several computers and workstations are available for data acquisition and analysis.

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In addition to fundamental wind-wave research the laboratory has been used for the development and testing of instrumentation and as a staging area for numerous field experiments.

Both collaborative and independent research have been conducted using the NRL WindWave tanks by a) the Johns Hopkins University/Applied Physics Laboratory for wave structure and radar backscattering from the ocean surface and b) the Massachusetts Institute of Technology, Department of Ocean Engineering for fluid dynamics research. Facility is shared approximately 50% of the time with Navy unique efforts.

Maryland Point Radio Observatory:

FUNCTIONS: Measures the environmental background radiation at frequencies from 100 MHz to 50 GHz to determine its direction, spatial structure, spectral characteristics, and intensity. Supports VLBI measurements of radio source positions. These radio source studies are essential elements of celestial reference frame determination, and provide data on interstellar propagation characteristics; they thus provide essential data required by the U. S. Naval Observatory to meet its unique, Congressionally mandated function to provide precise navigation, time, and time interval information. In providing the capability for long-term monitoring of sources, Maryland Point contributes to astronomical investigations of national and international scope; e.g., it has recently been used to search for changes in Jupiter's radio emission resulting from the impact of Comet

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The simulation capabilities of the integrated system include man-made and natural ocean signatures and their imaging by radar and optical sensors. End-to-End simulations can be performed by providing the required geometry and the required environmental and sensor parameters. The simulations are performed within the NASE computer facility where a number of high powered workstations are networked to provided not only for simulation runs but also for software configuration management and for data processing.

The integrated software system meets two major Navy needs. The first is application specific in support of remote sensing projects including experiment design and data analysis. The second is information specific in understanding and assessing existing simulation capabilities and providing guidance for future research.

Airship Suspended Platform: The airship suspended platform (ASP) is a unique instrument platform designed to be suspended from an airship for near surface measurements over ocean or land. The ASP dimensions are 8.4 m in length, 1.4m high, and 2.5 m wide. When empty, it weighs 135 kg and can carry up 230 kg of equipment. It is aerodynamically designed for stability and for minimum air flow distortion. The ASP was custom designed and built by AeroVironment Inc., and has been used for two major field experiments conducted by NRL, ONR, and the University of Washington in 1992 and 1993.

Windwave Channels: The NRL Remote Sensing Division (Code 7200) operates two wave-wind channels which are housed in a high-bay laboratory in Building A59. These channels and the laboratory in which they are housed were constructed between 1977 and 1982. Both channels are 30m in length and are equipped with hydraulically-actuated surface wave generators and fan-driven wind generators which can produce waves under varying conditions of wind velocity and fetch. One channel is 1. lm depth x 1 .2m width, and the other is 0.5m depth x 2.4m width. Both wind channels extend 0.5m in height above the water surface. This laboratory is unique because of the high bay which allows the deployment of a variety of radar sensors at distances well above the water surface with a minimum of interference from the surroundings.

The hydraulically-actuated wave generators permit the generation of complex unsteady wave packets under computer control. This capability is especially useful in focusing the wave energy at a prescribed location in the channel in order to study the fluid dynamics of wave breaking and the related radar scattering mechanisms under precisely controlled conditions. A typical sequence of breaking waves with increasing intensities is shown in the accompanying set of video frame images. The waves range vary in intensity from a symmetric, round wave that is not breaking, to an incipient breaker, and to a fully plunging or overturning breaker. When wind is blown over the water surface, the changes in the mechanisms of breaking due the presence of the wind can be studied with great precision. The laboratory is equipped with a full suite of wave measuring probes, wind flow measuring anemometers, and radar probes to support experiments such as these. Several computers and workstations are available for data acquisition and analysis.

The laboratory has been used also for the development and testing of instrumentation, and as a staging area for numerous field experiments.

Maryland Point Radio Observatory: The facility includes two fully steerable parabolic antennas. The 84 ft telescope is usable to a frequency of approximately 3 GHz; the 85 ft telescope can be used at frequencies as high as 50 GHz. The 85 ft antenna is equipped with a wide range of electronics, including cryogenic receivers for observations at the standard radio astronomy continuum frequencies of 2.7, 5, and 8.1 GHz, and spectral line frequencies of 1.8 GHz and 22 GHz. Spectral line observations are supported with a filter bank spectrometer.

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In addition to fundamental wind-wave research the laboratory has been used for the development and testing of instrumentation and as a staging area for numerous field experiments.

Both collaborative and independent research have been conducted using the NRL WindWave tanks by a) the Johns Hopkins University/Applied Physics Laboratory for wave structure and radar backscattering from the ocean surface and b) the Massachusetts Institute of Technology, Department of Ocean Engineering for fluid dynamics research. 50% on this CSF, and 50% for Space CSF. R

Maryland Point Radio Observatory:

FUNCTIONS: Measures the environmental background radiation at frequencies from 100 MHz to 50 GHz to determine its direction, spatial structure, spectral characteristics, and intensity. Supports VLBI measurements of radio source positions. These radio source studies are essential elements of celestial reference frame determination, and provide data on interstellar propagation characteristics; they thus provide essential data required by the U. S. Naval Observatory to meet its unique, Congressionally mandated function to provide precise navigation, time, and time interval information. In providing the capability for long-term monitoring of sources, Maryland Point contributes to astronomical investigations of national and international scope; e.g., it has recently been used to search for changes in Jupiter's radio emission resulting from the impact of Comet Shoemaker-Levy 9, as part of an international observation program. 100% on this CSF. R

DESCRIPTION: The Maryland Point Observatory is the closest radio facility with is adequately shielded from the high-interference environment of the Washington DC metropolitan area. It provides the capability of long-term observations of both continuum and spectral line radiation, and has made particular contribution as part of the international Very Long Baseline Interferometry network, leading to the establishment of a celestial radio reference frame for use in earth rotation and other geodetic studies. It also provides a test bed for the development of space instrumentation. R

INSTRUMENTATION: The facility includes two fully steerable parabolic antennas. The 84 ft telescope is usable to a frequency of approximately 3 GHz; the 85 ft telescope can be used at frequencies as high as 50 GHz. The 85 ft is equipped with a wide range of electronics, including cryogenic receivers for observations at the standard radio astronomy continuum frequencies of 2.7, 5, and 8.1 GHz, and spectral line frequencies of 1.8 GHz (OH) and 22 GHz (H_2O). Spectral line observations are supported with a filter bank spectrometer. The tracking capabilities allow observations at the sidereal rate and observations of Earth-orbiting satellites in high altitude orbits. The pointing accuracy of the 85 ft telescope is particularly good: approximately 6 arcseconds, which corresponds to 10% of the beamwidth at 50 GHz. The 85 ft telescope is computer controlled for fully automated operation. High speed recording equipment is available to record data for subsequent analysis for very high-frequency variations or for cross-correlation with data from other telescopes (VLBI). R

LOCATION: Maryland Point, MD.

Polar Ozone & Aerosol Monitor (POAM): (supplement) In addition to NRL, the University of Colorado, the Embry-Riddle Aeronautical University, NASA Goddard Space Flight Center, the Johns Hopkins University, the Harvard University, the Laboratory of Atmospheric Optics at the University of Lille (France), and the Service d'Aeronomie of the French Centre

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Shoemaker-Levy 9, as part of an international observation program. 100% on this CSF.

DESCRIPTION: The Maryland Point Observatory is the closest radio facility with is adequately shielded from the high-interference environment of the Washington DC metropolitan area. It provides the capability of long-term observations of both continuum and spectral line radiation, and has made particular contribution as part of the international Very Long Baseline Interferometry network, leading to the establishment of a celestial radio reference frame for use in earth rotation and other geodetic studies. It also provides a test bed for the development of space instrumentation.

INSTRUMENTATION: The facility includes two fully steerable parabolic antennas. The 84 ft telescope is usable to a frequency of approximately 3 GHz; the 85 ft telescope can be used at frequencies as high as 50 GHz. The 85 ft is equipped with a wide range of electronics, including cryogenic receivers for observations at the standard radio astronomy continuum frequencies of 2.7, 5, and 8.1 GHz, and spectral line frequencies of 1.8 GHz (OH) and 22 GHz (H_2O). Spectral line observations are supported with a filter bank spectrometer. The tracking capabilities allow observations at the sidereal rate and observations of Earth-orbiting satellites in high altitude orbits. The pointing accuracy of the 85 ft telescope is particularly good: approximately 6 arcseconds, which corresponds to 10% of the beamwidth at 50 GHz. The 85 ft telescope is computer controlled for fully automated operation. High speed recording equipment is available to record data for subsequent analysis for very high-frequency variations or for cross-correlation with data from other telescopes (VLBI).

LOCATION: Maryland Point, MD.

Polar Ozone & Aerosol Monitor (POAM): (supplement) In addition to NRL, the University of Colorado, the Embry-Riddle Aeronautical University, NASA Goddard Space Flight Center, the Johns Hopkins University, the Harvard University, the Laboratory of Atmospheric Optics at the University of Lille (France), and the Service d'Aeronomie of the French Centre Nationale de Recherche Scientifique are using the data for scientific objectives during the validation period ending on 30 Sept 94. Starting 1 Oct 94, validated POAM data will be archived at the Ballistic Missile Defense Organization Background Data Center located at the Naval Research Laboratory. Air Force and NOAA will join Navy in using the real time data for improving weather forecasts at Fleet Numerical Oceanographic Center, the Air Force Weather Forecasting facilities and at NOAA's National Meteorological Center for satisfying operational forecasting requirements on weather and space communication. Currently POAM data is being used to gather information on this year's Antarctic ozone hole; the data help determine, on a day-to-day basis, where the aircraft should sample for scientific purposes. 100% on this CSF.

Washington VLBI Correlator:

FUNCTIONS: Provides rapid turnaround correlation of geodetic VLBI data in support of USNO requirements for precision earth rotation determination, NOAA and NASA requirements for geodetic data, and NRL programs on radio/optical reference frames. It is in constant use to provide data to the GPS system, and thus is an essential element in all services' use of precise navigation data. In addition, the VLBI measurements provide positional data that are required by the U. S. Naval Observatory to meet its unique, Congressionally mandated function to provide precise navigation, time, and time interval information. 100% on this CSF.

DESCRIPTION: The Washington VLBI Correlator is a joint facility of the NRL, USNO, NOAA, and NASA, for processing geodetic Very Long Baseline Interferometry (VLBI) data. This $1.5M facility has been used since August 1986 for basic research, to determine the structure and precise positions of celestial objects, and to determine the earth's rotation rate with respect to them. The measurements are also used to determine shifts in station locations that indicate the motions of continental plates and variations in the deep structure of the earth. The fundamental reference frame determined by NRL and NASA scientists using this facility is now used by operational Navy.

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Polar Ozone & Aerosol Monitor (POAM): Polar Ozone and Aerosol Monitor (POAM) is a spaceborne sensor. This sensor has two major components: Optical Head Assembly (OHA) and Primary Control Electronic Module (PCEM). POAM sensor supports the Space Common Support Function and the Environmental Sciences Common Support Function equally at 50% each. POAM sensor is unique to DoD in its ability to provide, using solar occultation technique, global profiling measurements with 1 km vertical resolution of aerosols, nitrogen dioxide, oxygen (temperature can be inferred), ozone, and water vapor in the earth stratosphere (10 to 60 km). These measurements are required by IR search and track, VLF and ULF communications, global climate research and ozone depletion monitoring. POAM sensor is also unique to the federal government and the United States, and the world as well by its ability to monitor ozone depletion at a very low cost. The replacement cost of POAM sensor alone without including spacecraft, launch, and operation costs is $5,000,000.

VLBI Correlator: The Washington Correlator is a joint facility of the NRL, USNO, NOAA, and NASA for processing geodetic Very Long Baseline Interferometry (VLBI) data. It is located at the U.S. Naval Observatory headquarters. This $1.5M facility has been used since August 1986 for basic research, to determine the structure and precise positions of celestial objects and to determine the earth's rotation rate with respect to them. The fundamental reference frame determined by NRL and NASA scientists using this facility is now used by the operational agencies.

Multi-Sensor Suite For P3 Aircraft: A suite of remote sensing instruments for measurement of open ocean and coastal features operates from P3 research aircraft. Individual sensors include microwave and millimeter-wave real aperature radars, passive millimeter-wave radiometers, microwave and LIDAR altimeter and IR thermal measurement sensors. A multispectral camera can also be integrated. The suite is used for measurements in conjunction with airborne and space SAR experiments such as the recent Shuttle Radar Laboratory.
Estimated replacement value of hardware is $1500K.

Tactical Environmental Support System Laboratory: The Tactical Environmental Support System (TESS) laboratory adapts minicomputer technology for shipboard environmental applications such as ingest and display of satellite data, management of environmental databases, interfacing with NAVY communications network, and dissemination of environmental products to warfare spaces and to other ships/platforms.

No other facility exists within DoD that readily adapts microcomputer technology to the shipboard analysis and assimilation of environmental data.

Visualization Laboratory: The scientific data visualization laboratory provides opportunities for satellite researchers to perform multi-channel image manipulation tasks, modelers to perform graphical model diagnoses, and decision aid developers to access the atmospheric impact on the tactical systems. The NRL Monterey's visualization facility is linked to the existing computing facility for the following applications: the analysis of atmospheric processes and simulations, development of visualization methods for the existing Naval systems, and development of advanced methodologies for incorporating atmospheric effects into war game simulations and platform simulators.

No other Laboratory within DoD provides atmospheric visualization capabilities and atmospheric simulation standards for Navy training and wargaming.

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Nationale de Recherche Scientifique are using the data for scientific objectives during the validation period ending on 30 Sept 94. Starting 1 Oct 94, validated POAM data will be archived at the Ballistic Missile Defense Organization Background Data Center located at the Naval Research Laboratory. Air Force and NOAA will join Navy in using the real time data for improving weather forecasts at Fleet Numerical Oceanographic Center, the Air Force Weather Forecasting facilities and at NOAA's National Meteorological Center for satisfying operational forecasting requirements on weather and space communication. Currently POAM data is being used to gather information on this year's Antarctic ozone hole; the data help determine, on a day-to-day basis, where the aircraft should sample for scientific purposes. 100% on this CSF. R

Washington VLBI Correlator:

FUNCTIONS: Provides rapid turnaround correlation of geodetic VLBI data in support of USNO requirements for precision earth rotation determination, NOAA and NASA requirements for geodetic data, and NRL programs on radio/optical reference frames. It is in constant use to provide data to the GPS system, and thus is an essential element in all services' use of precise navigation data. In addition, the VLBI measurements provide positional data that are required by the U. S. Naval Observatory to meet its unique, Congressionally mandated function to provide precise navigation, time, and time interval information. 100% on this CSF. R

DESCRIPTION: The Washington VLBI Correlator is a joint facility of the NRL, USNO, NOAA, and NASA, for processing geodetic Very Long Baseline Interferometry (VLBI) data. This $1.5M facility has been used since August 1986 for basic research, to determine the structure and precise positions of celestial objects, and to determine the earth's rotation rate with respect to them. The measurements are also used to determine shifts in station locations that indicate the motions of continental plates and variations in the deep structure of the earth. The fundamental reference frame determined by NRL and NASA scientists using this facility is now used by operational Navy.

INSTRUMENTATION: The facility is a customized computer, incorporating high-speed, high-density multiple tape readers and specialized electronics for data synchronization.

LOCATION: U. S. Naval Observatory, Washington, DC

Multi-sensor Suite for P-3 Aircraft: A suite of remote sensing instruments for the measurement of open ocean and coastal features operates from P-3 aircraft. Individual sensors include microwave and millimeter-wave real aperture radars, passive millimeter-wave radiometers, microwave and laser altimeters and IR temperature sensors. A multispectral camera and a hyperspectral visual and IR sensor have also been integrated.

The suite is used for measurements in conjunction with airborne and spaceborne synthetic aperture radar (SAR) experiments such as the recent Shuttle Radar Laboratory (SIR-C/X-SAR). This multisensory suite has been used as a major component of the NRL and ONR multi-sensor High Resolution Remote Sensing program which investigates the submesoscale structure of the air-sea environment. It has also been used for OSD and NRL programs in Microwave Surveillance of the ocean. NRL, jointly with the Department of Energy, has used the multisensory suite for the RASTER-J program [Rapid-response Airborne Sensor Testbed for Environmental Research] to demonstrate such capabilities as a rapid response system to natural and man-made disasters. 50% on this CSF, and 50% for Environmental Quality CSF. R

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INSTRUMENTATION: The facility is a customized computer, incorporating high-speed, high-density multiple tape readers and specialized electronics for data synchronization.

LOCATION: U. S. Naval Observatory, Washington, DC

Multi-sensor Suite for P-3 Aircraft: A suite of remote sensing instruments for the measurement of open ocean and coastal features operates from P-3 aircraft. Individual sensors include microwave and millimeter-wave real aperture radars, passive millimeter-wave radiometers, microwave and laser altimeters and IR temperature sensors. A multispectral camera and a hyperspectral visual and IR sensor have also been integrated.

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Tactical Environmental Support System Laboratory: The Tactical Environmental Support System (TESS) laboratory supports minicomputer technology for shipboard environmental applications such as ingest and display of satellite data, management of environmental databases, interfacing with DoD communications network, and dissemination of environmental products to warfare spaces and to other ships/platforms. The equipment necessary to complete such tasks are displayed in Figures 1 through 5 and include both the original Engineering Developmental Model (#2) and proposed upgrades for future expansion.

No other facility exists within DoD that readily adapts microcomputer technology to the analysis and assimilation of environmental data for the development of tactical decision aids that are used to predict the effects of the atmosphere on weapons systems, platforms, and tactics. Facility is shared approximately 50% of the time with Navy unique efforts.

Computer Facilities: The facility retrieves global observations, numerical weather prediction model, and satellite data from Fleet Numerical Meteorology and Oceanography Center (FNMOC) and other data processing centers daily and prepares data sets for various research projects. The center has an on-line primary and secondary disk system at the capacity of 100 Gigabytes. Other than the computing power it provides, this facility has a METOC data management system which provides data management, user interface, and data archival functions.

The computer facility is unique to the Federal Government in that no other facility can provide its research staff with access to state-of-the-art mainframe computer and operational global telecommunications as well as instantaneous access to worldwide data. Facility is shared approximately 50% of the time with Navy unique efforts.

Visualization Laboratory: The facility provides opportunities for satellite researchers to perform multi-channel image manipulation tasks, modelers to perform graphical model diagnoses, and decision aid developers to access the atmospheric impact on the tactical systems. The visualization facility is linked to the existing computing facility for the following applications: the analysis of atmospheric processes and simulations, development of visualization methods for existing systems, and development of advanced methodologies for incorporating atmospheric effects into war game simulations and platform simulators.

No other Laboratory within DoD provides atmospheric visualization capabilities and atmospheric

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GOES Antenna: GOES (Geostationary Earth Orbiting Satellite) System: The NRL Marine Meteorology Division is working jointly with FNMOC to establish a Geostationary Earth Orbiting Satellite receiving system. A memorandum of agreement is currently being developed whereby the two facilities will exercise joint and uniform control over both antennas and satellite imaging workstations.

The GOES system will collect and distribute remotely sensed data to various global operational forecast models and assorted research projects unlike any other system in the world.

Computer Facilities: The NRL Marine Meteorology Division Computing Facility including data retrieval system and visualization laboratory. The facility retrieves global observations, numerical weather prediction model, and satellite data from Fleet Numerical Meteorology and Oceanography Center (FNMOC) and other data processing centers daily and prepares data sets for various research projects. The center has an on-line primary and secondary disk system at the capacity of 100 Gigabytes. Other than the computing power it provides, this facility has a METOC data management system which provides data management, user interface, and data archival functions.

The computer facility is unique to the Federal Government in that no other facility can provide its research staff with access to state-of-the-art mainframe computer and operational global telecommunications as well as instantaneous access to worldwide data.

Digital Image Processing Laboratory (DIPL): A central image processing facility (DIPL) provides the Naval Research Laboratory (NRL) with a powerful software/hardware complex for the support of various ongoing programs. The laboratory conducts research in computer-aided image enhancement, image interpretation, and image presentation. It also provides image processing services to various DoD organizations on a special need basis.

The computer room has its own environment control system and it contains about 20 racks of electronic equipment. Central processors include a Sun 4/420, a Sun Sparc 1, a Sun 3/260 (with VICOM image processing station) and a Data General MV/8000 Computer. Additional specialized equipment includes an Optronics Color Writer film recorder. Replacement cost is approximately 1175K.

The capabilities of the DIPL span four basic areas of image processing and image interpretation:

- Image Digitization
- Digital Image Processing
- Digital Image and Graphic Output
- Imaging Radar Processing

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Tactical Environmental Support System Laboratory: The Tactical Environmental Support System (TESS) laboratory supports minicomputer technology for shipboard environmental applications such as ingest and display of satellite data, management of environmental databases, interfacing with DoD communications network, and dissemination of environmental products to warfare spaces and to other ships/platforms. The equipment necessary to complete such tasks are displayed in Figures 1 through 5 and include both the original Engineering Developmental Model (#2) and proposed upgrades for future expansion.

No other facility exists within DoD that readily adapts microcomputer technology to the analysis and assimilation of environmental data for the development of tactical decision aids that are used to predict the effects of the atmosphere on weapons systems, platforms, and tactics. 50% on this CSF, and 50% on Weapons CSF. R

Computer Facilities: The facility retrieves global observations, numerical weather prediction model, and satellite data from Fleet Numerical Meteorology and Oceanography Center (FNMOC) and other data processing centers daily and prepares data sets for various research projects. The center has an on-line primary and secondary disk system at the capacity of 100 Gigabytes. Other than the computing power it provides, this facility has a METOC data management system which provides data management, user interface, and data archival functions.

The computer facility is unique to the Federal Government in that no other facility can provide its research staff with access to state-of-the-art mainframe computer and operational global telecommunications as well as instantaneous access to worldwide data. 100% on this CSF. R

Visualization Laboratory: The facility provides opportunities for satellite researchers to perform multi-channel image manipulation tasks, modelers to perform graphical model diagnoses, and decision aid developers to access the atmospheric impact on the tactical systems. The visualization facility is linked to the existing computing facility for the following applications: the analysis of atmospheric processes and simulations, development of visualization methods for existing systems, and development of advanced methodologies for incorporating atmospheric effects into war game simulations and platform simulators.

No other Laboratory within DoD provides atmospheric visualization capabilities and atmospheric simulation standards for training and wargaming. 50% on this CSF, and 50% on Weapons CSF. R

GOES (Geostationary Earth Orbiting Satellite) System: The GOES system collects and distributes remotely sensed data to various global operational forecast models and assorted research projects unlike any other system in the world. This system is not unique. 100% on this CSF. R

Digital Image Processing Laboratory [DIPL]: The DIPL is a central image processing laboratory which the Naval Research Laboratory (NRL) with a powerful software/hardware complex for the support of various ongoing programs especially in remote sensing in the ocean, atmospheric and space sciences. The laboratory conducts research in computer-aided image enhancement, image interpretation and image presentation. It provides image processing services to various DoD organizations on a special needs basis. The DIPL is a SCIF area which has its own environmental control system.

The DIPL is comprised of three major image handling subsystems, a preprocessing system, an image/signal processing system and a postprocessing system contained within approximately twenty racks of CPUs and peripherals which are integrated and interconnected for multi-user and

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simulation standards for training and wargaming. Facility is shared approximately 50% of the time with Navy unique efforts.

GOES (Geostationary Earth Orbiting Satellite) System: The GOES system collects and distributes remotely sensed data to various global operational forecast models and assorted research projects unlike any other system in the world. This system is not unique. Facility is shared approximately 50% of the time with Navy unique efforts.

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The DIPL is comprised of three major image handling subsystems, a preprocessing system, an image/signal processing system and a postprocessing system contained within approximately twenty racks of CPUs and peripherals which are integrated and interconnected for multi-user and multi-tasking operations. An adjoining, non-SCIF area contains several modern workstations with compatible peripherals having LAN and internet connectivity to essentially all of the non-SCIF systems at NRL. Facility is shared approximately 50% of the time with Navy unique efforts.

The capabilities of the DIPL span basic areas of image handling and interpretation :
Image Digitization/processing
End-to-End Synthetic & Real Aperture Signal & Image Processing
Data Merging/Image Fusion
Image Data Compression/Image Coding
Automatic Target Recognition (ATR)/Automatic Feature Detection (ATD)
Image Noise Reduction/Image Noise Interpretation
Image/Feature Classification

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multi-tasking operations. An adjoining, non-SCIF area contains several modern workstations with compatible peripherals having LAN and internet connectivity to essentially all of the non-SCIF systems at NRL. 50% on this CSF, and 50% on Space CSF. R

The capabilities of the DIPL span basic areas of image handling and interpretation :
Image Digitization/processing
End-to-End Synthetic & Real Aperture Signal & Image Processing
Data Merging/Image Fusion
Image Data Compression/Image Coding
Automatic Target Recognition (ATR)/Automatic Feature Detection (ATD)
Image Noise Reduction/Image Noise Interpretation
Image/Feature Classification

3.5 Expansion Potential

3.5.1 Laboratory Facilities:

			Space Capacity (KSF)		
Common Support Function	Facility or Equipment Description	Type of Space*	Current	Used	Excess
Environ Sci.	Office	Administrative	10.6	10.6	0
	Office/lab	Technical	124.2	124.2	0
	Rooms	Storage	3.7	3.7	0

* Administrative, Technical, Storage, Utility

3.5.1.1 Capacity to absorb additional similar workyears:

Have the capacity to absorb approximately 40 more work years with only minor facility modifications.

3.5.1.2 Capacity to support additional simular workyears:

Approximately 20 additional workyears can be supported.

3.5.1.3 For 3.5.1.1 and 3.5.1.2

NONE

3.5.2 Land Use:

Provide number of buildable acres for additional laboratory/administrative support construction at your installation. (BRAC Criteria II) R

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NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10%. This would involve minimal reconfiguration.

3.5.3 Utilities:

Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units -- e.g., KWH of electricity. (BRAC Criteria II) R

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD)	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

[1] The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.
[2] Production plant owned by PWC, Washington

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3.5 Expansion Potential

3.5.1 Laboratory Facilities.

			Space Capacity (KSF)		
Common Support Function	Facility or Equipment Description	Type of Space*	Current	Used	Excess
Environ Sci.	Office	Administrative	10.6	10.6	0
	Office/lab	Technical	124.2	124.2	0
	Rooms	Storage	3.7	3.7	0

* Administrative, Technical, Storage, Utility

3.5.1.1 Capacity to absorb additional similar workyears. Have the capacity to absorb approximately 40 more work years with only minor facility modifications.

3.5.1.2 Capacity to support additional simular workyears. Approximately 20 additional workyears can be supported.

3.5.1.3 For 3.5.1.1 and 3.5.1.2. Impact of programmed MILCON: NONE

3.5.2 Land Use. Not separately reportable - see response to BRAC Data Call 4.

3.5.3 Utilities: Not separately reportable - see response to BRAC Data Call 4.

16. **ENVIRONMENTAL SCIENCES QUESTION 3.0**

This question asks you to describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity. Your response addressed this to some extent in a general manner; however, the question is to be answered for each CSF. Your response identifies interconnectivity with "WEAPONS", "C4I", "SPACE", "TRAINING", AND "ENVIRONMENTAL QUALITY". Weapons, C4I, and Space need to be further broken down into applicable CSFs (i.e., Cruise Missiles, Bombs,..., Satellites,..., Airborne C4I, ...) per the listing in the Data Call, further amplified in MM-0193-F4, BSAT/JT dtd 2 June 1994. Please provide response by each CSF.

RESPONSE: See enclosure (8).

17. **ENVIRONMENTAL SCIENCES QUESTION 3.4.1**

The question asks you to "describe major facilities and equipment to support **each CSF**." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions."** (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

RESPONSE: See enclosure (9).

18. **ENVIRONMENTAL SCIENCES QUESTIONS 3.5.2, 3.5.3**

Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call #4 is not acceptable.

RESPONSES

a. **3.5.2** NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for

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expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

b. **3.5.3**: Utility service capacities are depicted in the following table:

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

19. **ENVIRONMENTAL QUALITY QUESTION 3.0**

In addition to describing the major capabilities at your activity contributing to the common support function for which you are responding, the question asks you to describe any relationship and interconnectivity with other functions (common or otherwise) in support of the overall activity. Your response addressed this to some extent in a general manner; however, the question is to be answered for each CSF. Please provide response by each CSF.

RESPONSE: See enclosure (10).

20. **ENVIRONMENTAL QUALITY QUESTION 3.2.1**

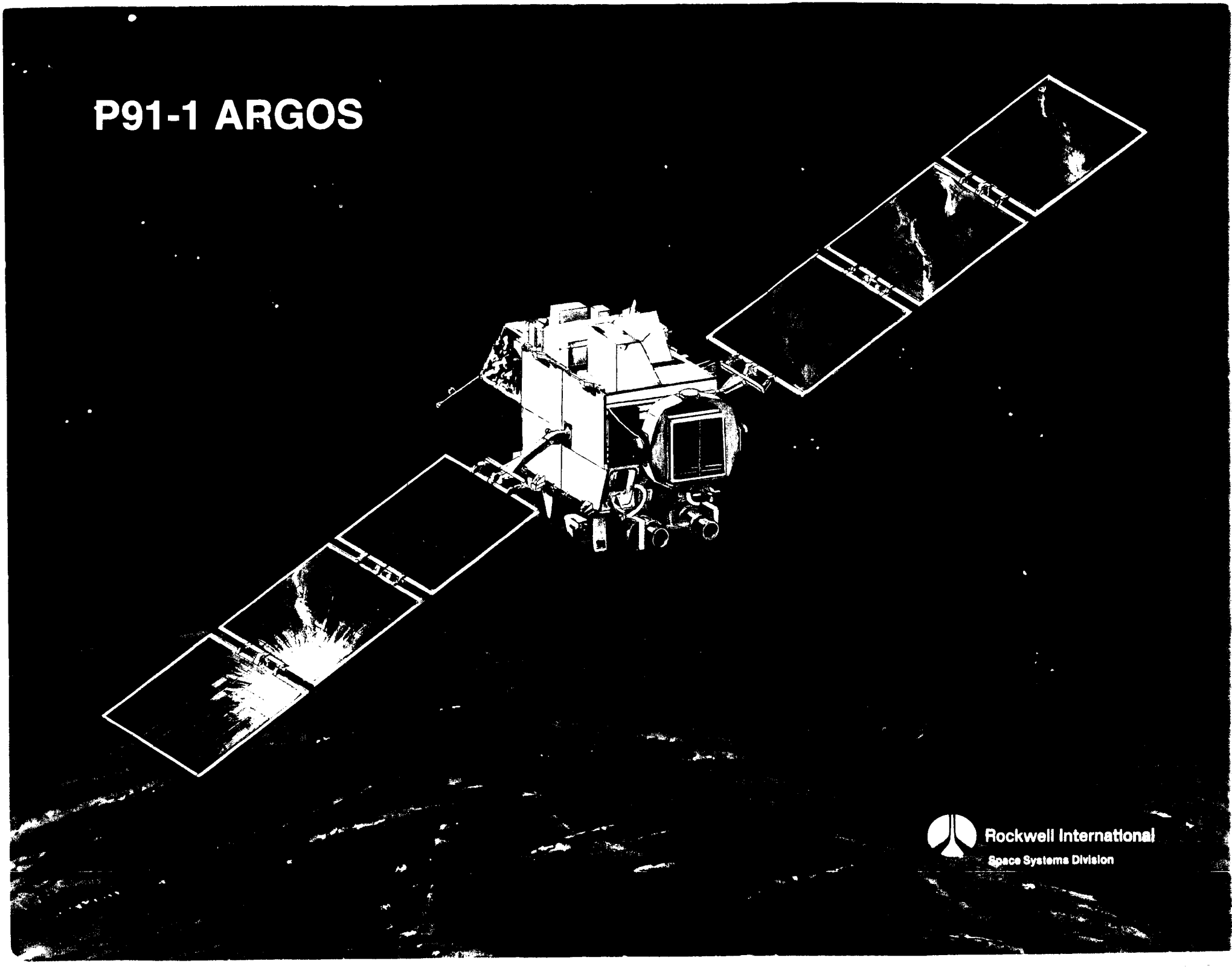
Total Personnel labeled "Electronic Devices". Is this a typo?

ANSWER: Yes; it should read "Environmental Quality".

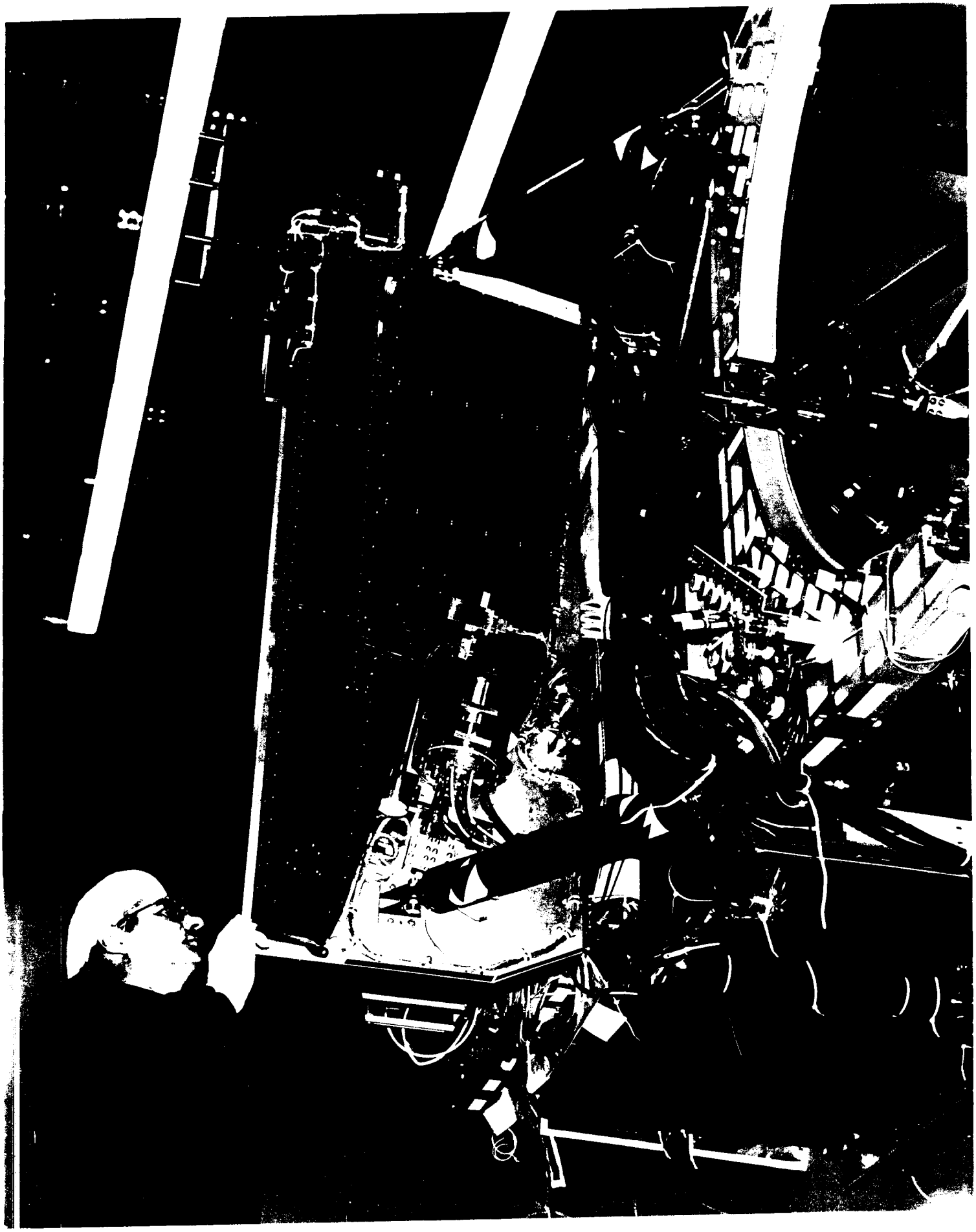
21. **ENVIRONMENTAL QUALITY QUESTION 3.4.1**

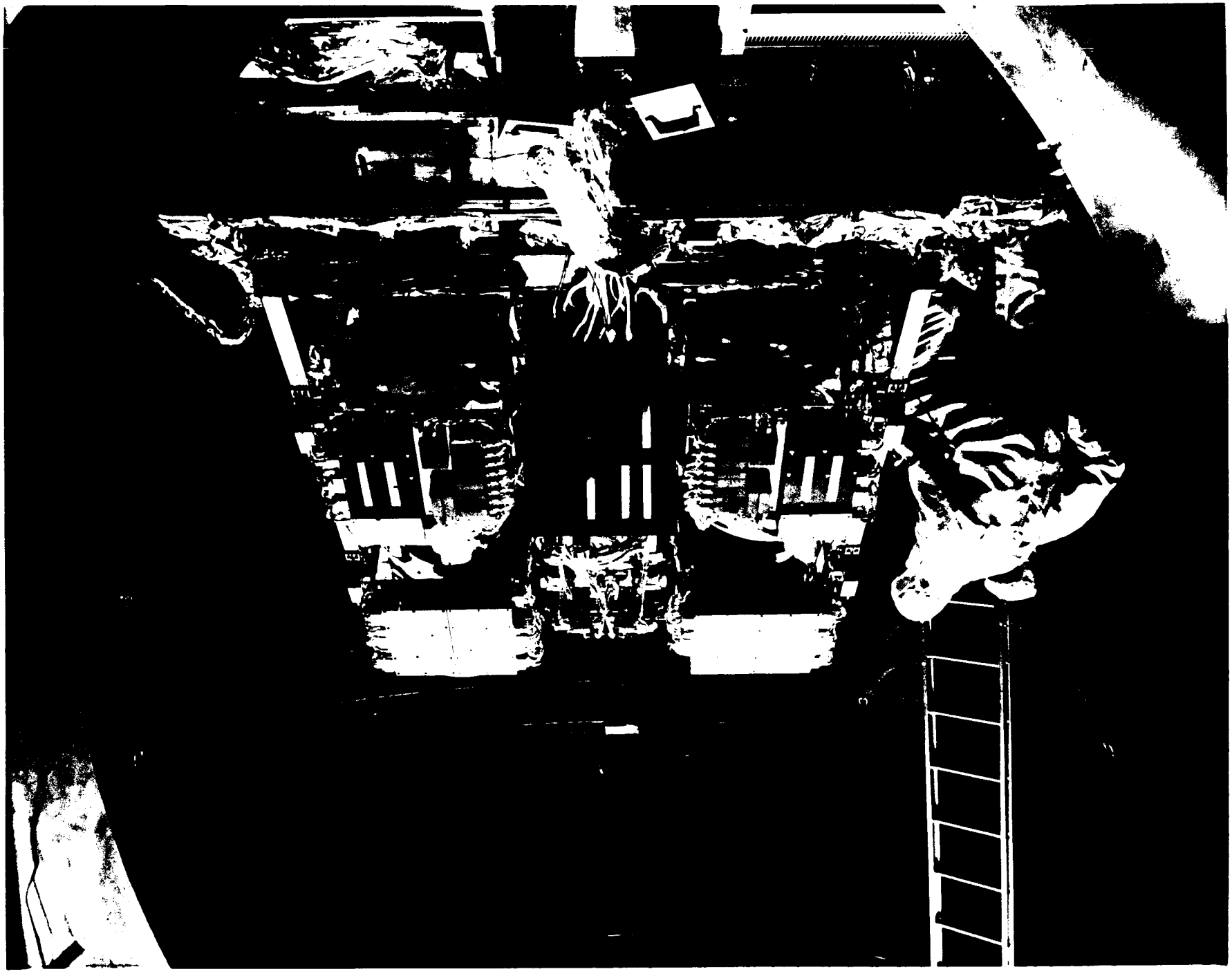
28 AUG 1994

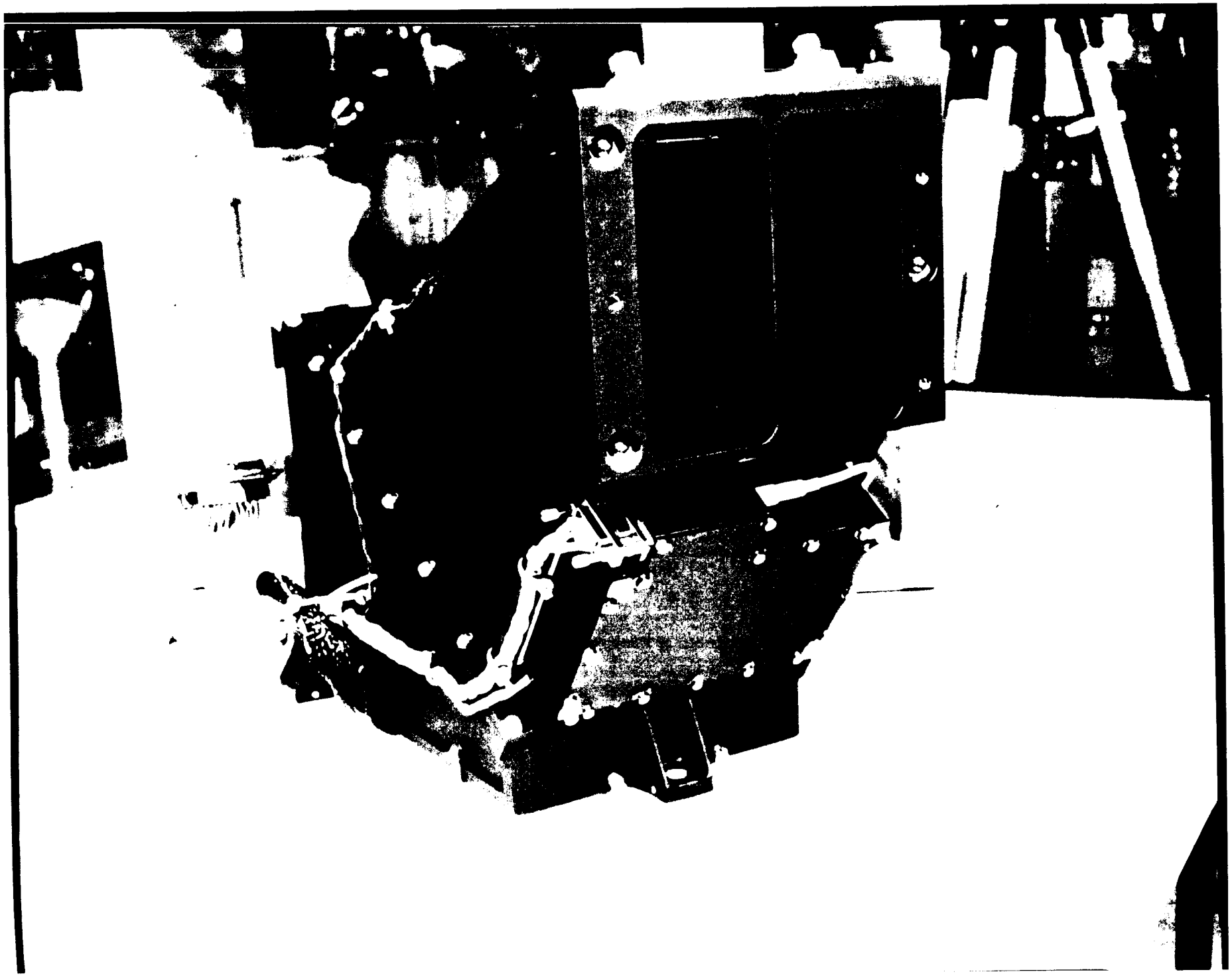
P91-1 ARGOS

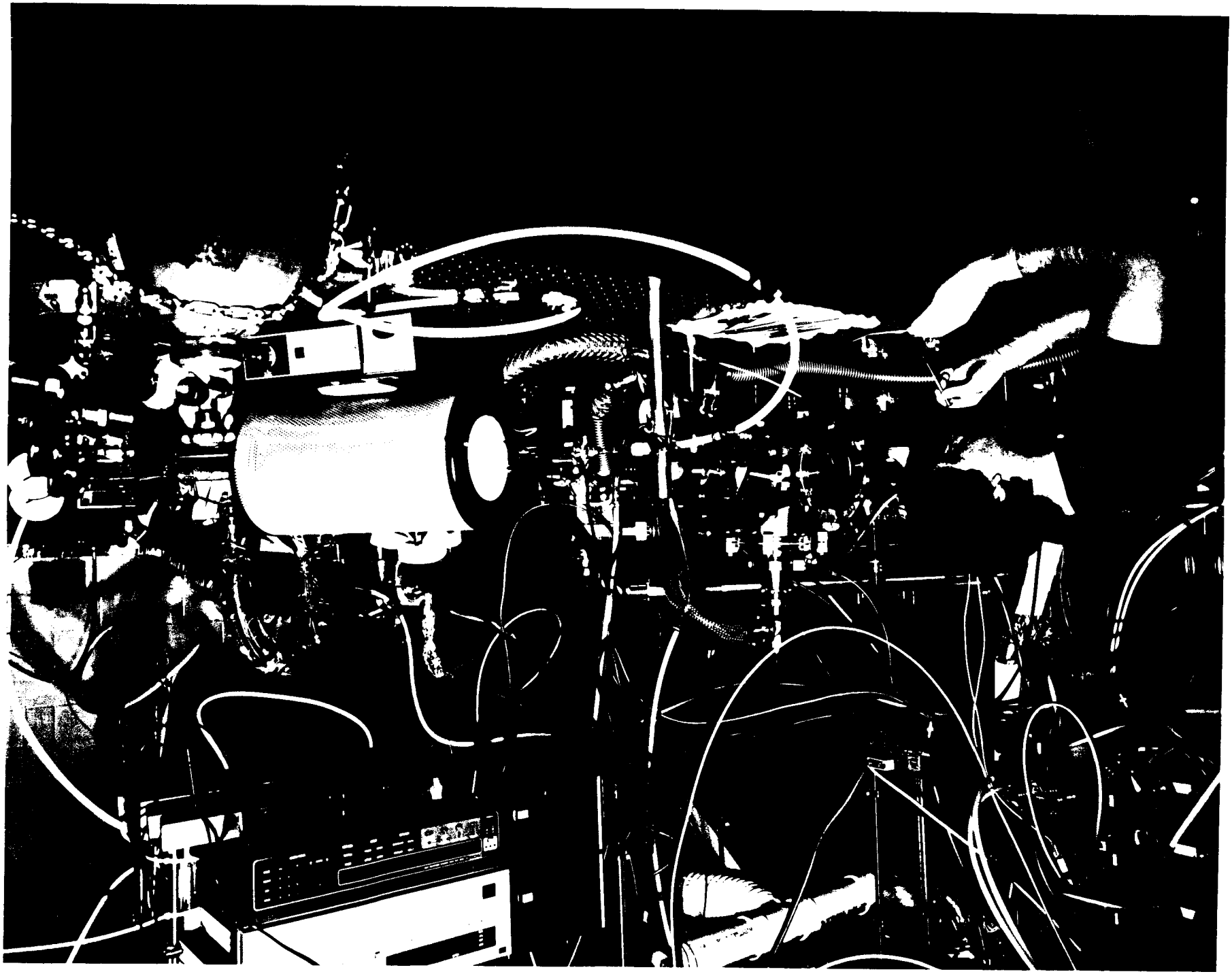


Rockwell International
Space Systems Division



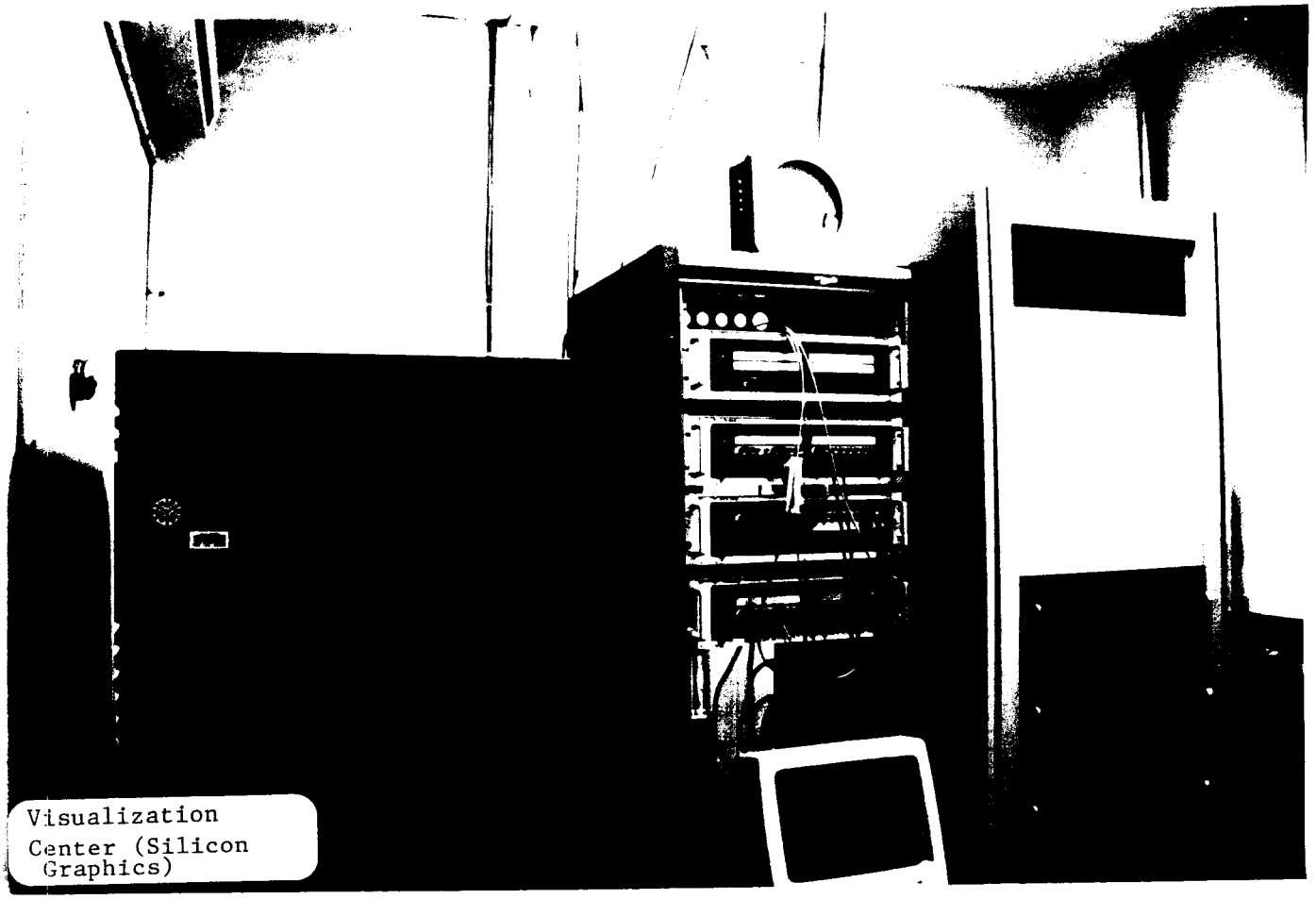






VISUALIZATION CENTER

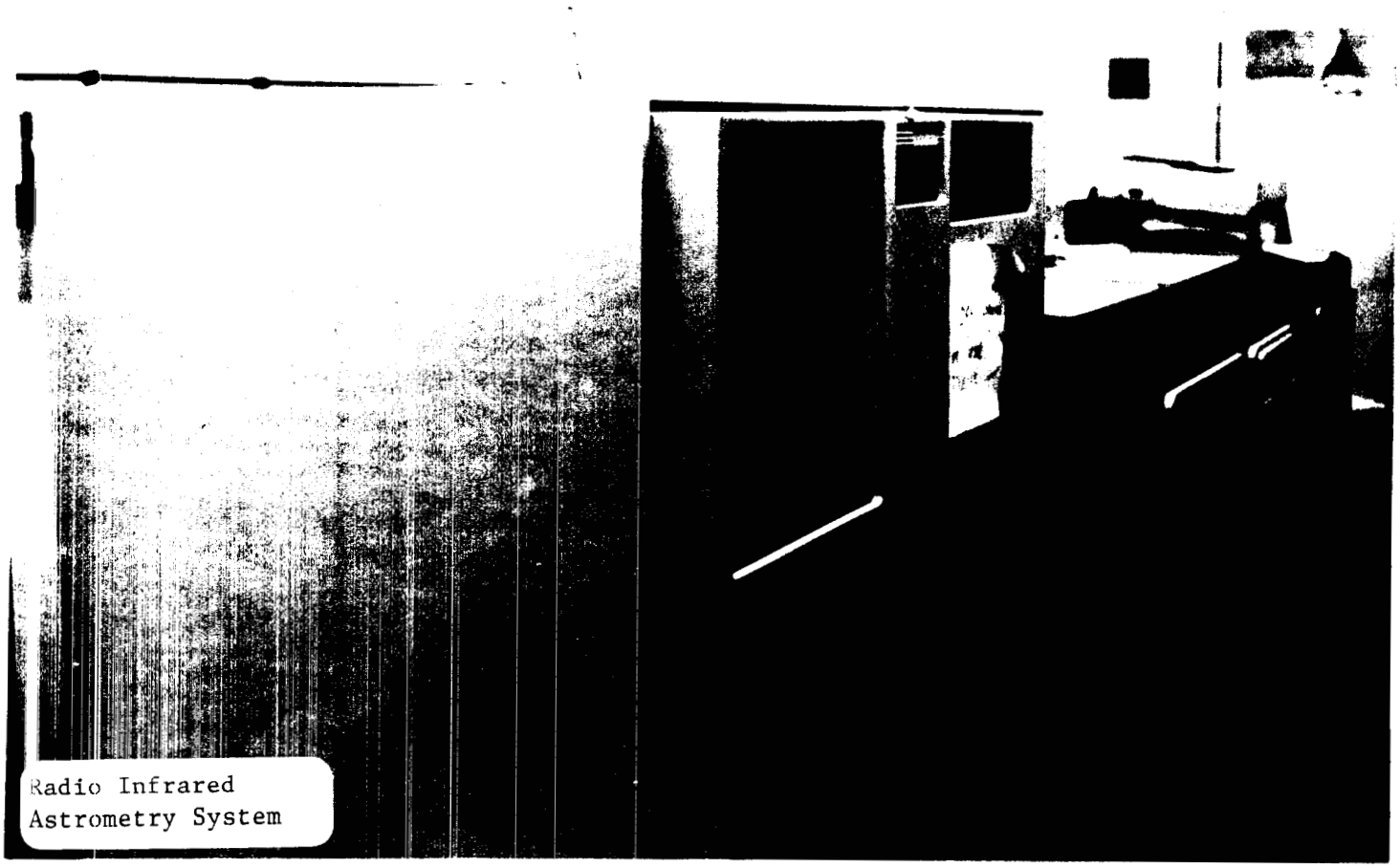
The Remote Sensing Visualization Center is a Silcon Graphics Computing System. This center analyzes and processes remotely sensed and modeled data associated with scientific and technical thrusts in the environmental science area. Replacement cost is 700K.



Visualization Center (Silicon Graphics)

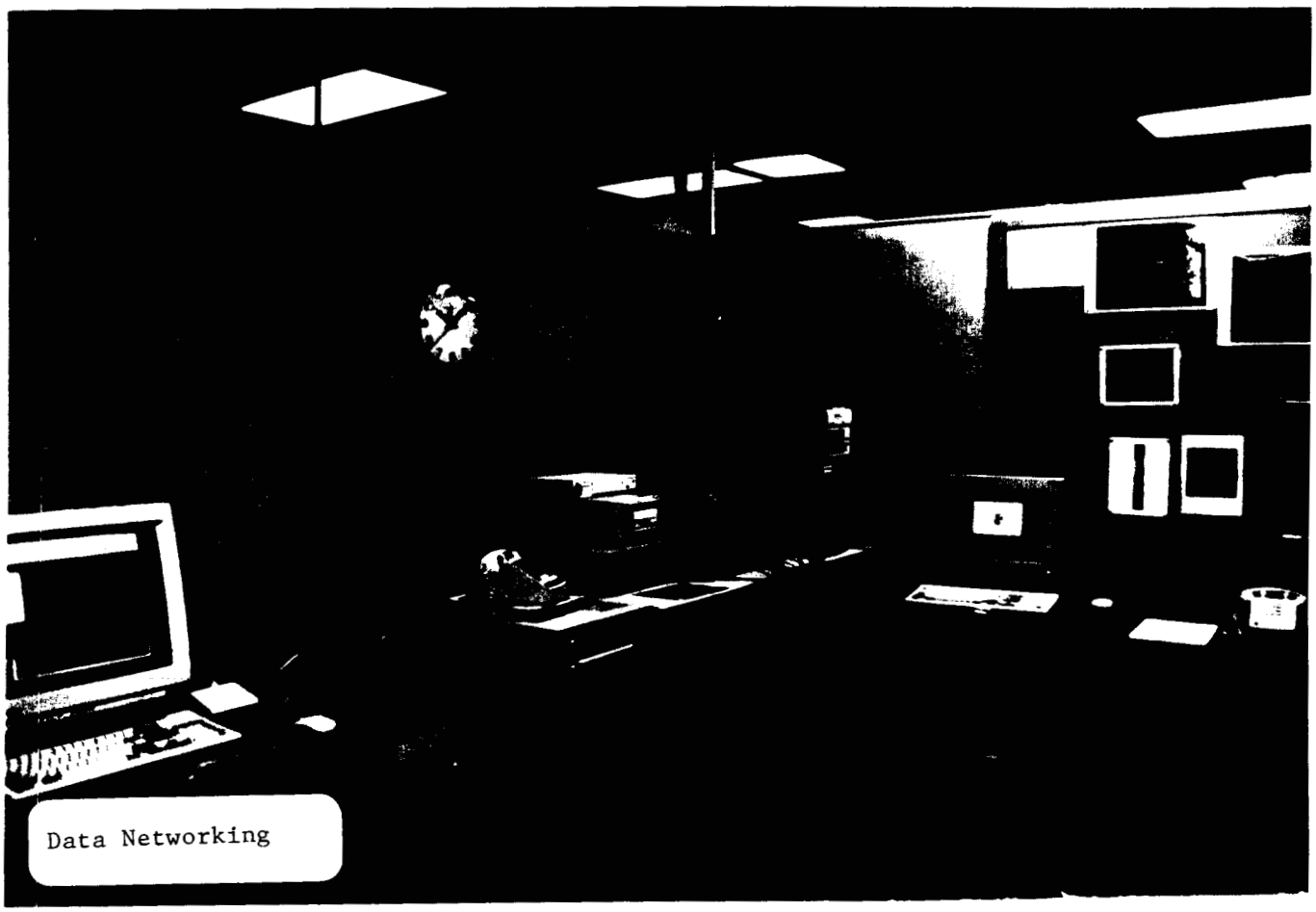
RIRA

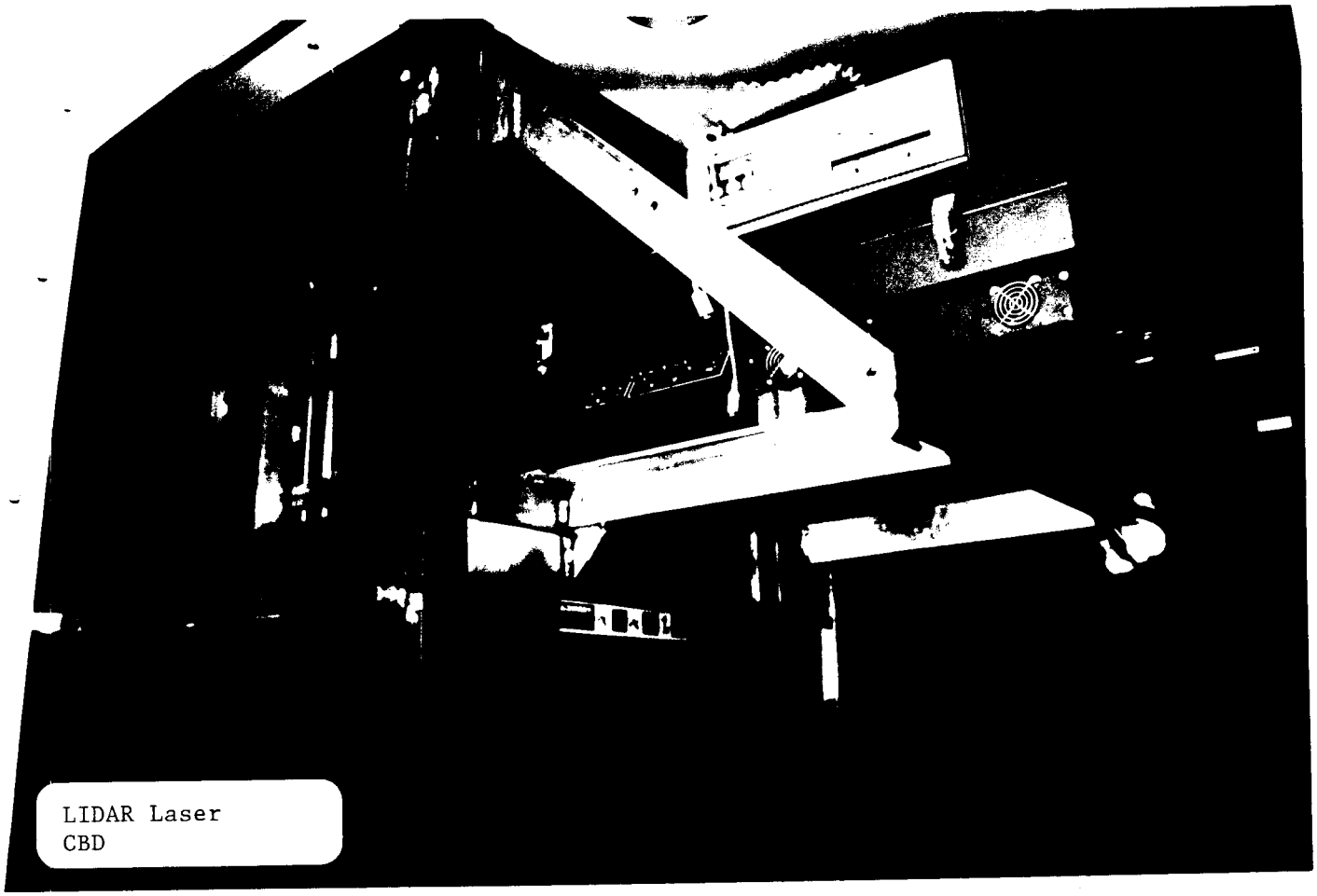
The Radio Infrared Astrometry System is an Alliant computer that supports research analysis associated with astrometric research and analysis.



DATA NETWORKING

The Remote Sensing Division Data Networking system consists of computer work stations, communication nets, data storage and retreival systems, and individual PC systems. These systems are networked together to support research functions.

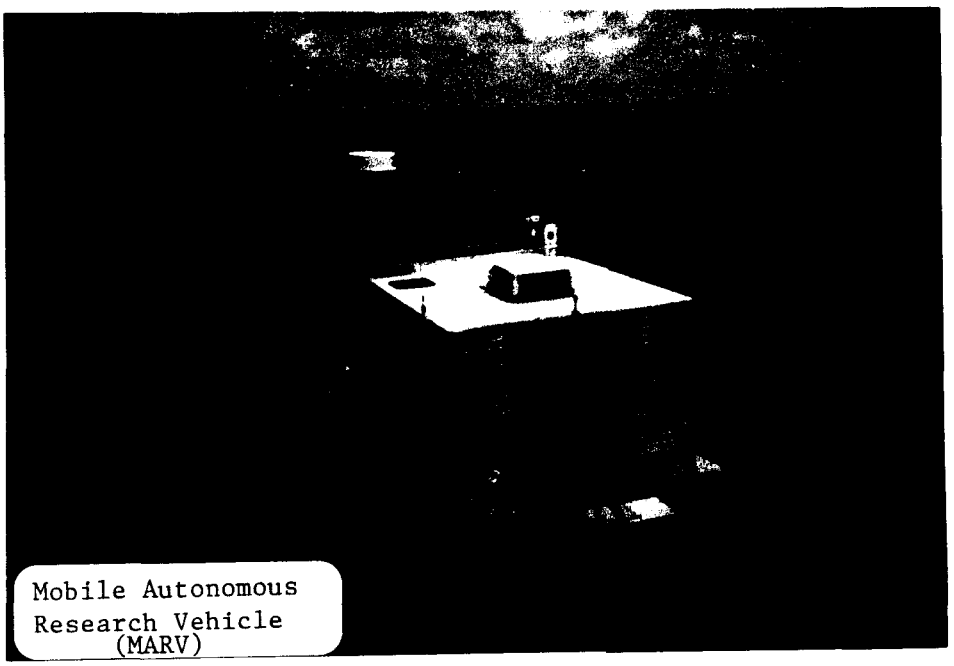




LIDAR Laser
CBD

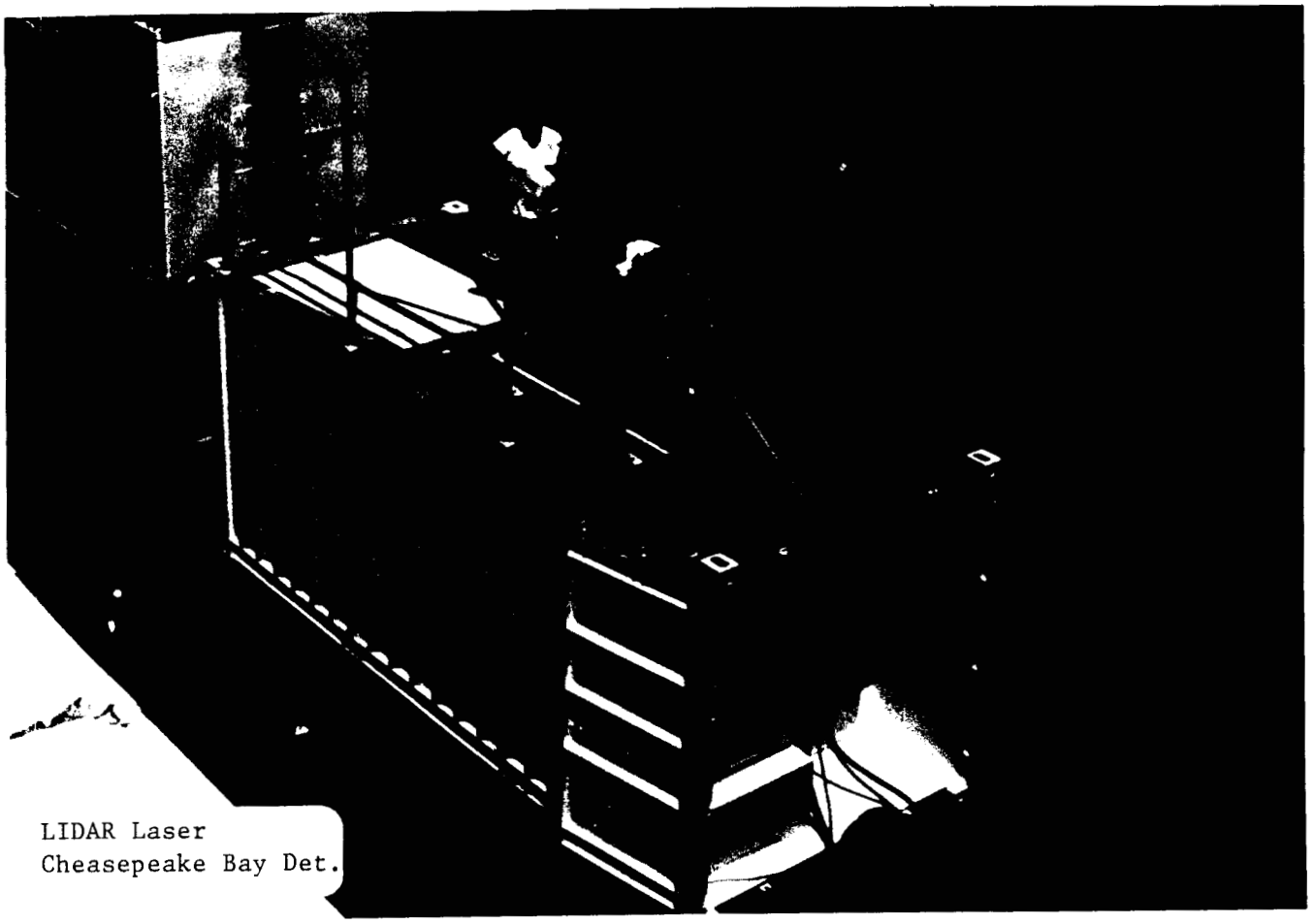
Mobile Autonomous Research Vehicle

This vessel is a self-propelled research platform (24' X 8') for measurement of near-surface and surface oceanographic variables of relevance to the radar remote sensing problem. Sensors on the forward instrument mount are: a Ku-band scatterometer, video wave imagers, and a wide-angle video camera. On the forward deck is a surface tension measuring system and wave slope gauge. Meteorological sensors are mounted on the mast. Navigation instrumentation, AC/DC power sources, and a depth profiler are included.



LASER EQUIPMENT

Several Laser systems are utilized in research functions associated with aerosol measurements (air/sea interface), altimetry, and non-acoustic ASW. Shown is the laser test site at the Cheasepeake Bay Site.



LIDAR Laser
Cheasepeake Bay Det.

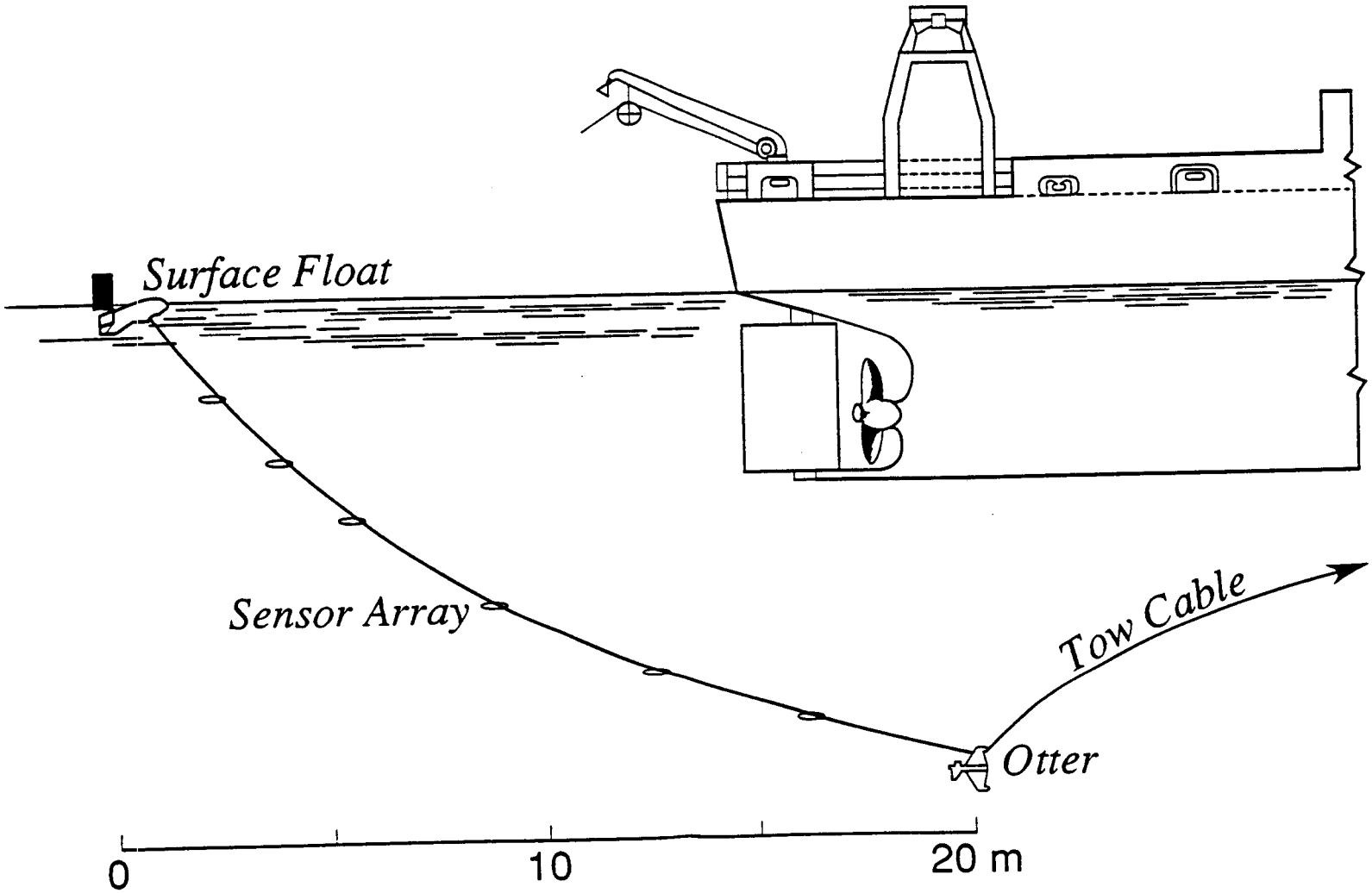
LIDAR Laser
CBD

Towed Sensor System - Surface Tension

This system measures the ocean surface tension well away from the contaminating influence of the ship's wake. Results are used to interpret and model remotely sensed data fields.

Towed Sensor System - Density

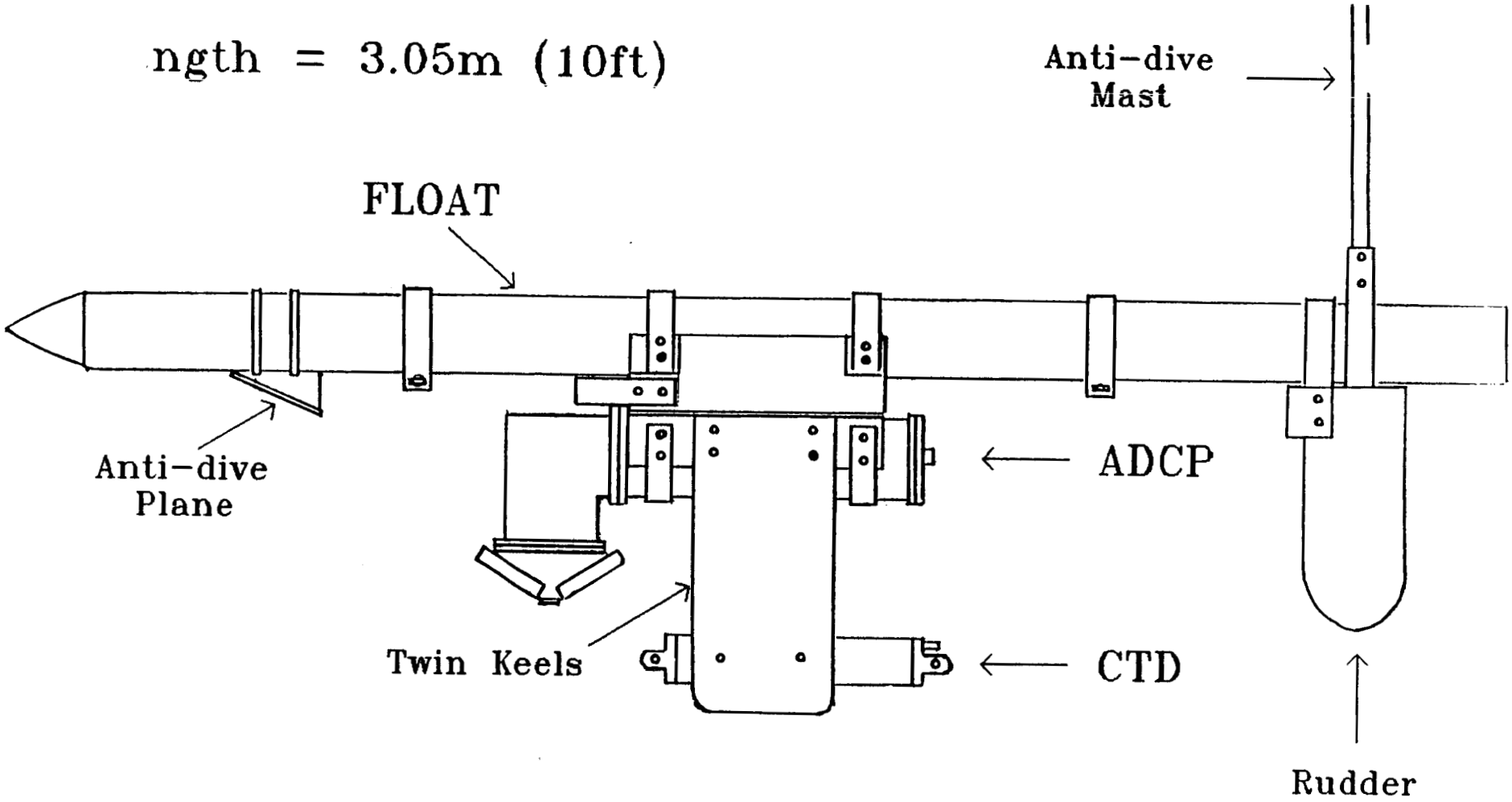
This towed sensor system is used to obtain the temperature and salinity in the uppermost 10m of the ocean well away from the contaminating influence of the ship's wake. The system consists of a tow cable, an otter/depressor, and a temperature/salinity sensor array suspended from a surface float. These data are used in support of modeling and experiments in remote sensing realizations.



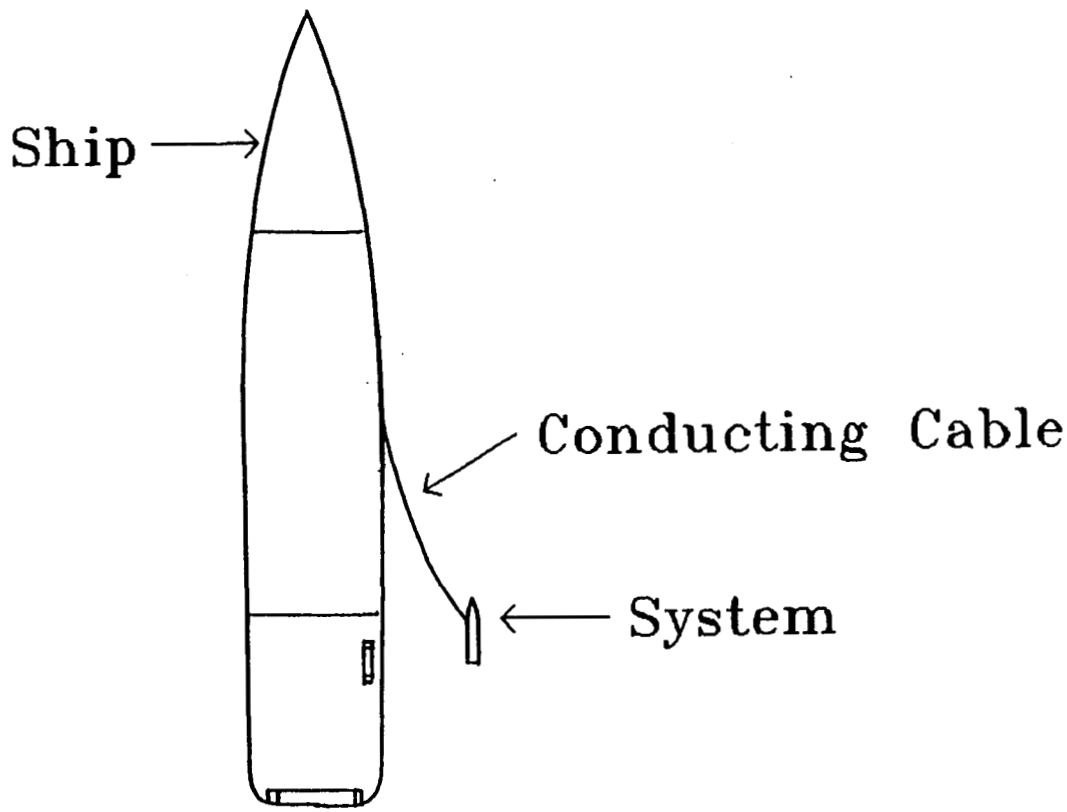
TOWED SENSOR SYSTEM (TSS) DENSITY

Towed Sensor System - Velocity

This system consists of a broad band acoustic doppler current profiler deployed in a specially designed body which sails off to the side of the ship to obtain velocity profiles in the upper 100m of the ocean for use in modeling and experiments of remotely sensed fields.



TOWED SENSOR SYSTEM (TSS) VELOCITY



TOWED SENSOR SYSTEM (TSS) VELOCITY

Remote Sensing Division

Mark III Optical Interferometer

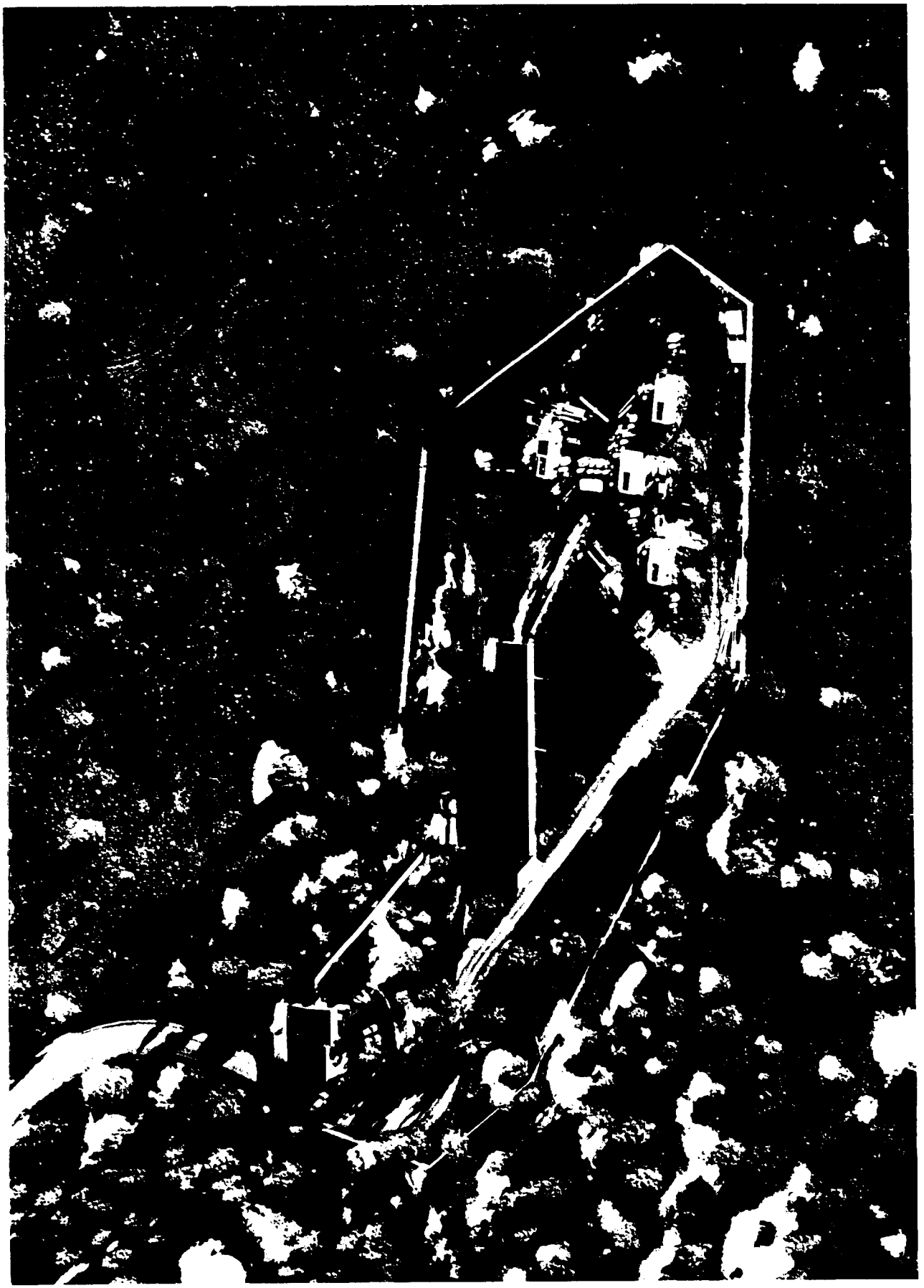
FUNCTIONS: Makes very high angular resolution optical observations of stars for astrometry and astrophysics. High resolution measurement of stellar positions provides essential data for earth rotation and celestial reference frame determinations; such position data for binary stars enables determination of stellar masses. It was built as a prototype to demonstrate the basic concepts later implemented in the Navy Prototype Optical Interferometer.

DESCRIPTION: The Mark III Optical Interferometer is the most advanced Michelson interferometer operating in the world today. It combines light from pairs of telescopes spaced over baselines from 3 to 31 m. The visible light from these telescopes is combined in a central optics laboratory, where interference fringes are detected and tracked. The facility can determine stellar positions with an accuracy as fine as 10 milliarcseconds (mas), more than 50 times better than normal ground based telescopes (and better than the Hubble Space Telescope). Built to test some of the technologies that will be used by the Naval Prototype Optical Interferometer, it has been operated as a scientific instrument for seven years, producing high accuracy binary star orbits and measurements of stellar diameters and limb darkening.

INSTRUMENTATION: The facility includes 5 telescopes of 10" diameter that can be used two at a time. Two delay lines (movable mirrors on a cart within an evacuated tube) are used to equalize the path length from the source through the telescopes. Three computers are used to control the operation of the system.

PRIMARY CONTACT: Dr. David Mozurkewich
Code 7215
(602) 773-4868

LOCATION: Anderson Mesa
Flagstaff, AZ



Remote Sensing Division

Navy Prototype Optical Interferometer

FUNCTIONS: Makes very high angular resolution optical observations of stars for astrometry and astrophysics. High resolution measurement of stellar positions provides essential data for earth rotation and celestial reference frame determinations; such position data for binary stars enables determination of stellar masses. High resolution imaging of stellar surfaces and near-surface structures provides basic data on stellar structure and activity.

DESCRIPTION: The NPOI facility is a joint project with the U. S. Naval Observatory and Lowell University, and is currently under construction on Anderson Mesa, outside Flagstaff, AZ. When complete, it will consist of 4 fixed and 6 portable telescopes. The visible (450-800 nm) light from these telescopes is combined in a central optics laboratory, where interference fringes are detected and tracked. The facility can be operated in two modes. In the astrometric mode, the interference fringe positions from the 4 fixed telescopes are used to determine stellar positions with an accuracy of 1 to 3 milliarcseconds (mas). In the imaging mode, the fringe contrast and phase data from the 6 movable telescopes are used to build up an image of stellar surfaces. In its initial configuration, with telescope separations up to 60 m, it should be capable of detecting 1 mas structures; enhancements over the next few years (including baselines as long as 470m) should increase the resolution to 0.1 mas.

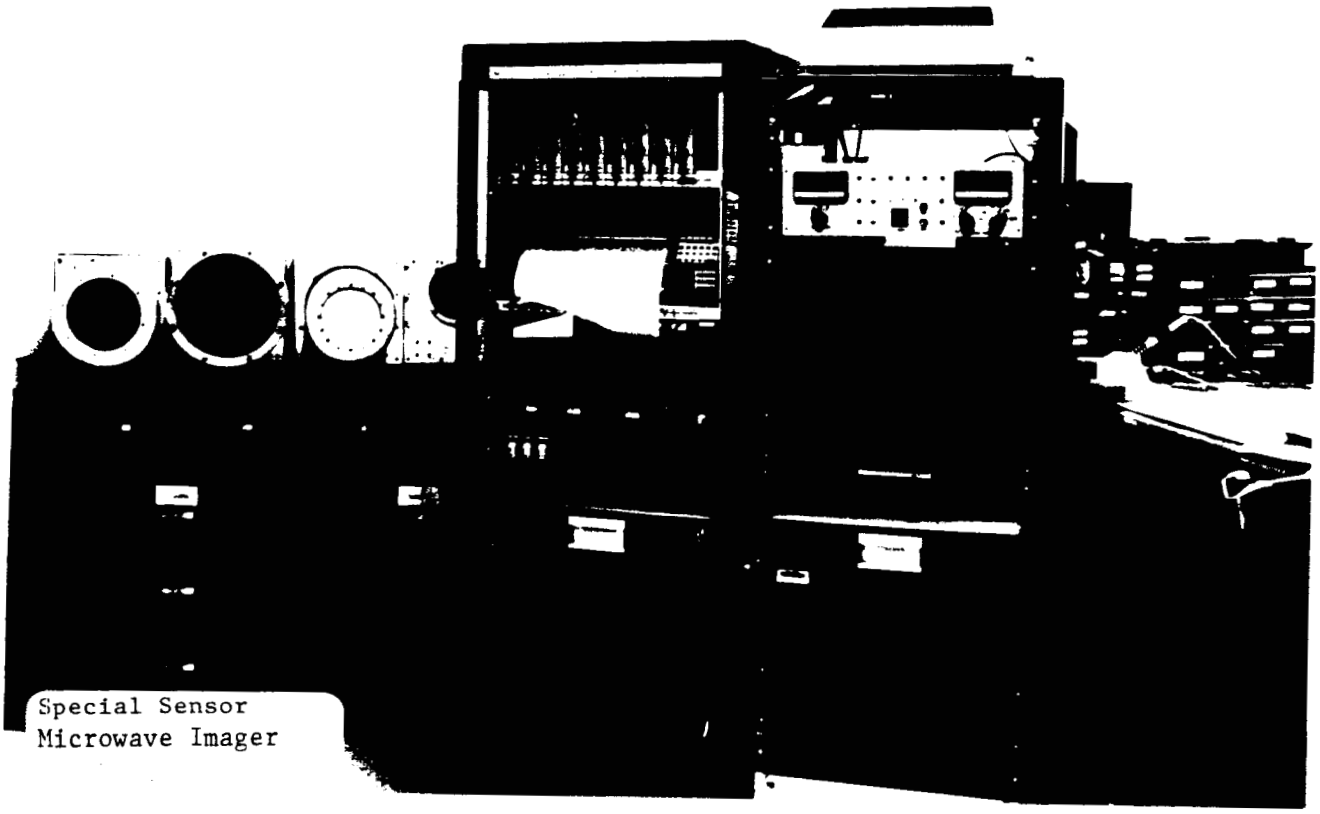
INSTRUMENTATION: In addition to the telescopes, the facility is equipped with delay lines (movable mirrors on carts within evacuated tubes) that are used to equalize the path length from the source through the telescopes to the point of beam combination. The delays can be moved at speeds of up to 1 cm/sec with position errors < 10 nm (rms). The beams are combined with unique optical assemblies that enable simultaneous observation of several pairs of baselines (telescope separations). The facility uses 3-, 4-, and 6-way beam combiners. Precise astrometry also requires a complex laser metrology system, using 50 laser path-length measurements, to monitor the positions of the telescopes and delay lines during the observations. There is also a distributed computer control system that allows complete automation of the system, and several medium laboratory computers for the processing of data.

PRIMARY CONTACT: Dr. David Mozurkewich
Code 7215
(602) 773-4868

LOCATION: Anderson Mesa
Flagstaff, AZ

MILLIMETER WAVE RADIOMETRY

The Special Sensor Microwave Imager prototype is a test unit to support analysis and research for the sensor which is operationally deployed on the Defense Meterological Satellite. The system is a millimeter wave radiometer and associated test equipment. It is usually utilized on a P3 research aircraft or on an access tower. Fixtures and antenna mounts for these applications are not shown.



Special Sensor
Microwave Imager

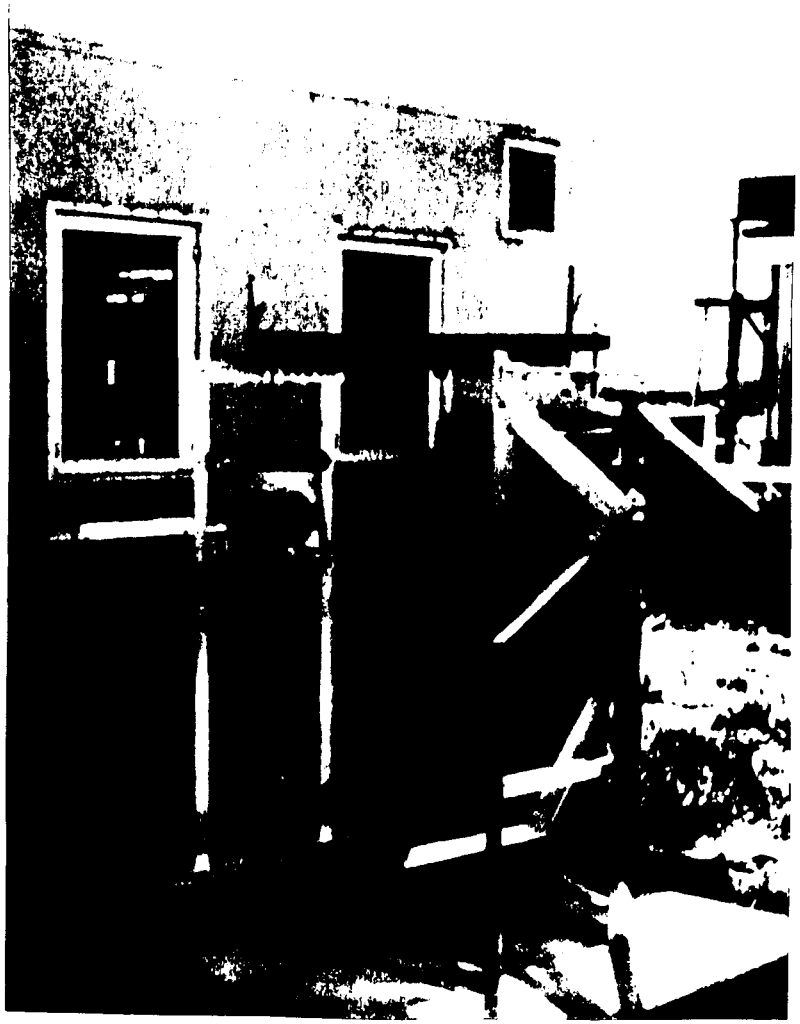
MILLIMETER-WAVE ATMOSPHERIC SOUNDER

The Millimeter-wave Atmospheric Sounder (MAS) is an integral part of NRL's space-based research in support of SERDP. MAS is designed to study the formation and destruction of Ozone by measuring emission lines of Ozone, Water Vapor, and Chlorine Monoxide from the Space Shuttle. During an 8-day shuttle flight, MAS scans the limb of the Earth to produce maps of the global distribution of these trace molecules as a function of altitude. MAS, which first flew in March 1992 and had a second flight in April 1993, is scheduled to fly once a year to provide a database for the study of changes in the middle atmosphere.

The replacement cost for NRL's part of the MAS space hardware is $2M. Total system cost includes elements built by European co-investigators and ground support equipment is $15M.

WVMS

Water Vapor Millimeter-wave Spectrometer



Goal

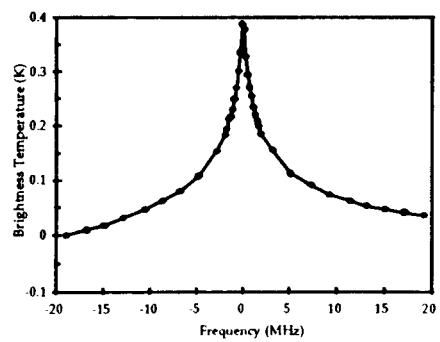
- **To monitor seasonal variability and interannual changes of water vapor in the stratosphere and mesosphere at NDSC sites**

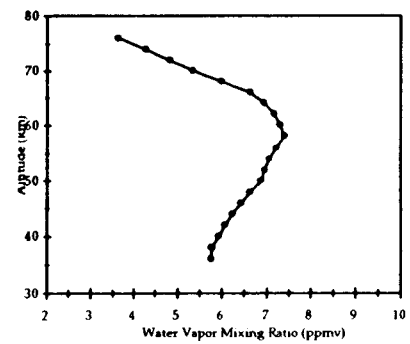
Approach

- **Use ground based microwave spectroscopy to measure the pressure broadened 22.2 GHz water vapor line**
- **Retrieve mixing ratios using optimal estimation**

Results

- **Nearly continuous daily retrievals from 35-75 km at Table Mountain CA (1/92-10/92 & 5/93-present) and Lauder New Zealand (11/92-4/93 & 12/93-present)**





WATER VAPOR MILLIMETER-WAVE SPECTROMETER

The Water Vapor Millimeter-wave Spectrometer (WVMS) project uses ground based radiometry to measure the 22.2 GHz water vapor transition in the middle atmosphere (40-70 km). The radiometers are a key element in the international Network for Stratospheric Change (NDSC) and as such are used as a check on space-based measurements. At present the radiometers are operating in Table Mountain, California and at the NDSC site in Lauder, New Zealand. The instruments are operated remotely from the Naval Research Laboratory, where the data is analyzed daily. The measurements are unique in that they provide the first nearly continuous record of water vapor in the middle atmosphere from a fixed site. The replacement cost for each WVMS is $600K.

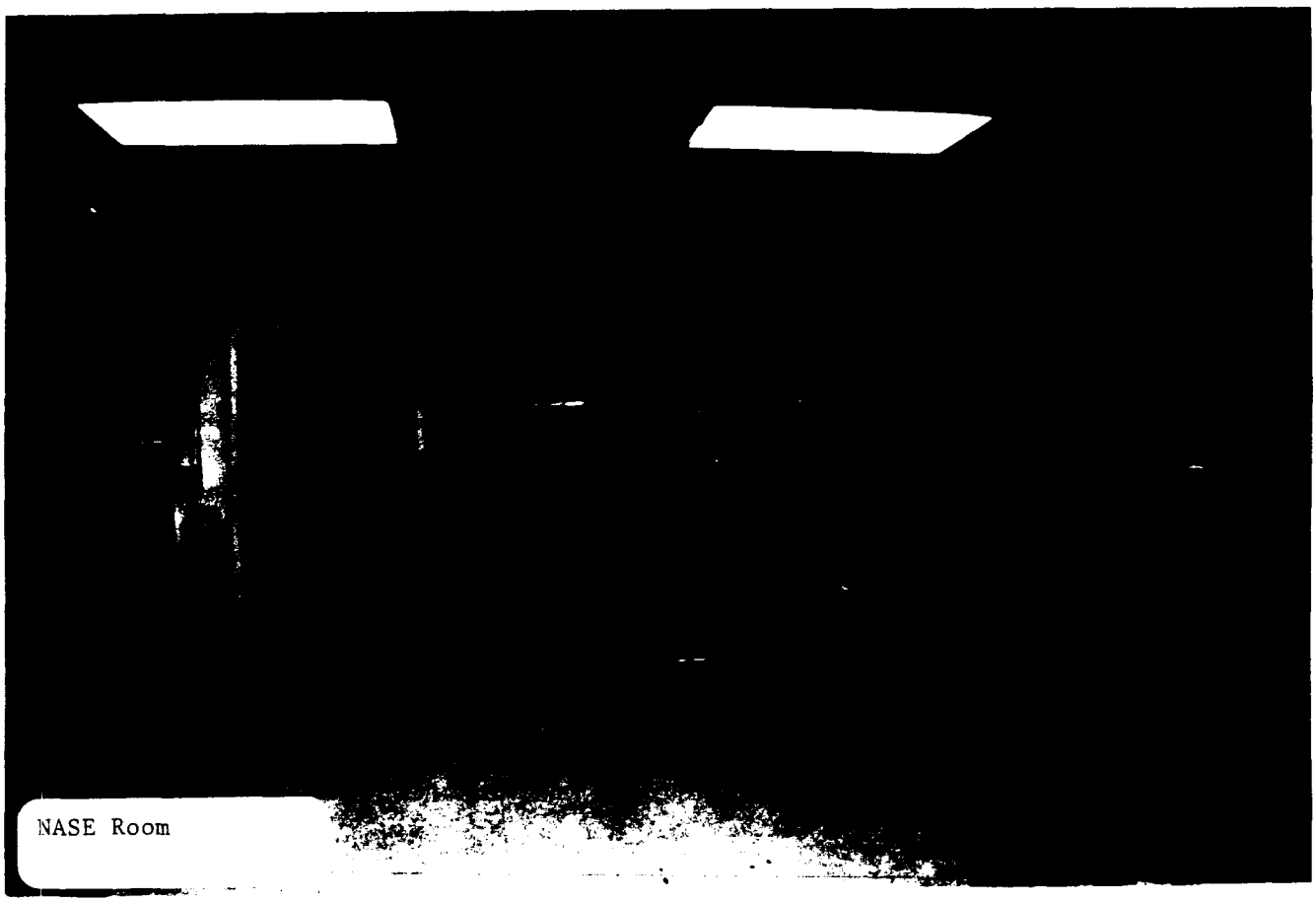
A third sensor is under construction. A similar sensor to measure Ozone is also under construction. The replacement cost is $800K.

Littoral Remote Sensing Modeling And Simulation System

The Littoral Modeling And Simulation System (LRS-MASS) is an integrated software system for Non Acoustic Surface Effects (NASE) simulations of the ocean environment. The integrated system has been designed according to industry standards and its development and implementation satisfies specific Navy requirements. The system includes a large number of software components that have been developed during the last fifteen years under Navy R & D funds. Most of the existing software components of the integrated system have been developed independently of each other and this is the first time that such an integration effort has been attempted successfully. The major modeling blocks of the integrated system are shown in the attached diagram and each of these blocks represents the area of physics that it is modeled within the system. Each of the modeling blocks is composed of the required software components necessary to perform the corresponding simulations for that block.

The simulation capabilities of the integrated system include man-made and natural ocean signatures and their imaging by radar and optical sensors. End-to-End simulations can be performed by providing the required geometry and the required environmental and sensor parameters. The simulations are performed within the NASE computer facility where a number of high powered workstations are networked to provided not only for simulation runs but also for software configuration management and for data processing.

The integrated software system meets two major Navy needs. The first is application specific in support of remote sensing projects including experiment design and data analysis. The second is information specific in understanding and assessing existing simulation capabilities and providing guidance for future research.

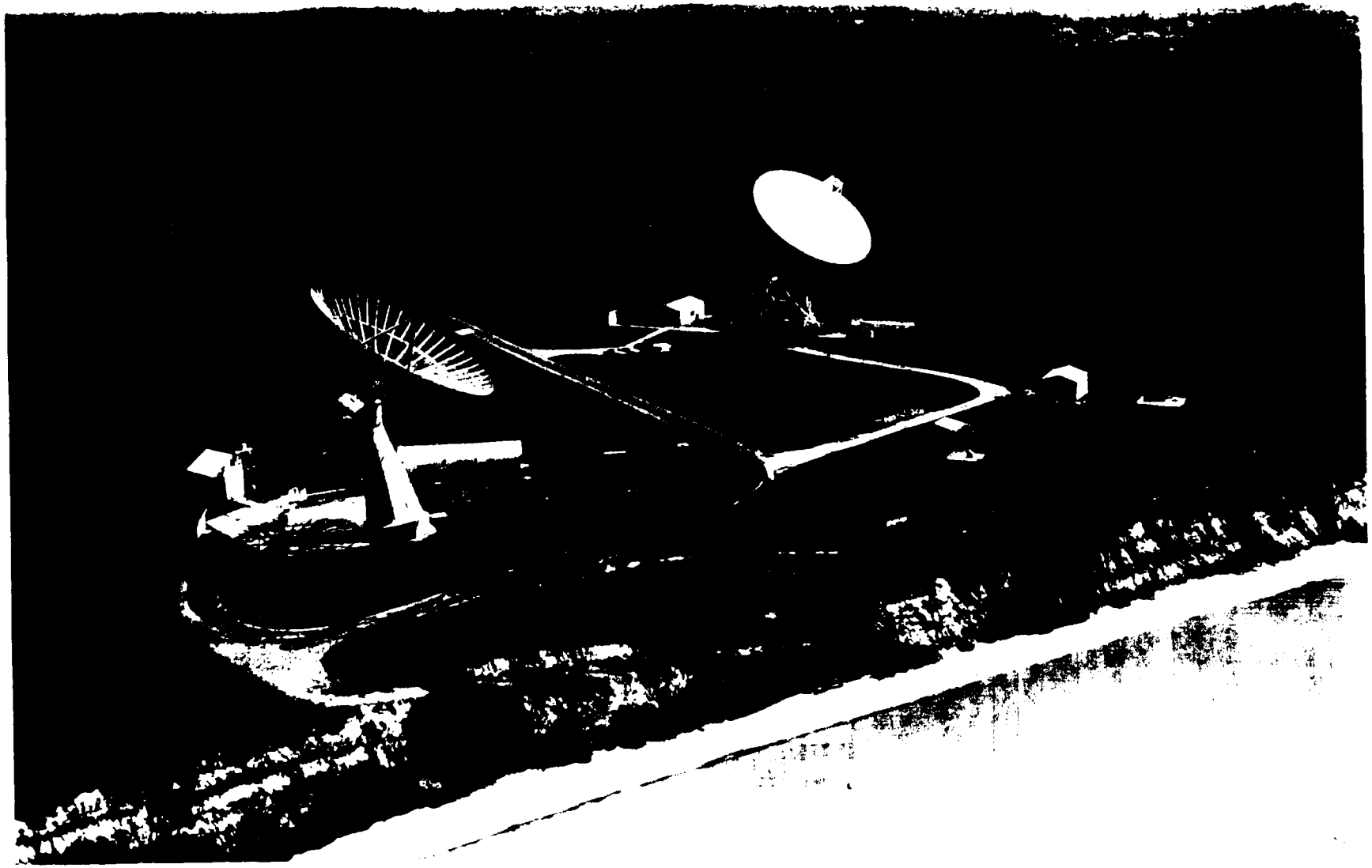


NRL WAVE-WIND CHANNELS

The NRL Remote Sensing Division (Code 7200) operates two wave-wind channels which are housed in a high-bay laboratory in Building A59. These channels and the laboratory in which they are housed were constructed between 1977 and 1982. Both channels are 30m in length and are equipped with hydraulically-actuated surface wave generators and fan-driven wind generators which can produce waves under varying conditions of wind velocity and fetch. One channel is 1.1m depth x 1.2m width, and the other is 0.5m depth x 2.4m width. Both wind channels extend 0.5m in height above the water surface. This laboratory is unique because of the high bay which allows the deployment of a variety of radar sensors at distances well above the water surface with a minimum of interference from the surroundings.

The hydraulically-actuated wave generators permit the generation of complex unsteady wave packets under computer control. This capability is especially useful in focusing the wave energy at a prescribed location in the channel in order to study the fluid dynamics of wave breaking and the related radar scattering mechanisms under precisely controlled conditions. A typical sequence of breaking waves with increasing intensities is shown in the accompanying set of video frame images. The waves range vary in intensity from a symmetric, round wave that is not breaking, to an incipient breaker, and to a fully plunging or overturning breaker. When wind is blown over the water surface, the changes in the mechanisms of breaking due the presence of the wind can be studied with great precision. The laboratory is equipped with a full suite of wave measuring probes, wind flow measuring anemometers, and radar probes to support experiments such as these. Several computers and workstations are available for data acquisition and analysis.

The laboratory has been used also for the development and testing of instrumentation, and as a staging area for numerous field experiments. Plans are being developed for the construction of a single new wave channel to replace the two existing channels. The cost of such an undertaking is estimated to be approximately $800 K.

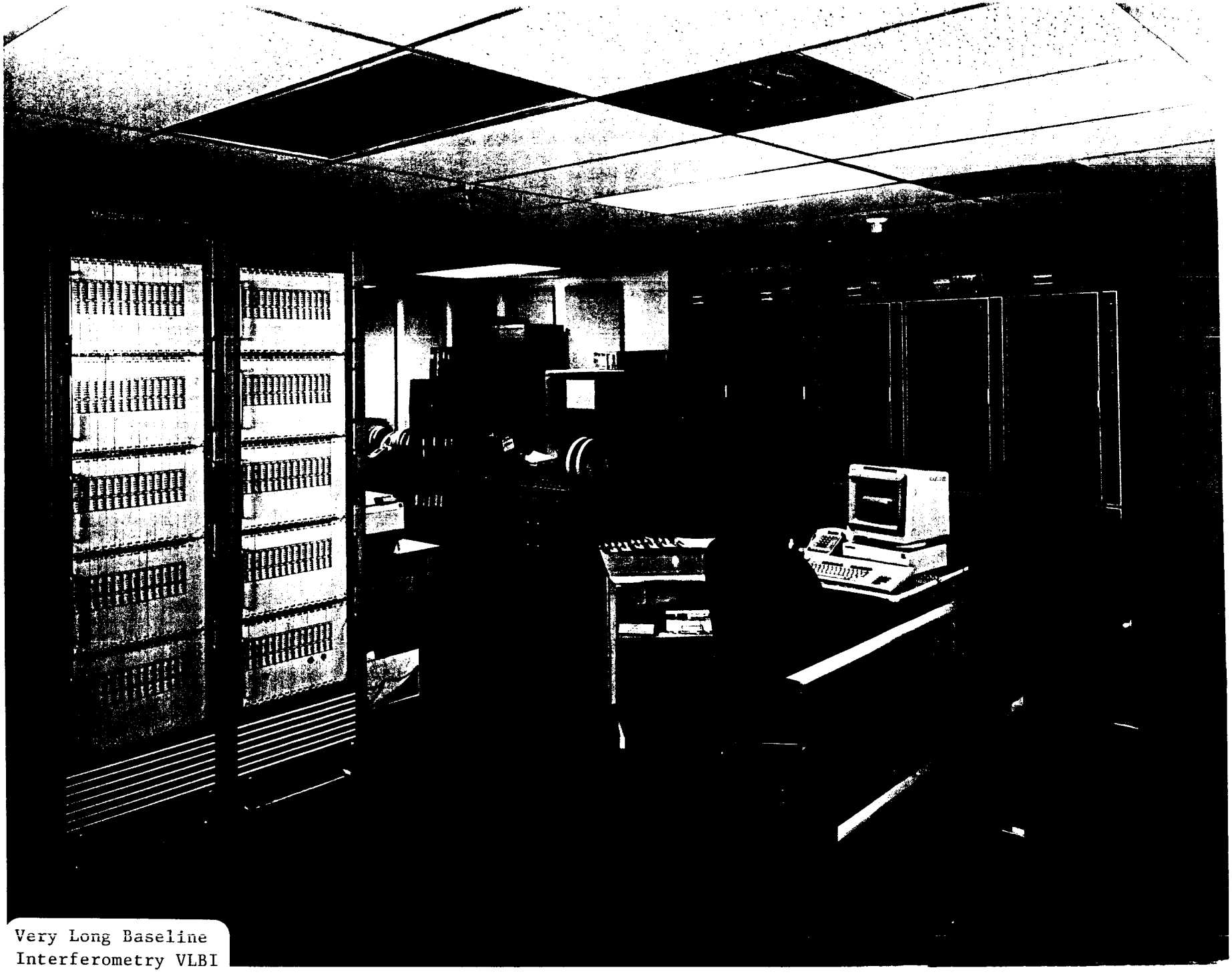


MARYLAND POINT RADIO OBSERVATORY

The facility includes two fully steerable parabolic antennas. The 84 ft telescope is usable to a frequency of approximately 3 GHz; the 85 ft telescope can be used at frequencies as high as 50 GHz. The 85 ft antenna is equipped with a wide range of electronics, including cryogenic receivers for observations at the standard radio astronomy continuum frequencies of 2.7, 5, and 8.1 GHz, and spectral line frequencies of 1.8 GHz and 22 GHz. Spectral line observations are supported with a filter bank spectrometer.

VLBI

The Washington Correlator is a joint facility of the NRL, USNO, NOAA, and NASA for processing geodetic Very Long Baseline Interferometry (VLBI) data. It is located at the U.S. Naval Observatory headquarters. This $1.5M facility has been used since August 1986 for basic research, to determine the structure and precise positions of celestial objects and to determine the earth's rotation rate with respect to them. The fundamental reference frame determined by NRL and NASA scientists using this facility is now used by the operational agencies.



Very Long Baseline
Interferometry VLBI

POLAR OZONE & AEROSOL MONITOR (POAM)

Polar Ozone and Aerosol Monitor (POAM) is a spaceborne sensor. This sensor has two major components: Optical Head Assembly (OHA) and Primary control Electronic Module (PCEM). POAM sensor supports the Space Common Support Function and the Environmental Sciences Common Support Function equally at 50% each. POAM sensor is unique to DoD in its ability to provide, using solar occultation technique, global profiling measurements with 1 km vertical resolution of aerosols, nitrogen dioxide, oxygen (temperature can be inferred), ozone, and water vapor in the earth stratosphere (10 to 60 km). These measurements are required by IR search and track, VLF and ULF communications, global climate research and ozone depletion monitoring. POAM sensor is also unique to the federal government and the United States, and the world as well by its ability to monitor ozone depletion at a very low cost. The replacement cost of POAM sensor alone without including spacecraft, launch, and operation costs is $5,000,000.

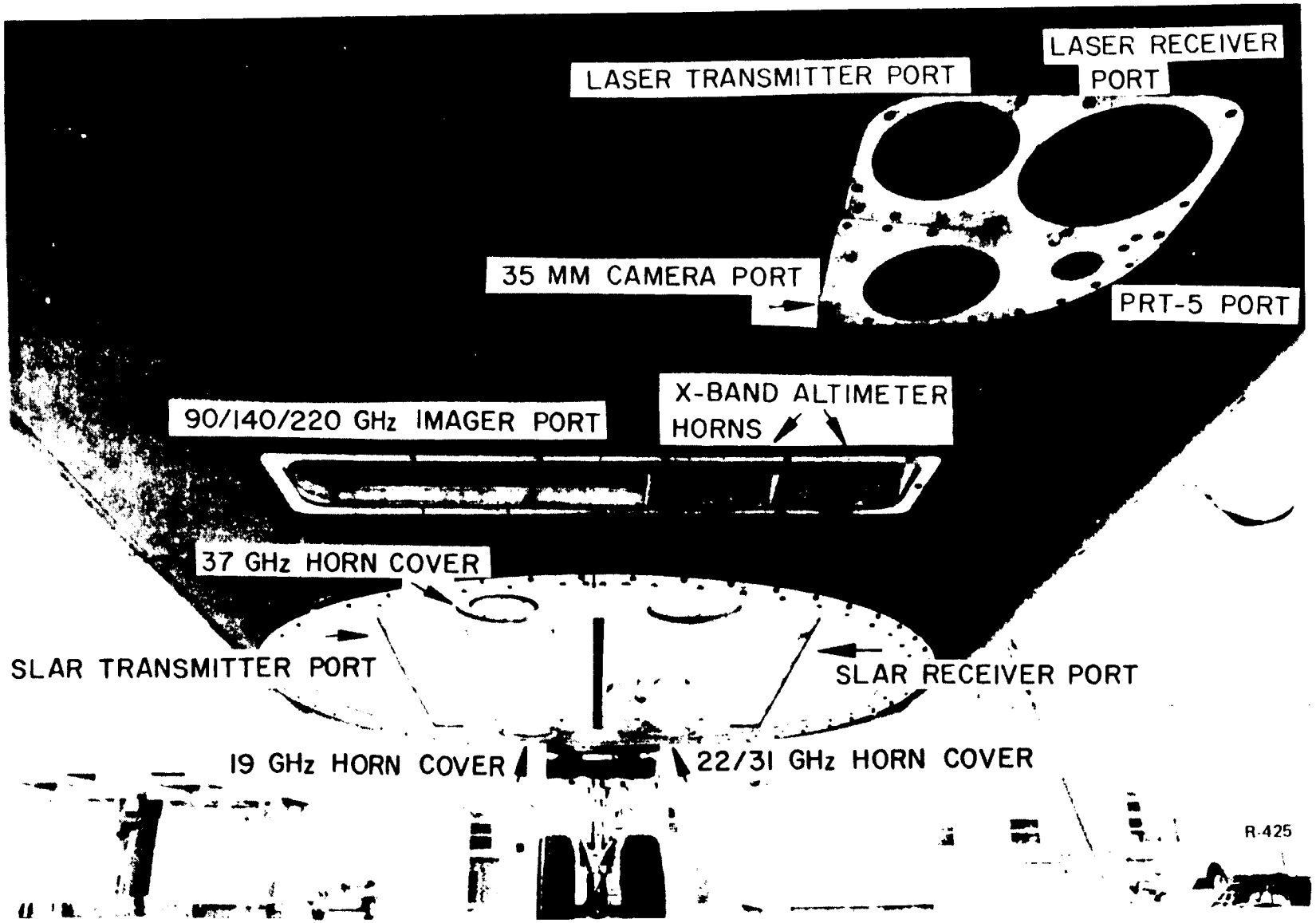


Fig. 2 — The radome underside with the SLAR pallet installed

MULTI-SENSOR SUITE FOR P3 AIRCRAFT

A suite of remote sensing instruments for measurement of open ocean and coastal features operates from P3 research aircraft. Individual sensors include microwave and millimeter-wave real aperature radars, passive millimeter-wave radiometers, microwave and LIDAR altimeter and IR thermal measurement sensors. A multispectral camera can also be integrated. The suite is used for measurements in conjunction with airborne and space SAR experiments such as the recent Shuttle Radar Laboratory.

Estimated replacement value of hardware is $1500K.

Figure 3. Peripherals in TESS Laboratory including TESS 2.0 Workstation (left), laser printer, and personal computer used to simulate data transformation. Satellite Receiving Unit (center).

Figure 4. TESS Laboratory High-resolution Graphic (right) and SUN/X-Window workstations.

Figure 5. Upgrade to the Engineering Developmental Model's high-resolution graphics workstation in TESS Laboratory.

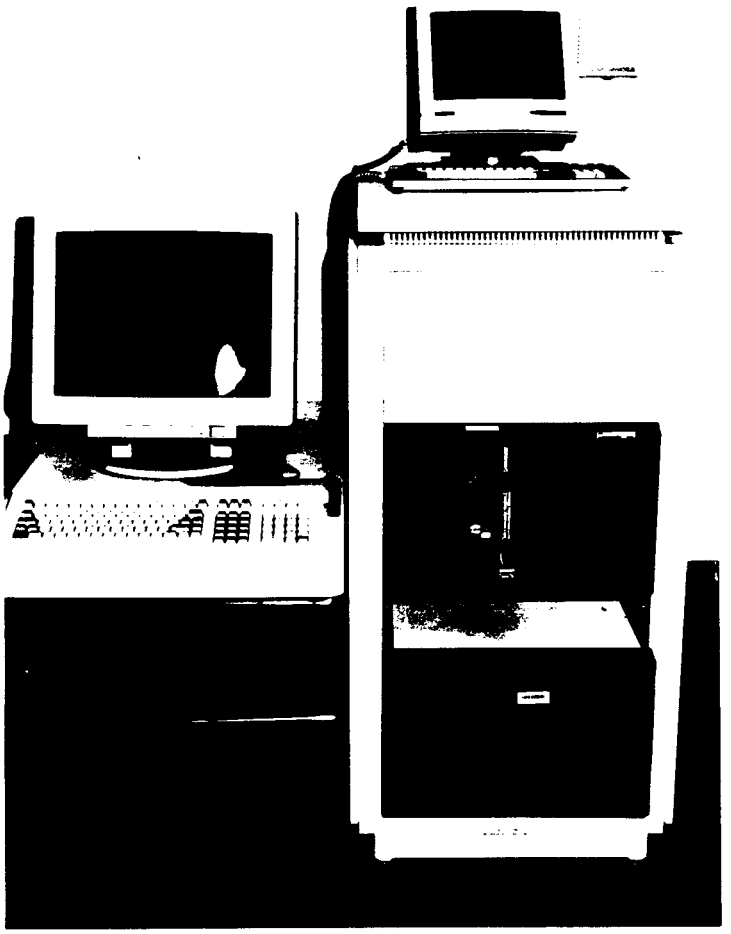


Figure 8. Visualization Laboratory at NRL Marine Meteorology Division includes (from left) a Panasonic Color monitor, Silicon Graphics computer system, (Panasonic video recorder, Silicon Graphics video creator and Mitsubishi monitor.

Figure 9. GOES East and West antennas.

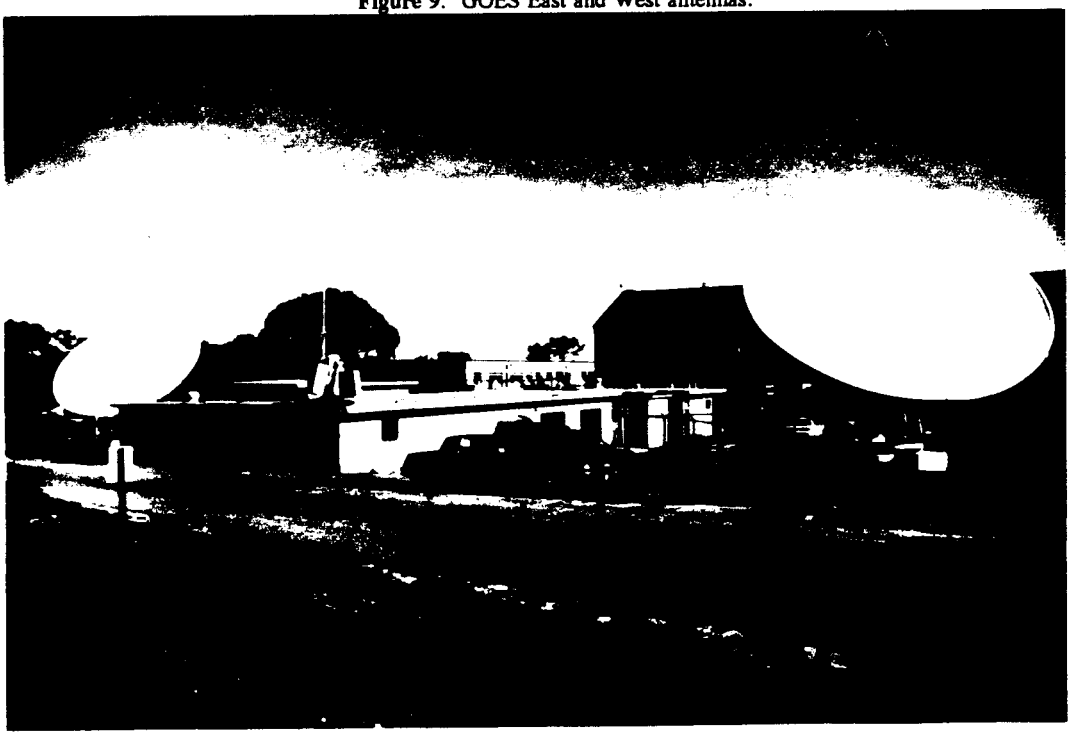


Figure 1. Engineering Development Model #2 and SMQ-11 Satellite Receiving Unit (Center).

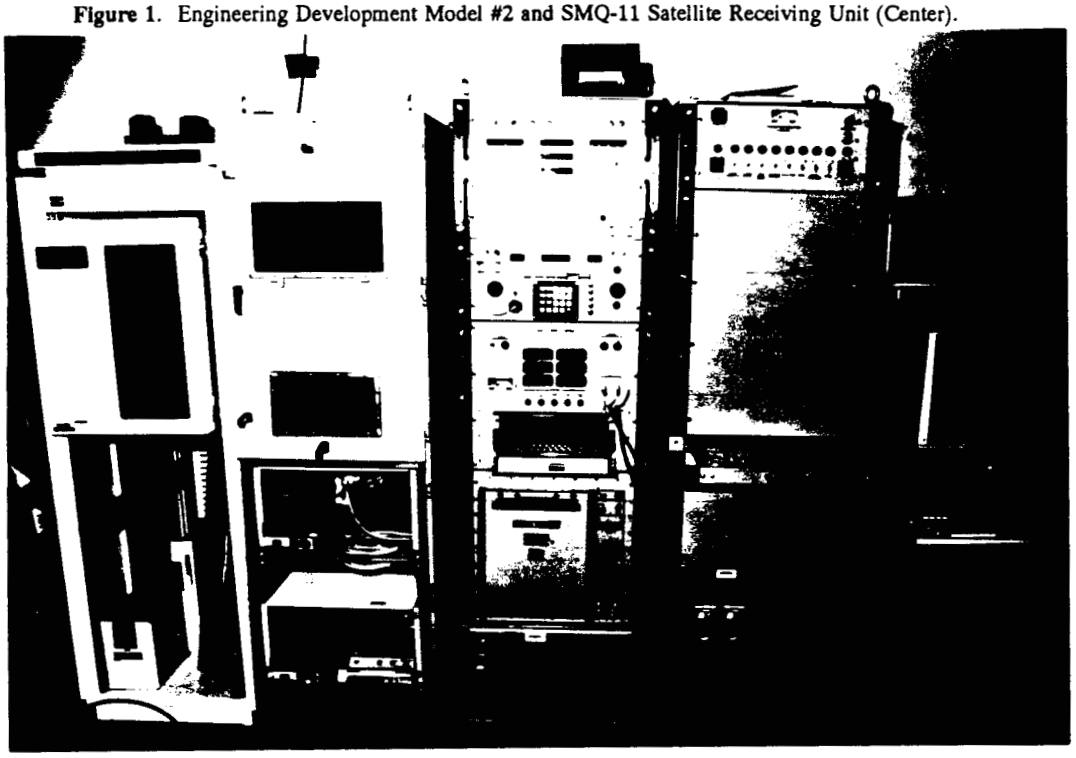


Figure 2. Engineering Development Model #2, High-resolution Graphic and Alphanumeric (center) workstations.

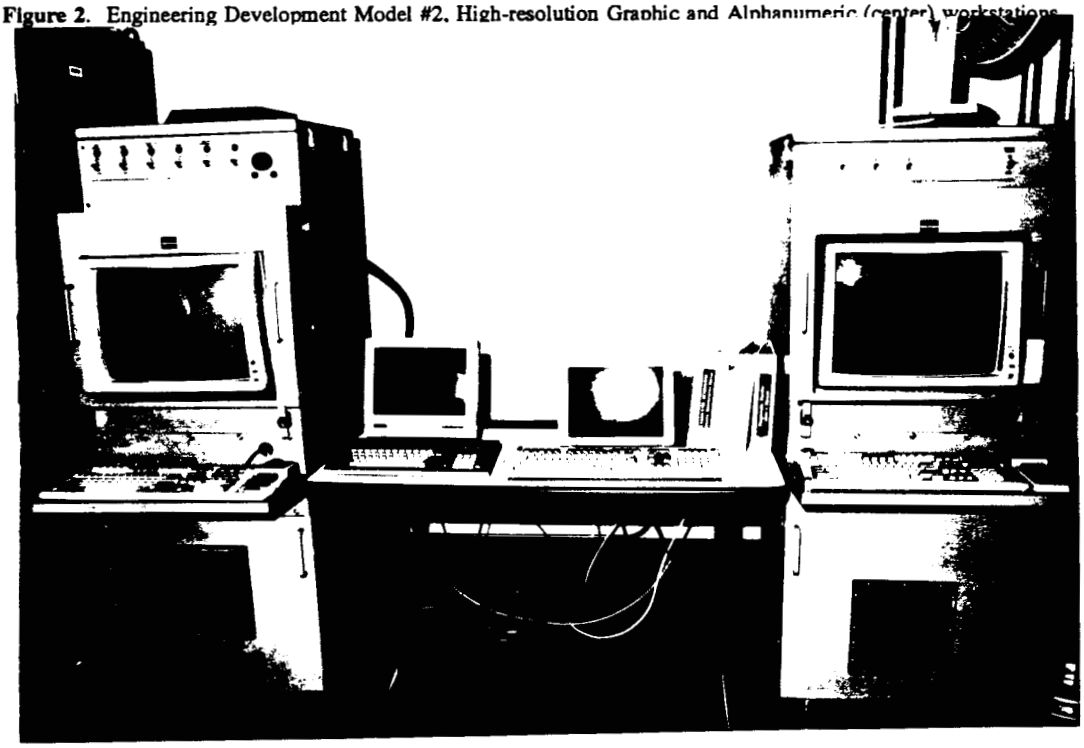


Figure 6. Computer facilities at NRL Marine Meteorology Division.

Figure 7. Computer facilities at NRL Marine Meteorology Division.

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ATTACHMENT A

3.2.4.1 Patent Titles

Pseudo-Random Support Structure for Transmission Gratings, #5,025,464

Optical Communication System Having a Wide Core Planar Waveguide, #4,961,618

Optical Logic Gates with High Extiction Ratio Using Inverse Scattering Techniques

"ELECTROCHEMICAL ETCHING OF AMORPHOUS CARBON ON DIAMOND", Moses, J. Dan (Dr), Marchywka, Michael J., BINARI,S., PEHRSSON,P., J. ELECTROCHEMICAL SOCIETY

"METHOD FOR FORMING ADHERENT SI O2 LAYER ON DIAMOND", Moses, J. Dan (Dr), Marchywka, Michael J., BINARI,S., GEIS,M., HECHT,M., YODER,M., PATENT NAVY CASE # 74,726

"INTERFERENCE PHOTOCATHODE", Seely, John F.(Dr), W. HUNTER, PATENT-NAVY CASE #72,964 U.S. #4,614,871

"LOW-DAMAGE MULTILAYER COATINGS FOR THE SOFT X-RAY REGION", Seely, John F.(Dr), W. R. HUNTER, NAVY PATENT # 73,911

"PROCESS FOR POLISHING AND LARGE AREA POLYCRYSTALLIINE CHEMICALLY VAPOR-DEPOSITED FILMS", Marchywka, Michael J., P. PEHRSSON, PATENT

"X-RAY IMAGING MICROSCOPE", Seely, John F.(Dr), Holland, Glenn, PATENT

"A FOURIER TRANSFORM MICROSCOPE FOR X-RAY AND/OR GAMMA-RAY IMAGING", Feldman, Uri (Dr), Wood, Kent S.(Dr)

3.2.4.2 Paper Titles

PUBLICATIONS
ENVIRONMENTAL SCIENCES

"Location of the dust formation region for Mira Variables" Astrophysical Journal Letters, 390,27, May 1992.

"Positions and Distributions of Water Masers Around Late-Type Stars" Astronomical Journal, 105, 284, January 1993.

"Variability of Interstellar Hydroxyl Masers" Astrophysical Journal, 374, 150, May 1991.

"Rotation Measures of Low-Latitude Extragalactic Sources and the Magnetoionic Structure of the Galaxy" Astrophysical Journal, 386, 143, February 1992.

"Electron Density fluctuations in the Local Interstellar Bubble" Nature, 360, 137, November 1992.

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16 SEP 1994

DIGITAL IMAGE PROCESSING LABORATORY (DIPL)

A central image processing facility (DIPL) provides the Naval Research Laboratory (NRL) with a powerful software/hardware complex for the support of various ongoing programs. The laboratory conducts research in computer-aided image enhancement, image interpretation, and image presentation. It also provides image processing services to various DoD organizations on a special need basis.

The computer room has its own environment control system and it contains about 20 racks of electronic equipment. Central processors include a Sun 4/420, a Sun Sparc 1, a Sun 3/260 (with VICOM image processing station) and a Data General MV/8000 Computer. Additional specialized equipment includes an Optronics Color Writer film recorder. Replacement cost is approximately 1175K.

The capabilities of the DIPL span four basic areas of image processing and image interpretation:

Image Digitization
Digital Image Processing
Digital Image and Graphic Output
Imaging Radar Processing

ATTACHMENT A replaced in its entirety by Pages E-A1R thru E-A27R dated 16SEP94

ATTACHMENT A

3.2.4.1 Patent Titles

Pseudo-Random Support Structure for Transmission Gratings, #5,025,464

Optical Communication System Having a Wide Core Planar Waveguide, #4,961,618

Optical Logic Gates with High Extiction Ratio Using Inverse Scattering Techniques

"ELECTROCHEMICAL ETCHING OF AMORPHOUS CARBON ON DIAMOND", Moses, J. Dan (Dr), Marchywka, Michael J., BINARI,S., PEHRSSON,P., J. ELECTROCHEMICAL SOCIETY

"METHOD FOR FORMING ADHERENT SI O2 LAYER ON DIAMOND", Moses, J. Dan (Dr), Marchywka, Michael J., BINARI,S., GEIS,M., HECHT,M., YODER,M., PATENT NAVY CASE # 74,726

"INTERFERENCE PHOTOCATHODE", Seely, John F.(Dr), W. HUNTER, PATENT-NAVY CASE #72,964 U.S. #4,614,871

"LOW-DAMAGE MULTILAYER COATINGS FOR THE SOFT X-RAY REGION", Seely, John F.(Dr), W. R. HUNTER, NAVY PATENT # 73,911

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3.2.4.2 Paper Titles

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F. ENVIRONMENTAL QUALITY

3.0 Mission. To apply NRL's broad, multidisciplinary intellectual and technological resources to the science and technology issues encompassed by the four Pillars of the DoD Environmental Quality (EQ) program. These issues include monitoring the global environment, clean up of contaminated sites, means of compliance, and pollution prevention. The technical approach to these issues is through NRL's unique capabilities and platforms, for example in areas such as remote sensing in near-to-far-space for global monitoring, as well as three-dimensional mapping of contaminants in the upper and lower atmosphere and on land or sea; environmentally friendly coatings for preventing large-scale corrosion, equipment fouling, and leaching or leaking of toxicants from pipelines and storage tanks; remediation of recalcitrant fuel-spill contaminants through advanced encapsulation and biomolecular technology; and fiber optic and surface acoustic wave sensor technologies for in situ and remote detection and analysis of contaminants in air and liquid waste streams. NRL will remain dedicated not only to achieving and maintaining environmentally sound ships and shore facilities, but to the employment of its unique skills to the enhancement of the national EQ capabilities required to ensure Environmental Security.

3.1 Location

3.1.1 Geographic/Climatological Features. A large, isolated area (NRL's Chesapeake Bay Detachment) is required for intermediate-scale tests of experimental firefighting agents and methods being researched as alternatives to Halon firefighting agents.

A remote berthing area in a sheltered location (Mobile Bay) for the firefighting testbed ship, **ex-USS Shadwell**, serves to allow full-scale ship fires and exercises.

3.1.2 Licenses & permits.

• A Calvert County, MD burning permit for firefighting tests at NRL's Chesapeake Bay Detachment.

• Permission to operate large ship (**ex-USS Shadwell**) as firefighting testbed at Sand Is. in Mobile Bay, Alabama, under the USCG permit to do fire tests at same location.

• Permit to use and store isotopes under NRL site license #08-00173-EINP for Radioactive Use Authorization (RUA) granted by Nuclear Regulatory Commission.

• Controlled Substance Registration Certificate granted by the Department of Justice, Drug Enforcement Administration, to the Center for Biomolecular Science & Engineering for the use and storage of drugs.

3.1.3 Environmental constraints. N/A

3.1.4 Special Support Infrastructure.

• Laboratories with clean room facilities are available at NRL to fabricate optical fibers needed for the fiber optic infrared (IR) chemical sensors. Additional special facilities include optical fiber preform manufacturing equipment, a fiber draw tower, and miscellaneous purification facilities. Special test equipment includes IR spectrometers, IR lasers and detectors, and optical measurement facilities.

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BRAC DATA CALL 12, SEC. III - COMMON SUPPORT FUNCTIONS - - ENVIRONMENTAL QUALITY

Filename BRAC12EQ.#5 8/1/94 2:30 P.M.

3. Mission: To apply NRL's broad, multidisciplinary intellectual and technological resources to the science and technology issues encompassed by the four Pillars of the DoD Environmental Quality (EQ) program. These issues include monitoring the global environment, clean up of contaminated sites, means of compliance, and pollution prevention. The technical approach to these issues is through NRL's unique capabilities and platforms, for example in areas such as remote sensing in near-to-far-space for global monitoring, as well as three-dimensional mapping of contaminants in the upper and lower atmosphere and on land or sea; environmentally friendly coatings for preventing large-scale corrosion, equipment fouling, and leaching or leaking of toxicants from pipelines and storage tanks; remediation of recalcitrant fuel-spill contaminants through advanced encapsulation and biomolecular technology; and fiber optic and surface acoustic wave sensor technologies for in situ and remote detection and analysis of contaminants in air and liquid waste streams. NRL will remain dedicated not only to achieving and maintaining environmentally sound ships and shore facilities, but to the employment of its unique skills to the enhancement of the national EQ capabilities required to ensure Environmental Security.

Revision
7CE/ONR91
8/17/94

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F. ENVIRONMENTAL QUALITY

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3.1 Location

3.1.1 Geographic/Climatological Features. A large, isolated area (NRL's Chesapeake Bay Detachment) is required for intermediate-scale tests of experimental firefighting agents and methods being researched as alternatives to Halon firefighting agents.

A remote berthing area in a sheltered location (Mobile Bay) for the firefighting testbed ship, **ex-USS Shadwell**, serves to allow full-scale ship fires and exercises.

3.1.2 Licenses & permits.

• A Calvert County, MD burning permit for firefighting tests at NRL's Chesapeake Bay Detachment.

• Permission to operate large ship (**ex-USS Shadwell**) as firefighting testbed at Sand Is. in Mobile Bay, Alabama, under the USCG permit to do fire tests at same location.

• Permit to use and store isotopes under NRL site license #08-00173-EINP for Radioactive Use Authorization (RUA) granted by Nuclear Regulatory Commission.

• Controlled Substance Registration Certificate granted by the Department of Justice, Drug Enforcement Administration, to the Center for Biomolecular Science & Engineering for the use and storage of drugs.

3.1.3 Environmental constraints. N/A

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• Laboratories with clean room facilities are available at NRL to fabricate optical fibers needed for the fiber optic infrared (IR) chemical sensors. Additional special facilities include optical fiber preform manufacturing equipment, a fiber draw tower, and miscellaneous purification facilities. Special test equipment includes IR spectrometers, IR lasers and detectors, and optical measurement facilities.

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• NRL's fiber sensor construction facilities include coil winding machines, optical fiber fusion splicers, annealing facilities for sensing materials, and degassing facilities. Sensor evaluations utilize computer controlled data reduction and analysis stations both for acoustic and magnetic sensors. There is a unique environmental chamber which operates from -50°C to 100°C for lifetime testing of prototype sensors.

• Special infrastructure has evolved in connection with joint fire testing operations with USCG, Mobile Bay, Alabama

• The nature of available utilities is an important part of the supporting infrastructure. For example, much of the experimental work requires a sufficiency of "clean" power of adequate amperage (high amperage 440V, 220V, 208 three phase, etc). "Clean", controlled air is also required, and controlled atmosphere chambers (Class 100 Clean Rooms; 50% humidity with less than 5% fluctuation at 20°C; P2 Facilities; Cold Rooms). An extensive chilled water system (for lasers & spectrometers) and major storage/supplies of cryogenic fluids are essential.

3.1.5 **Proximity to Mission-Related organizations:**

Common Support Function	Name	Type of Organization	Distance	Workyrs Performed by Your Activity	Workyrs Funded by Your Activity
Environmental Quality	US Army Environmental Center	US Army	40 mi.	7.0	7.0
Environmental Quality	Naval Sea Systems Comm., Naval Air Systems Command	SYSCOMS - Hdqtrs & support staff	9 mi.	N/A	N/A
Environmental Quality	U.S. Coast Guard fire training center, Mobile Bay, AL	Government	Colocated Sand Is., Mobile	N/A	N/A
Environmental Quality	Naval Surface Warfare Center-Annapolis	Navy	40 mi.	0.8	0.5
Environmental Quality	National Institutes of Health	Government	10 mi.	N/A	N/A

3.2 Personnel:

3.2.1 Total Personnel:

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
Environ. Quality	Civilian	Military		
Technical	49	0	0	33
Management (Supv)	10	2	0	0
Other	0	0	0	2

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Environmental Quality	U.S. Coast Guard fire training center, Mobile Bay, AL	Government	Colocated Sand Is., Mobile	N/A	N/A
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Environmental Quality	National Institutes of Health	Government	10 mi.	N/A	N/A

3.2 Personnel:

3.2.1 Total Personnel:

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
Environ. Quality	Civilian	Military		
Technical	49	0	0	33
Management (Supv)	10	2	0	0
Other	6	0	0	2

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Environmental Quality	National Institutes of Health	Government	10 mi.	N/A	N/A

3.2 Personnel:

3.2.1 Total Personnel:

Types of personnel	Number of Personnel			
	Government		On-Site FFRDC	On-Site SETA
Electronic Devices	Civilian	Military		
Technical	49	0	0	33
Management (Supv)	10	2	0	0
Other	6	0	0	2

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3.2.2 Education.

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less	1	0	0
Associates	1	0	0
Bachelor	5	1	0
Masters	5	0	0
Doctorate (include Med/Vet/etc.)	37	11	0

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3.2.3 Experience.

Type of Position	Years of Government and/or Military Service (Includes Military)				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	4	21	9	0	15
Management (Supv)	0	2	3	1	6
Other	0	0	0	0	0

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3.2.4. Accomplishments During FY91-93.

3.2.4.1. Patents

CSF	Disclosures Total=26	Awarded Total=16	Patent Titles (List)
Environmental Quality		#5,049,382 9/17/91	Marine Antifouling Coating with Lipid Microstructures and Encapsulated Toxicant (Price et al.)
Environmental Quality		#5,061,857 10/29/91	Waveguide-Binding Sensor for Use with Assays (Thompson)
Environmental Quality		#5,108,931 4/28/92	Method for Detecting Chemical Vapors using a Lasing Dye Sensor (Barrett et al.)
Environmental Quality		#5,111,221 5/5/92	Receptor-Based Sensor (Fare et al.)
Environmental Quality		#5,141,312 8/5/92	Fiber Optic Photoluminescence Sensor (Thompson et al.)
Environmental Quality		#5,162,274 11/10/92	Regeneration of Whetlerite for Adsorbing Toxic Pollutants from Air (Dietz)
Environmental Quality		#5,183,740 2/2/93	Flow Immunosensor and Apparatus (Ligler et al.)
Environmental Quality		#5,185,131 2/9/93	Lasing Dye Sensor for Chemical Applications (Barrett et al.)
Environmental Quality		#5,192,667 3/9/93	Method for Evaluating Anti-Fouling Paints (Stiffey)

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3.2.2 Education.

Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less	1	0	6
Associates	1	0	0
Bachelor	5	1	0
Masters	5	0	0
Doctorate (include Med/Vet/etc.)	37	11	0

3.2.3 Experience.

Type of Position	Years of Government and/or Military Service (Includes Military)				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	4	21	9	0	15
Management (Supv)	0	2	3	1	6
Other	2	0	1	1	2

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Type of Degree/ Diploma	Number of Government Personnel by Type of Position		
	Technical	Management (Supv)	Other
High School or Less	1	0	6
Associates	1	0	0
Bachelor	5	1	0
Masters	5	0	0
Doctorate (include Med/Vet/etc.)	37	11	0

3.2.3 Experience.

Type of Position	Years of Government and/or Military Service (Includes Military)				
	Less than 3 years	3-10 years	11-15 years	16-20 years	More than 20 years
Technical	4	21	9	0	15
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Environmental Quality		#5,206,592 4/27/93	Detection of Explosives by Nuclear Quadrupole Resonance (Buess et al.)
Environmental Quality		#5,225,374 7/6/93	Method of Fabricating a Receptor-based Sensor (Fare et al.)
Environmental Quality		#5,233,300 8/3/93	Detection of Explosive and Narcotics by Low Power Large Sample Volume Nuclear Quadrupole Resonance (NQR)
Environmental Quality		#5,238,610 8/24/93	Method of Detecting Oxidizing Agents in Aqueous Media Through the use of Chemiluminescent Emulsions (Thompson)
Environmental Quality		#5,260,414 11/9/93	Spirobislactone Acrylate Polymers (Sikes and Brady)
		#5,270,853 1993	Method and Apparatus for Imaging an Object in or Through a Scattering Medium by Using Multiple-Wave Mixing
Environmental Quality		Statutory Invention Regis. No. 07/627,393	Laser Aerosol Infrared Decoy
Environmental Quality	Case 72234		Methods for the Isolation of Gene Activation Factors (Chang)
Environmental Quality	Case 72625		Detection of Explosives by Nuclear Quadrupole Resonance (Buess et al.)
Environmental Quality	Case 73336		The Optical Correlation Spectrometer
Environmental Quality	Case 73375		Detection of Toxins (Ligler et el.)
Environmental Quality	Case 73545		Electrified Microheterogeneous Catalysis (Rolison & Stemple)
Environmental Quality	Case 73545		Electric-Field Driven Reactions in Microheterogeneous Media (Rolison et al.)
Environmental Quality	Case 73563		Decomposition and Detoxification of Polychlorinated Biphenyls by Application ofElectric Fields to Microheterogeneous Media (Rolison et al.)
Environmental Quality	Case 73568		Sensor for Single Molecule Recognition (Colton et al.)
Environmental Quality	Case 73614		Decomposition of Halogenated and Polyhalogenated Organic Materials by Electrified Microheterogeneous Catalysis (Rolison & Stemple)
Environmental Quality	Case 74036		Nontoxic Antifouling System (Griffith)
Environmental Quality	Case 74122		Polymerizable Lipids in the Development of Controlled Release Carriers (Singh et al.)
Environmental Quality	Case 74172		Method of controlled Release and controlled Release Microstructure (Price et al.)

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Environmental Quality	Case 74172		Method of controlled Release and controlled Release Microstructure (Price et al.)

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Environmental Quality	Case 74285		Time Gated Imaging Through Dense-Scattering Materials Using Stimulated Raman Amplification
Environmental Quality	Case 74286		Time Gated Image Detector Using Correlated Coherent Anti-Stokes Raman Scattering
Environmental Quality	Case 74322		A Smart Sensor System and Method Using A Surface Acoustic Wave Vapor Sensor Array and Pattern Recognition for Selective Trace Organic Vapor Detection (Rose-Pehrsson et al.)
Environmental Quality	Case 74325		Improvements in Explosives Detection by NQR (Buess et al.)
Environmental Quality	Case 74399		Flow Immunosensor (Ligler et al.)
Environmental Quality	Case 74772		Nucleic Acid Reagents for the Inhibition of Malaria Infections (Chrisey et al.)
Environmental Quality	Case 74848		DNA-Based Fluorescent Sensor (Campbell)
Environmental Quality	Case 74852		Real Suspended Particle Monitor (Reintjes)
Environmental Quality	Case 74974		Time Gated Imaging Through Scattering Material Using Polarization and Stimulated Raman Amplification .
Environmental Quality	Case 75121		Mode-Matched Combination Tape Fiber Optic Probe (Anderson et al.)
Environmental Quality	Case 75315		Optical Immunoassay for Microbial Analytes using Non-Specific Dyes (Ligler et al.)
Environmental Quality	Case 75451		The Fluorescence Detection of Hydrazines via Derivatization with 2,3-Napthalene Dicarboxaldehyde and 2,3-Anthracene Dicarboxaldehyde
Environmental Quality	Case 75677		Non-Covalent Immobiliozation of Proteins on Polymerized Lipid Assemblies (Singh)
Environmental Quality	Case 76105		Epoxy Pipe Linings (Adkins and Brady)

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Environmental Quality	Case 74285		Time Gated Imaging Through Dense-Scattering Materials Using Stimulated Raman Amplification
Environmental Quality	Case 74286		Time Gated Image Detector Using Correlated Coherent Anti-Stokes Raman Scattering
Environmental Quality	Case 74322		A Smart Sensor System and Method Using A Surface Acoustic Wave Vapor Sensor Array and Pattern Recognition for Selective Trace Organic Vapor Detection (Rose-Pehrsson et al.)
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Environmental Quality	Case 74852		Real Suspended Particle Monitor (Reintjes)
Environmental Quality	Case 74974		Time Gated Imaging Through Scattering Material Using Polarization and Stimulated Raman Amplification .
Environmental Quality	Case 75121		Mode-Matched Combination Tape Fiber Optic Probe (Anderson et al.)
Environmental Quality	Case 75315		Optical Immunoassay for Microbial Analytes using Non-Specific Dyes (Ligler et al.)
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Environmental Quality	Case 75677		Non-Covalent Immobiliozation of Proteins on Polymerized Lipid Assemblies (Singh)
Environmental Quality	Case 76105		Epoxy Pipe Linings (Adkins and Brady)

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3.2.4.2 Papers

1. "Absorption effects on microdroplet resonant emission structure", P. Chylek, H-B. Lin, J.D. Eversole, and A.J. Campillo, *Opt. Lett.*, **16**, 1723 (1991). R

2. "A New Fluorinated Polyurethane: Polymerization, Characterization and Mechanical Properties" T. Ho and K.J. Wynne, *Macromolecules*, **25**, 3521 (1992)

3. "A Fiber Optic Evanescent Wave Immunosensor for Large Molecules", L.C. Shriver-Lake, R.A. Ogert, and F.S. Ligler, *Sensors and Actuators B*, **11**, 239 (1993)

4. "Absorption Effects on Microdroplet Resonant Emission Structure", P. Chylek, H-B. Lin, J.D. Eversole, and A.J. Campillo, *Opt. Lett.*, **16**, 1723 (1991). R

5. "Anionic Copolymerization of Bislactone End-Capped Diols with the Diglycidyl Ether of Bisphenol A", R.F. Brady and A.M. Sikes, *Macromolecules*, **24**, 688 (1991)

6. "Cavity Modified Spontaneous Emission Rates in Liquid Microdroplets", H-B. Lin, J.D. Eversole, C.D. Merritt and A.J. Campillo, *Phys. Rev. A*, **45**, 6756 (1992).

7. "Cavity Quantum Electrodynamic Enhancement of Spontaneous and Stimulated Emission in Microdroplets", A.J. Campillo, J.D. Eversole and H-B. Lin, *Mod. Phys. Lett. B.*, **6**, 447 (1992).

8. "Cavity Quantum Electrodynamic Enhancement of Stimulated Emission in Microdroplets", A.J. Campillo, J.D. Eversole and H-B. Lin, *Phys. Rev. Lett.*, **67**, 437 (1991). R

9. "Cavity Mode Identification of Fluorescence and Lasing in Dye-doped Microdroplets", J.D. Eversole, H-B. Lin and A.J. Campillo, *Appl. Opt.*, **31**, 1982 (1992).

10. "Continuous Flow Immunosensor for Detection of Explosives", J.P. Whelan, A.W. Kusterbeck, G.A. Wemhoff, R. Bredehorst, and F.S. Ligler, *Analytical Chemistry*, **65**, 3561 (1993)

11. "Controlled Release From Cylindrical Microstructures", R.R. Price and M. Patchan, *J. of Microencapsulation*, **8(3)**, 301 (1991)

12. "Correlation Effects in Pump-depleted Broadband Stimulated Raman Amplification", M. Bashkansky and J. Reintjes, *Opt. Comm.*, **83**, 103 (1991).

13. "Coulometric Method for the Quantification of Low Level Concentrations of Hydrazine and Monomethylhydrazine" J.R. Wyatt, S.L. Rose-Pehrsson, K.P. Crossman, T.L. Cecil, N.K. Mehta and R. Young, *Am. J. Ind. Hygiene*, **54**, 285 (1993).

14. "CW Stimulated Raman Scattering in Microdroplets", H-B. Lin, J.D. Eversole and A.J. Campillo, *Opt. Lett.*, **17**, 828 (1992).

15. "Detection of *Clostridium Botulinum* Toxin A Using a Fiber Optic-Based Biosensor", J.E. Brown, B.R. Singh, R. Ogert, L. Shriver-Lake, and F.S. Ligler, *Analytical Biochemistry*, **205**, 306 (1992) R

16. "Detection of Low Levels of Trichloroethylene Vapor Using Raman Spectroscopy

17. "Development of a Fiber-Optic Sensor for Trace Metal Detection in Aqueous Environments" A.M. Ervin, K.J. Ewing, R.A. Lamontagne, I.D. Aggarwal and D.A Rowley, *Applied Optics*,

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3.2.4.2 Papers.

CSF	Number Published Total=72	Paper Titles (List)
Environmental Quality		"A New Fluorinated Polyurethane: Polymerization, Characterization and Mechanical Properties"
Environmental Quality		"A Fiber Optic Evanescent Wave Immunosensor for Large Molecules"
Environmental Quality		"A Nonequilibrium Phase in 1-octadecanol Monolayers on Levitated Waterdrops"
Environmental Quality		"Absorption Effects on Microdroplet Resonant Emission Structure"
Environmental Quality		"Absorption Spectroscopy Using Microdroplet Resonance Fluorescence Intensities"
Environmental Quality		"Anionic Copolymerization of Bislactone End-Capped Diols with the Diglycidyl Ether of Bisphenol A"
Environmental Quality		"Cavity Modified Spontaneous Emission Rates in Liquid Microdroplets"
Environmental Quality		"Cavity Quantum Electrodynamic Enhancement of Stimulated Emission in Microdroplets"
Environmental Quality		"Cavity Mode Identification of Fluorescence and Lasing in Microdroplets"
Environmental Quality		"Continuous Flow Immunosensor for Detection of Explosives"
Environmental Quality		"Correlation Effects in Pump-depleted Broadband Stimulated Raman Amplification"
Environmental Quality		"Coulometric Method for the Quantification of Low Level Concentrations of Hydrazine and Monomethylhydrazine"
Environmental Quality		"CW Stimulated Raman Scattering in Microdroplets"
Environmental Quality		"Detection of Low Levels of Trichloroethylene Vapor Using Raman Spectroscopy
Environmental Quality		"Development of a Fiber-Optic Sensor for Trace Metal Detection in Aqueous Environments"
Environmental Quality		"Electrified Microheterogeneous Catalysis in Low Ionic Strength Media"
Environmental Quality		"Entrapment and Release Characteristics of 2-Methoxynaphthalene from Cylindrical Microstructures Formed from Phospholipids"
Environmental Quality		"Epoxy Anticorrosion Coatings for Copper-Nickel Piping"
Environmental Quality		"Evaluation of Shipboard Formation of a Neurotoxicant (Trimethylolpropane Phosphate) from Thermal Decomposition of Synthetic Aircraft Lubricant"
Environmental Quality		"Evaluation of Refractivity Intercept as a Method for Determining Fuel Composition According to Hydrocarbon Type"
Environmental Quality		"Evaporation Kinetics of Ventilated Waterdrops Coated with Octadecanol Monolayers"

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3.2.4.2 Papers.

CSF	Number Published Total=72	Paper Titles (List)
Environmental Quality		"A New Fluorinated Polyurethane: Polymerization, Characterization and Mechanical Properties"
Environmental Quality		"A Fiber Optic Evanescent Wave Immunosensor for Large Molecules"
Environmental Quality		"A Nonequilibrium Phase in 1-octadecanol Monolayers on Levitated Waterdrops"
Environmental Quality		"Absorption Effects on Microdroplet Resonant Emission Structure"
Environmental Quality		"Absorption Spectroscopy Using Microdroplet Resonance Fluorescence Intensities"
Environmental Quality		"Anionic Copolymerization of Bislactone End-Capped Diols with the Diglycidyl Ether of Bisphenol A"
Environmental Quality		"Cavity Modified Spontaneous Emission Rates in Liquid Microdroplets"
Environmental Quality		"Cavity Quantum Electrodynamic Enhancement of Stimulated Emission in Microdroplets"
Environmental Quality		"Cavity Mode Identification of Fluorescence and Lasing in Microdroplets"
Environmental Quality		"Continuous Flow Immunosensor for Detection of Explosives"
Environmental Quality		"Correlation Effects in Pump-depleted Broadband Stimulated Raman Amplification"
Environmental Quality		"Coulometric Method for the Quantification of Low Level Concentrations of Hydrazine and Monomethylhydrazine"
Environmental Quality		"CW Stimulated Raman Scattering in Microdroplets"
Environmental Quality		"Detection of Low Levels of Trichloroethylene Vapor Using Raman Spectroscopy
Environmental Quality		"Development of a Fiber-Optic Sensor for Trace Metal Detection in Aqueous Environments"
Environmental Quality		"Electrified Microheterogeneous Catalysis in Low Ionic Strength Media"
Environmental Quality		"Entrapment and Release Characteristics of 2-Methoxynaphthalene from Cylindrical Microstructures Formed from Phospholipids"
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Environmental Quality		"Evaporation Kinetics of Ventilated Waterdrops Coated with Octadecanol Monolayers"

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20. "Entrapment and Release Characteristics of 2-Methoxynaphthalene from Cylindrical Microstructures Formed from Phospholipids", R. Price and M. Patchan, *Journal of Microencapsulation*, **10**, 215 (1993)

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Environmental Quality		"Gas Scavenging of Organic Materials by Levitated Waterdrops"
Environmental Quality		"Halon 1301 Test Gas Simulants"
Environmental Quality		"High Precision Identification of Morphology Dependent Resonances in Optical Processes in Microdroplets"
Environmental Quality		"Imaging Through a Strong Scattering Medium with Nonlinear Optical Field Cross-correlation Techniques"
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49. "On the Characterization of the Reaction of Organotin Compounds with D-Glucuronic Acid" H.E. Guard, W.M. Coleman and M.M. Ross, *Carbohydrate Research*, **235**, 41 (1992).

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53. "Rapid and Specific Identification of *Yersinia pestis*, using a Nested Polymerase Chain Reaction", J.R. Campbell, J. Lowe, S.E. Walz, and J. Ezzell, *Journal of Clinical Microbiology*, **31**, 758 (1993)

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NOTE: There is very significant non-peer review journal technology transfer, both written and oral, formal and informal, to other DoD, government, civilian, and international functions. As just one example, this includes an Invited Presentation to the National Fire Protection Association 2001 Committee, specifically to guide formulation of the US Standard for Halon Replacements; invitation by the President-Elect of the Society of Fire Protection Engineers to give an encompassing advanced research developments lecture at their upcoming meeting; and an Invited Presentation at the special Symposium on Ozone Depleting Compounds at the August '94 National American Chemical Society Meeting. There is strong participation (and presentations, with published proceedings) at the Halons Options Technical Working Conference (4 papers); CF_3I Ad Hoc Working Group (Gov-Ind-Univ consortium, which decided to sponsor additional research at NRL); SFE (Solid fine aerosol fire suppressant) Working Group (Gov-Ind-Univ consortium); and the International CFC/HALON Alternatives Conference. This is in addition to scientific presentations to the International Combustion InstitutE and Eastern States (US) Section of the International Combustion Institute. There is also direct participation in the Montreal Protocol process as a US Representative on the Halon Technical Options Committee of the United Nations. Committee duties include evaluation of halon production exemption requests from the signatory country governments.

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle.

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	37.7	3.3		26.5
Engineering Development	2.0			3.0
In-Service Engineering	0	0	0	0

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NOTE: There is very significant non-peer review journal technology transfer, both written and oral, formal and informal, to other DoD, government, civilian, and international functions. As just one example, this includes an Invited Presentation to the National Fire Protection Association 2001 Committee, specifically to guide formulation of the US Standard for Halon Replacements; invitation by the President-Elect of the Society of Fire Protection Engineers to give an encompassing advanced research developments lecture at their upcoming meeting; and an Invited Presentation at the special Symposium on Ozone Depleting Compounds at the August '94 National American Chemical Society Meeting. There is strong participation (and presentations, with published proceedings) at the Halons Options Technical Working Conference (4 papers); CF_3I Ad Hoc Working Group (Gov-Ind-Univ consortium, which decided to sponsor additional research at NRL); SFE (Solid fine aerosol fire suppressant) Working Group (Gov-Ind-Univ consortium); and the International CFC/HALON Alternatives Conference. This is in addition to scientific presentations to the International Combustion InstitutE and Eastern States (US) Section of the International Combustion Institute. There is also direct participation in the Montreal Protocol process as a US Representative on the Halon Technical Options Committee of the United Nations. Committee duties include evaluation of halon production exemption requests from the signatory country governments.

3.3 Workload

3.3.1 FY93 Workload

3.3.1.1 Work Year and Lifecycle.

"LAB"	Fiscal Year 1993 Actual			
	Civilian	Military	FFRDC	SETA
Science & Technology	37.7	3.3		26.5
Engineering Development	2.0			3.0
In-Service Engineering	0	0	0	0

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3.3.1.2 Engineering Development By ACAT.

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
ACAT IC	(Name)	N/A		(Description)
ACAT ID	(Name)	N/A		(Description)
ACAT II	(Name)	N/A		(Description)
ACAT III/IV	(Number)	N/A		(List)
Other	(Number)	N/A		(List)

3.3.1.3 In-Service Engineering

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received (Obligation Authority)	Workyears	
N/A	N/A	N/A	N/A	N/A

3.3.2 Projected Funding.

3.3.2.1 Direct Funding.

CSF	FY94	FY95	FY96	FY97
N/A	N/A	N/A	N/A	N/A

3.3.2.2 Other Obligation Authority.

CSF	FY94 ($K)	FY95 ($K)	FY96 ($K)	FY97 ($K)
TOTAL	14052	14774	15033	15372

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3.3.1.2 Engineering Development By ACAT.

Engineering Development	Name or Number	Workyears (FY93 Actual)	FY93 Funds Received (Obligation Authority)	Narrative
ACAT IC	(Name)	N/A		(Description)
ACAT ID	(Name)	N/A		(Description)
ACAT II	(Name)	N/A		(Description)
ACAT III/IV	(Number)	N/A		(List)
Other	(Number)	N/A		(List)

3.3.1.3 In-Service Engineering

Common Support Functions	In-Service Engineering Efforts (List)	FY93 Actual		Weapon System(s) Supported
		Funds Received (Obligation Authority)	Workyears	
N/A	N/A	N/A	N/A	N/A

3.3.2 Projected Funding.

3.3.2.1 Direct Funding.

CSF	FY94	FY95	FY96	FY97
N/A	N/A	N/A	N/A	N/A

3.3.2.2 Other Obligation Authority.

CSF	FY94 ($K)	FY95 ($K)	FY96 ($K)	FY97 ($K)
TOTAL	14052	14774	15033	15372

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3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities.

		Unique To			
Common Support Function	**Major Facility or Equipment Description**	**DOD**	**Federal Gov't**	**U. S.**	**Replacement Cost ($K)**
EQ=14% Electronics=70% Adv. Mat'ls=14% DualUse=2%	Laser Probe Facility (see description below)	YES	YES		2000
EQ=15% Strain sensors for hulls & wings=10% Undersea sensors=75%	World-unique Fiber construction & evaluation facilities for optical, acoustic, & magnetic sensors	YES	YES	YES	2100
EQ=20% Adv. Mat'ls=20% Sensors=20% Electronics=20% Diagnostics=20%	Laser Systems and Spectrometers				2175
EQ=100%	Multisensor Towed Array Detection System (MTADS) (see description below)	YES	YES		2500
EQ=40% Lo-observables=30% Exploratory=5%	Coating Facility (see description below)	no	no	no	400
EQ=30% Damage control=25%; Fire-fighting 25%; Model verification=10%; Training=10%	Ex-USS Shadwell, Fire Research Ship & Testbed (see description below)	YES	YES	YES	10,000
EQ=20%; Mat'ls & Stds=50% FF Doctrine=20% Simulations=10%	The Fire Research Facility at CBD (see description below)	YES	YES		3000
	TOTAL				**22275**

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3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities:

Common Support Function	Major Facility or Equipment Description	Unique To			Replacement Cost ($K)
		DOD	Federal Gov't	U. S.	
EQ=14% Electronics=70% Adv. Mat'ls=14% DualUse=2%	Laser Probe Facility (see description below)	YES	YES		2000
EQ=15% Strain sensors for hulls & wings=10% Undersea sensors=75%	World-unique Fiber construction & evaluation facilities for optical, acoustic, & magnetic sensors	YES	YES	YES	2100
EQ=20% Adv. Mat'ls=20% Sensors=20% Electronics=20% Diagnostics=20%	Laser Systems and Spectrometers				2175
EQ=100%	Multisensor Towed Array Detection System (MTADS) (see description below)	YES	YES		2500
EQ=40% Lo-observables=30% Exploratory=5%	Coating Facility (see description below)	no	no	no	400
EQ=30% Damage control=25%; Fire-fighting 25%; Model verification=10%; Training=10%	Ex-USS Shadwell, Fire Research Ship & Testbed (see description below)	YES	YES	YES	10,000
EQ=20%; Mat'ls & Stds=50% FF Doctrine=20% Simulations=10%	The Fire Research Facility at CBD (see description below)	YES	YES		3000
	TOTAL				**22275**

Revision
7C4/JNR9/
8/17/94

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LASER PROBE FACILITY: This facility consists presently of seven laser laboratories that are dedicated to a wide range of material parameter measurements and optical characterization spanning wavelengths from the UV to the IR. Material properties investigated include optical transmission, elastic and inelastic scattering, ground and excited state absorption, nonlinear and electro-optical constants, free carrier- and photo-transport, magneto-optical, band structure, lattice structure, photonic band behavior, quantum confinement and reduced dimensionality, cavity QED behavior, inter- and intra-molecular energy transfer rates, electroluminescence and low temperature excitonic behavior. Laser spectroscopies utilized include spontaneous and coherent Raman, degenerate and non-degenerate four wave mixing, photothermal, second and third harmonic generation, two-photon absorption, z-scan, subpicosecond transient absorption, laser-induced fluorescence, and subpicosecond excite-probe.

MTADS: The Multi-sensor Towed Array Detection System, ***MTADS***, is an operating prototype of a unique, fully field-worthy, commercializable site characterization instrument designed to address most remediation requirements for locating buried ordnance while sharply lowering the cost of site characterizations. The system carries an array of seven full-field magnetometers and other sensors which address a spectrum of hazards, including chemicals, radioactivity, and buried ordnance and other ferrous materials. Sophisticated software reduces the data into interpolated images allowing clear visualization of both large, deeply buried, and small, shallow ordnance items. Targets are iteratively computer-fit with an algorithm to determine position, depth and size. The ***MTADS*** will provide for high speed, wide area, non-intrusive site characterization. Specifically, *MTADS* is a ground mobile towed-array system incorporating precise GPS navigation data with sensitive sensor measurements and powerful computer imaging and analysis capabilities. R

COATINGS FACILITY: The Coatings Laboratory is used 75% of the time (including 15% on this CSF) and has facilities to formulate, manufacture, apply, and test (lab and field) new organic coatings. Dissolvers (Cowles, Dispermat), Keith 3-roll mills, Binks spray booths, air- and airless spray equipment (Binks, Grayco), and lab facilities for thermal, mechanical, chemical, physical, and optical evaluation; shares field sites at Key West and CBD for durability, weathering, and antifouling testing.

EX-USS SHADWELL (LSD-15) is a decommissioned 475-ft vessel which has been extensively renovated and instrumented as a firefighting and damage control testbed; selected ship systems important to fire protection and damage control have been installed, including ventilation, ship electrical power, fluid distribution, fire mains, fire pumps, and internal communications. Fire tests aboard this vessel, located in Mobile, Alabama, permit replication of actual fire and damage control scenarios.

THE FIRE RESEARCH FACILITY at the Chesapeake Bay Detachment (CBD) site is extensively equipped for large-scale experiments in fire protection and its environmental consequences. The facility includes (1) an extensively instrumented, pressurizable 10,000 ft^3 chamber (Fire I) for studying large-scale fires in confined spaces such as submarine compartments; (2) special test beds for simulating actual shipboard and aircraft carrier deck fire conditions; and (3) four test buildings for enclosed fire experiments, qualification of fire-fighting agents and delivery systems, and control of smoke.

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LASER PROBE FACILITY: This facility consists presently of seven laser laboratories that are dedicated to a wide range of material parameter measurements and optical characterization spanning wavelengths from the UV to the IR. Material properties investigated include optical transmission, elastic and inelastic scattering, ground and excited state absorption, nonlinear and electro-optical constants, free carrier- and photo-transport, magneto-optical, band structure, lattice structure, photonic band behavior, quantum confinement and reduced dimensionality, cavity QED behavior, inter- and intra-molecular energy transfer rates, electroluminescence and low temperature excitonic behavior. Laser spectroscopies utilized include spontaneous and coherent Raman, degenerate and non-degenerate four wave mixing, photothermal, second and third harmonic generation, two-photon absorption, z-scan, subpicosecond transient absorption, laser-induced fluorescence, and subpicosecond excite-probe.

MTADS: The Multi-sensor Towed Array Detection System, ***MTADS***, is an operating prototype of a unique, fully field-worthy, commercializable site characterization instrument designed to address most remediation requirements for locating buried ordnance while sharply lowering the cost of site characterizations. The system carries an array of seven full-field magnetometers and other sensors which address a spectrum of hazards, including chemicals, radioactivity, and buried ordnance and other ferrous materials. Sophisticated software reduces the data into interpolated images allowing clear visualization of both large, deeply buried, and small, shallow ordnance items. Targets are iteratively computer-fit with an algorithm to determine position, depth and size. The ***MTADS*** will provide for high speed, wide area, non-intrusive site characterization. Specifically, *MTADS* is a ground mobile towed-array system incorporating precise GPS navigation data with sensitive sensor measurements and powerful computer imaging and analysis capabilities.

COATINGS FACILITY: The Coatings Laboratory is used 75% of the time (including 15% on this CSF) and has facilities to formulate, manufacture, apply, and test (lab and field) new organic coatings. Dissolvers (Cowles, Dispermat), Keith 3-roll mills, Binks spray booths, air- and airless spray equipment (Binks, Graco), and lab facilities for thermal, mechanical, chemical, physical, and optical evaluation; shares field sites at Key West and CBD for durability, weathering, and antifouling testing.

EX-USS SHADWELL (LSD-15) is a decommissioned 475-ft vessel which has been extensively renovated and instrumented as a firefighting and damage control testbed; selected ship systems important to fire protection and damage control have been installed, including ventilation, ship electrical power, fluid distribution, fire mains, fire pumps, and internal communications. Fire tests aboard this vessel, located in Mobile, Alabama, permit replication of actual fire and damage control scenarios.

THE FIRE RESEARCH FACILITY at the Chesapeake Bay Detachment (CBD) site is extensively equipped for large-scale experiments in fire protection and its environmental consequences. The facility includes (1) an extensively instrumented, pressurizable 10,000 ft^3 chamber (Fire I) for studying large-scale fires in confined spaces such as submarine compartments; (2) special test beds for simulating actual shipboard and aircraft carrier deck fire conditions; and (3) four test buildings for enclosed fire experiments, qualification of fire-fighting agents and delivery systems, and control of smoke.

Revision
JCE/ONR91
8/17/94

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3.4 Facilities and Equipment

3.4.1 Major Equipment and Facilities.

Common Support Function	Major Facility or Equipment Description	Unique To			Replacement Cost ($K)
		DOD	Federal Gov't	U. S.	
Environ-mental Quality	Laser Probe Facility (see description below)	YES	YES		2000
	Fiber construction and evaluation facilities for optical, acoustic, & magnetic sensors	YES	YES		2100
	Laser Systems and Spectrometers				2175
Environ-mental Quality	Coating Facility (see description below)	no	no	no	400
Environ-mental Quality	Ex-USS Shadwell, Fire Research Ship & Testbed (see description below)	YES	YES	YES	10,000
Environ-mental Quality	10,000 ft^3 "Fire-I" Fire Test Chamber (see description below)	YES	YES		400
	TOTAL				**19675**

LASER PROBE FACILITY: This facility consists presently of seven laser laboratories that are dedicated to a wide range of material parameter measurements and optical characterization spanning wavelengths from the UV to the IR. Material properties investigated include optical transmission, elastic and inelastic scattering, ground and excited state absorption, nonlinear and electro-optical constants, free carrier- and photo-transport, magneto-optical, band structure, lattice structure, photonic band behavior, quantum confinement and reduced dimensionality, cavity QED behavior, inter- and intra-molecular energy transfer rates, electroluminescence and low temperature excitonic behavior. Laser spectroscopies utilized include spontaneous and coherent Raman, degenerate and non-degenerate four wave mixing, photothermal, second and third harmonic generation, two-photon absorption, z-scan, subpicosecond resolution transient absorption, laser-induced fluorescence, and subpicosecond excite-probe.

COATINGS FACILITY: The Coatings Laboratory is used 75% of the time (including 15% on this CSF) and has facilities to formulate, manufacture, apply, and test (lab and field) new organic coatings. Dissolvers (Cowles, Dispermat), Keith 3-roll mills, Binks spray booths, air- and airless spray equipment (Binks, Grayco), and lab facilities for thermal, mechanical, chemical, physical, and optical evaluation; shares field sites at Key West and CBD for durability, weathering, and antifouling testing.

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3.5 Expansion Potential

3.5.1 Laboratory Facilities:

			Space Capacity (KSF)		
Common Support Function	**Facility or Equipment Description**	**Type of Space***	**Current**	**Used**	**Excess**
Environmen-tal Quality	Optical Sciences Labs	Technical	4.32	3.9	.4
	Aerosol Optics Lab of Laser Probe Facility	Technical	0.5	0.45	0.05
	Labs	Technical	6.3	6.3	
	Labs	Technical	6.4	6.4	
	Clean Room	Technical	0.8	0.8	
	Code 6100 Labs	Technical	4.8	4.8	0
	Code 6100 Offc	Administrative	0.2	0.2	0
	Code 6110 Labs	Technical	3.3	3.3	0
	Coatings Lab	Technical	0.2	0.2	0
	Electrochem Labs	Technical	0.9	0.9	0
	Fire R&D Labs	Technical/Office	1.8	1.8	0
	"FIRE-I" (CBD)	Technical/Contr-ol Center/Utility	1.5	1.5	0
	Condensed Matter & Radiation Sciences	Technical	1.7	0	
		Administrative	1.5	0	
		Storage	0.85	0	
	Biomol. Engr'g.	Administrative	1.31	1.31	0
		Technical	2.47	2.47	0
		Storage	0.04	0.04	0
		TOTALS	**28.49**	**27.97**	**0.45**

* Administrative, Technical, Storage, Utility

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EX-USS SHADWELL (LSD-15) is a decommissioned 475-ft vessel which has been extensively renovated and instrumented as a firefighting and damage control testbed; selected ship systems important to fire protection and damage control have been installed, including ventilation, ship electrical power, fluid distribution, fire mains, fire pumps, and internal communications. Fire tests aboard this vessel, located in Mobile, Alabama, permit replication of actual fire and damage control scenarios.

THE FIRE RESEARCH FACILITY at the CBD site is extensively equipped for large-scale experiments in fire protection and its environmental consequences. The facility includes (1) an extensively instrumented, pressurizable 10,000 ft^3 chamber (Fire I) for studying large-scale fires in confined spaces such as submarine compartments; (2) special test beds for simulating actual shipboard and aircraft carrier deck fire conditions; and (3) four test buildings for enclosed fire experiments, qualification of fire-fighting agents and delivery systems, and control of smoke.

3.5 Expansion Potential

3.5.1 Laboratory Facilities

Common Support Function	Facility or Equipment Description	Type of Space*	Space Capacity (KSF)		
			Current	Used	Excess
Environmental Quality	Optical Sciences Labs	Technical	4.32	3.9	.4
	Aerosol Optics Lab of Laser Probe Facility	Technical	0.5	0.45	0.05
	Labs	Technical	6.3	6.3	
	Labs	Technical	6.4	6.4	
	Clean Room	Technical	0.8	0.8	
	Code 6100 Labs	Technical	4.8	4.8	0
	Code 6100 Offc	Administrative	0.2	0.2	0
	Code 6110 Labs	Technical	3.3	3.3	0
	Coatings Lab	Technical	0.2	0.2	0
	Electrochem Labs	Technical	0.9	0.9	0
	Fire R&D Labs	Technical/Office	1.8	1.8	0
	"FIRE-I" (CBD)	Technical/Control Center/Utility	1.5	1.5	0
	Condensed Matter & Radiation Sciences	Technical	1.7	0	
		Administrative	1.5	0	
		Storage	0.85	0	
	Biomol. Engr'g.	Administrative	1.31	1.31	0
		Technical	2.47	2.47	0
		Storage	0.04	0.04	0
		TOTALS	**28.49**	**27.97**	**0.45**

* Administrative, Technical, Storage, Utility

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3.5.1.1 Describe the capacity of your activity to absorb additional similar workyears categorized in the same common support function with minor facility modification. If major modification is required, describe to what extent the facilities would have to be modified. (Use FY97 workyears as your requirement) (BRAC Criteria III) R

• No modifications would be required to permit the Optical Sciences Division to absorb a modest level of additional work.

• Additional work in the Coatings Lab can be absorbed by utilizing the 25% of the time the space is idle. No modification to facilities would be required.

• The facilities of the Navy Technology Center for Safety and Survivability include the unique research and evaluation testbeds with extensive instrumentation. These resources, as well as some of the personnel, are shared with other NRL Code 6180 programs and projects. The CBD 56 m^3 Compartment itself is actively used for testing on this project perhaps 40 percent of the time. However, the command facility with its control and analysis instrumentation is employed on other projects to a total of over 80 per cent capacity. Additional usage could be made within our environmental and fire protection mission with additional funding and with appropriate additional personnel, including at test director level. There would need to be extensive interactive scheduling arrangements.

• The Ex-USS SHADWELL is very heavily used for many different projects. It is possible that some additional projects could be added, but appropriate manpower and funding would be required. There is one central command and data acquisition point. While it is being employed on a particular test, no other projects can be conducted. This is a distinct safety issue. Preparation work on other projects may, or may not, be allowed during test periods.

• For Biomolecular Science and Engineering, the FY93 capacity was strained, and no increase in effort could be absorbed at that time; the renovation of Building 30, due to be completed at the end of FY94, will make possible an increase of about 10% in the near term.

3.5.1.2 If there is capacity to absorb additional workyears, how many additional workyears can be supported? (BRAC Criteria III)

• In the Optical Sciences Division, 7-8 additional workyears can be supported.

• For the Chemistry Division and the Center for Biomolecular Science and Engineering about six additional owrkyears can be supported.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II)

None.

3.5.2 Land Use: Provide number of buildable acres for additional laboratory-administrative support construction at your installation. (BRAC Criteria II)

NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion. R

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The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note however, that NRL facilities can be re-configured, e.g.., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new of expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration. R

3.5.3 Utilities: Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units -- e.g. KWH of electricity. (BRAC Criteria II)

Utility service capacities are depicted in the following table: R

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD)	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lbr/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

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3.5.1.1 Describe the capacity of your activity to absorb additional similar workyears categorized in the same common support function with minor facility modification. If major modification is required, describe to what extent the facilities would have to be modified. (Use FY97 workyears as your requirement) (BRAC Criteria III)

• No modifications would be required to permit the Optical Sciences Division to absorb a modest level of additional work.

• Additional work in the Coatings Lab can be absorbed by utilizing the 25% of the time the space is idle. No modification to facilities would be required.

• The facilities of the Navy Technology Center for Safety and Survivability include the unique research and evaluation testbeds with extensive instrumentation. These resources, as well as some of the personnel, are shared with other NRL Code 6180 programs and projects. The CBD 56 m^3 Compartment itself is actively used for testing on this project perhaps 40 percent of the time. However, the command facility with its control and analysis instrumentation is employed on other projects to a total of over 80 per cent capacity. Additional usage could be made within our environmental and fire protection mission with additional funding and with appropriate additional personnel, including at test director level. There would need to be extensive interactive scheduling arrangements.

• The Ex-USS SHADWELL is very heavily used for many different projects. It is possible that some additional projects could be added, but appropriate manpower and funding would be required. There is one central command and data acquisition point. While it is being employed on a particular test, no other projects can be conducted. This is a distinct safety issue. Preparation work on other projects may, or may not, be allowed during test periods.

• For Biomolecular Science and Engineering, the FY93 capacity was strained, and no increase in effort could be absorbed at that time; the renovation of Building 30, due to be completed at the end of FY94, will make possible an increase of about 10% in the near term.

3.5.1.2 If there is capacity to absorb additional workyears, how many additional workyears can be supported? (BRAC Criteria III)

• In the Optical Sciences Division, 7-8 additional work years can be supported.

• For the Chemistry Division and the Center for Biomolecular Science and Engineering about six additional workyears can be supported.

3.5.1.3 For 3.5.1.1 and 3.5.1.2 (above) describe the impact of military construction programs or other alteration projects programmed in the FY95 PBS. (BRAC Criteria II)

None.

3.5.2 Land Use. Provide number of buildable acres for additional laboratory-administrative support construction at your installation. (BRAC Criteria II)

• N/A

3.5.3 Utilities. Provide an estimate of your installation's capability to expand or procure additional utility services (electric, gas, water). Estimates should be provided in appropriate units -- e.g. KWH of electricity. (BRAC Criteria II)

• N/A

The question asks you to "describe major facilities and equipment to support **each CSF**." The question further asks **"If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions**." (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

RESPONSE: See ~~enclosure (11)~~.

22. **ENVIRONMENTAL QUALITY QUESTIONS 3.5.2, 3.5.3**

Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call #4 is not acceptable.

RESPONSES:

a. **3.5.2:** NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

b. **3.5.3:** Utility service capacities are depicted in the following table:

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	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

23. **ADVANCED MATERIALS**

Enclosure (12) is a revised Section 3.0 to the Advanced Materials CSF.

24. **ADVANCED MATERIALS QUESTION 3.4.1**

The question asks you to "describe major facilities and equipment to support **each CSF**." The question further asks **If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions**." (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

RESPONSE: See enclosure (13).

25. **ADVANCED MATERIALS QUESTIONS 3.5.2, 3.5.3**

Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call #4 is not acceptable.

RESPONSE

a. **3.5.2**: NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

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G. ADVANCED MATERIALS

3.0 Mission.

Advanced Materials are the key foundation for all technological advances. Improved material properties enable new technologies by providing enhanced performance capabilities that are affordable and environmentally compatible. Indeed the use of advanced materials impacts all areas of research and development at NRL and the interactions of these diverse programs with scientists within the advanced materials CSF is extensive. Future demands on systems performance, reliability, life cycle affordability, and environmental quality all require increased interaction/integration of material scientists into all technology programs. R

The advanced materials facilities at NRL are high-technology laboratories that include atomic-level synthesis, control, and characterization facilities; sophisticated, computer-controlled data acquisition systems; and contamination free processing facilities. These capabilities enable precise control of temperature, pressure, and composition; the computers provide rapid data analysis and theoretical evaluations; the characterization facilities provide the "eyes" to see what is made and to determine properties. These advanced facilities are essential to our research on materials, and indeed provide necessary information on materials and their use to most programs at NRL that are using advanced materials to develop new technologies. R

At NRL the advanced materials research effort combines and integrates science and technology from a wide span of disciplines including chemistry, biology, physics, metallurgy, mechanics, radiation sciences, electronics, and optics. The multi-disciplinary efforts include activities spanning the range from fundamental research through exploratory and advanced development for specific applications. This synergism of disciplines and activities leads to a very effective materials science and technology program at NRL that is responsive to the Navy, DOD, and national needs of today and--most importantly--of tomorrow. R

The NRL materials research efforts are closely linked to other technology programs within NRL as well as to other common support functions. For instance, the low-observable materials and structures (LOMS) program was spawned by work in advanced materials and continues to closely interact with materials scientists on a daily basis. Similarly, scientists in the advanced materials CSF closely couple with the scientists and engineers in the Naval Center for Space Technology (NCST) at NRL where many joint projects have occurred, e.g. high temperature superconducting satellite experiments, long duration exposure facility satellite, micro-electronic and phontonic test bed, etc. Fleet needs are often addressed by employing new techniques and materials available in the CSF, such as biological and chemical sensors, or polymeric coatings for corrosion protection. These efforts involve interactions with systems engineers at NRL and often involve a variety of disciplines. Similarly, because of the wide spectrum of expertise, analytical skills, and advanced facilities, NRL material scientists are often called upon to provide failure analysis for Navy ships, submarines, aircraft, and satellites - and to recommend remedies to improve the performance of the system or platform, e.g. sonar rubber dome failures, IOWA explosion incident, etc. Through these and many other interactions, the bench-level scientists, as well as managers, stay atuned to the performance needs of the operational Navy which, in turn, impacts the direction of research and development activities at NRL, e.g.. space materials research initiative , environment effects task area , advanced materials transition project . This ability to provide cross-disciplinary interaction is indeed vital to our materials efforts and an integral part of NRL's philosophy. (For a further reference to interactions of the advanced materials CSF with other groups at NRL see section 3.4.1 b.) R

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NAVAL RESEARCH LABORATORY

ADVANCED MATERIALS

SECTION III: CAPABILITY OF ACTIVITIES TO PERFORM COMMON SUPPORT FUNCTIONS (CSFs):

3.0 Mission:

** Advanced Materials are the key foundation for all technological advances. Improved material properties enable new technologies by providing enhanced performance capabilities that are affordable and environmentally compatible. Indeed the use of advanced materials impacts all areas of research and development at NRL and the interactions of these diverse programs with scientists within the advanced materials CSF is extensive. Future demands on systems performance, reliability, life cycle affordability, and environmental quality all require increased interaction/integration of material scientists into all technology programs.

** The advanced materials facilities at NRL are high-technology laboratories that include atomic level synthesis, control, and characterization facilities; sophisticated, computer-controlled data acquisition systems; and contamination free processing facilities. These capabilities enable precise control of temperature, pressure, and composition; the computers provide rapid data analysis and theoretical evaluations; the characterization facilities provide the "eyes" to see what is made and to determine properties. These advanced facilities are essential to our research on materials, and indeed provide necessary information on materials and their use to most programs at NRL that are using advanced materials to develop new technologies.

** At NRL the advanced materials research effort combines and integrates science and technology from a wide span of disciplines including chemistry, biology, physics, metallurgy, mechanics, radiation sciences, electronics, and optics. The multi-disciplinary efforts include activities spanning the range from fundamental research through exploratory and advanced development for specific applications. This synergism of disciplines and activities leads to a very effective materials science and technology program at NRL that is responsive to the Navy, DOD, and national needs of today and--most importantly--of tomorrow.

** The NRL materials research efforts are closely linked to other technology programs within NRL as well as to other common support functions. For instance, the low observable materials and structures (LOMS) program was spawned by work in advanced materials and continues to closely interact with materials scientists on a daily basis. Similarly, scientists in the advanced materials CSF closely couple with the scientists and engineers in the Naval Center for Space Technology (NCST) at NRL where many joint projects have occurred, e.g. high temperature superconducting satellite experiments, long duration exposure facility satellite, micro-electronic and phontonic test bed, etc. Fleet needs are often addressed by employing new techniques and materials available in the CSF, such a biological and chemical sensors, or polymeric coatings for corrosion protection. These efforts involve interactions with systems engineers at NRL and often involve a variety of disciplines. Similarly, because of the wide spectrum of expertise, analytical skills, and advanced facilities, NRL material scientists are often called upon to provide failure analysis for Navy ships, submarines, aircraft, and satellites - and to recommend remedies to improve the performance of the system or platform, e.g. sonar rubber dome failures, Iowa explosion incident, etc. Through these and many other interactions, the bench level scientists, as well as managers, stay atuned to the performance needs of the operational Navy which, in turn, impacts the direction of research and development activities at

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8/17/94

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Specific NRL mission goals for the advanced materials research at NRL are to: R

1. Develop fabrication and processing procedures for newly emerging materials;
2. Develop and exploit synthetic chemistry principles toward the creation of fundamentally new molecular structures;
3. Establish a scientific knowledge base to provide optimum materials use for Naval applications;
4. Apply scientific principles for predictions of improved materials, improved properties, and improved processing procedures;
5. Establish methodologies for materials processing, performance, and survivability prediction;
6. Promote cross-disciplinary research in areas of common interest to development of a new or improved technology;
7. Promote systems/application acceptance of advanced materials through demonstration programs (close coupling with systems activities within NRL);
8. Assist in the implementation of advanced materials by supplying advice and diagnostic tools to solve materials-related problems (close coupling with other activities within NRL);
9. Provide expert consulation to the operational Navy and conduct appropriate experiments to decifer causes of material failures and hence suggest solutions to improve performance (close coupling to the operational Navy) .
10. Develop industrial interest and capability for advanced materials through joint research and development efforts (close coupling through Navy headquarters activities in the Washington DC).

3.1 Location

3.1.1 Geographic/Climatological Features. There are no Geographic/ Climatological features relevant to advanced materials research at NRL. Much of our research is conducted in laboratory controlled environments and depends on quality-constructed buildings and facilities, and the availability of proper utilities.

3.1.2 Licenses & Permits. There are licenses held by NRL to allow tests and experiments on advanced materials. These licenses deal with our ability to handle radiation sources, explosives, and drugs.

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NRL, e.g.. space materials research initiative , environment effects task area , advanced materials transition project . This ability to provide cross-disciplinary interaction is indeed vital to our materials efforts and an integral part of NRL's philosophy. (For a further reference to interactions of the advanced materials CSF with other groups at NRL see section 3.4.1 b)

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8. Assist in the implementation of advanced materials by supplying advice and diagnostic tools to solve materials related problems (close coupling with other activities within NRL);
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10. Develop industrial interest and capability for advanced materials through joint research and development efforts (close coupling through Navy headquarters activities in the Washinton DC).

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NAME:	NAVY RADIOACTIVE MATLS PERMIT NO. 08-00173-E1NP
COVERS:	The acquisition, receipt possession, use, storage and disposal of radioactive materials and use of ionizing radiation.
DATE ISSUED:	Our Nuclear Regulatory Commission License (08-01393-02) was converted to the Navy Permit on 31 May 1988.
NEED:	NRL uses radioactive materials in various research projects, including the effect of radiation on materials, materials analysis, detector calibration, and identifiers in biological processes.

NAME:	NAVY EXPLOSIVES HANDLING SOP #6030-001 UNDER NAVSEA OP5
COVERS:	The receipt, use and storage of explosives.
DATE ISSUED:	Standard Operating Procedure approved April, 1994.
NEED:	NRL Code 6030 uses the explosive materials for x-ray diffraction studies to determine structural properties of newly synthesized materials.

NAME:	CONTROLLED SUBSTANCES REGISTRATION CERTIFICATE DEA REGISTRATION # RL0171190
COVERS:	The acquisition, use, and storage of Schedule 1, 2, 3, 3N, 4 and 5 materials for analysis.
DATE ISSUED:	Current License from U. S. Department of Justice Drug Enforcement Administration issued 2/28/94. License is subject to annual renewal.
NEED:	NRL Code 6030 uses materials in crystalline form for structure determination by x-ray diffraction analysis.

3.1.3 Environmental constraints. There are no major environmental constraints relevant to advanced materials research at NRL. Our research is conducted in laboratory controlled environments with proper safety and pollution controls carefully obeyed. We require and use chemical hoods, chemical storage alarming systems, special scrubbing operations, etc. to make our facilities environmentally compliant.

3.1.4 Special Support Infrastructure. There are no special support infrastructures required. This assumes that normal support infrastructure includes availability of utilities [water, gas, electricity (60 cycle, 110, 220, and 440 volts, up to 200 amperes)] and the ability to procure and transport equipment and supplies without excessive costs or time delays. We do require readily available liquid cryogens (helium and nitrogen), compressed gas, chilled water, and humidity/temperature controlled rooms.

3.1.5 Proximity to Mission-Related Organizations. The greater Washington DC area has an abundance of Universities providing numerous formal and informal scientific exchanges. For advanced materials research the common exchange of ideas, samples, students, scientists, and facilities is mutually beneficial to all organizations. Also these Universities provide students to NRL for part time work and future employment potential, and NRL provides the students a wide range of valuable research/work experience.

While not R&D centers, the close proximity of the National Science Foundation, Advanced Research Projects Agency, Office of Naval Research, National Institutes of Health, and the Department of Energy provide NRL materials scientists with easy exposure to research programs in these organizations. Because of the recognized stature of NRL scientists, our scientists are frequently used as local reviewers of programs. This increases the breadth of knowledge for the NRL scientist while providing a valuable service to our overall national efforts.

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G. ADVANCED MATERIALS

3.0 Mission.

Advanced Materials are the key foundation for all technological advances. Improved material properties enable new technologies by providing enhanced performance capabilities that are affordable and environmentally compatible.

The advanced materials facilities at NRL are high-technology laboratories that include atomic level synthesis, control, and characterization facilities; sophisticated, computer-controlled data acquisition systems; and contamination free processing facilities. These capabilities enable precise control of temperature, pressure, and composition; the computers provide rapid data analysis and theoretical evaluations; the characterization facilities provide the "eyes" to see what is made and to determine properties.

At NRL the advanced materials research effort combines and integrates science and technology from a wide span of disciplines including chemistry, biology, physics, metallurgy, mechanics, radiation sciences, electronics, and optics. The multi-disciplinary efforts include activities spanning the range from fundamental research through exploratory and advanced development for specific applications. This synergism of disciplines and activities leads to a very effective materials science and technology program at NRL that is responsive to the Navy, DOD, and national needs of today and--most importantly--of tomorrow.

The NRL materials research efforts are closely linked to other common support areas at NRL as well as to systems development groups within NRL via daily interactions, joint planning, and common reviews. The ability to provide cross-disciplinary interaction is vital to our materials efforts.

Specific NRL mission goals for the advanced materials research at NRL are to:

1. Develop fabrication and processing procedures for newly emerging materials;
2. Develop and exploit synthetic chemistry principles toward the creation of fundamentally new molecular structures;
3. Establish a scientific knowledge base to provide optimum materials use for Naval applications;
4. Apply scientific principles for predictions of improved materials, improved properties, and improved processing procedures;
5. Establish methodologies for materials processing, performance, and survivability prediction;
6. Promote systems/application acceptance of advanced materials through demonstration programs;
7. Develop industrial interest and capability for new advanced materials through joint research and development efforts.

3.1 Location

3.1.1 Geographic/Climatological Features. There are no Geographic/ Climatological features relevant to advanced materials research at NRL. Much of our research is conducted in laboratory controlled environments and depends on quality constructed buildings and facilities, and the availability of proper utilities.

3.1.2 Licenses & Permits. There are licenses held by NRL to allow tests and experiments on advanced materials. These licenses deal with our ability to handle radiation sources, explosives, and drugs.

NAME:	NAVY RADIOACTIVE MATLS PERMIT NO. 08-00173-E1NP
COVERS:	The acquisition, receipt possession, use, storage and disposal of radioactive materials and use of ionizing radiation.
DATE ISSUED:	Our Nuclear Regulatory Commission License (08-01393-02) was converted to the Navy Permit on 31 May 1988.
NEED:	NRL uses radioactive materials in various research projects, including the effect of radiation on materials, materials analysis, detector calibration, and identifiers in biological processes.
NAME:	NAVY EXPLOSIVES HANDLING SOP #6030-001 UNDER NAVSEA OP5
COVERS:	The receipt, use and storage of explosives.
DATE ISSUED:	Standard Operating Procedure approved April, 1994.
NEED:	NRL Code 6030 uses the explosive materials for x-ray diffraction studies to determine structural properties of newly synthesized materials.
NAME:	CONTROLLED SUBSTANCES REGISTRATION CERTIFICATE DEA REGISTRATION # RL0171190
COVERS:	The acquisition, use, and storage of Schedule 1, 2, 3, 3N, 4 and 5 materials for analysis.
DATE ISSUED:	Current License from U. S. Department of Justice Drug Enforcement Administration issued 2/28/94. License is subject to annual renewal.
NEED:	NRL Code 6030 uses materials in crystalline form for structure determination by x-ray diffraction analysis.

3.1.3 Environmental constraints. There are no major environmental constraints relevant to advanced materials research at NRL. Our research is conducted in laboratory controlled environments with proper safety and pollution controls carefully obeyed. We require and use chemical hoods, chemical storage alarming systems, special scrubbing operations, etc. to make our facilities environmentally compliant.

3.1.4 Special Support Infrastructure. There are no special support infrastructures required. This assumes that normal support infrastructure includes availability of utilities [water, gas, electricity (60 cycle, 110, 220, and 440 volts, up to 200 amperes)] and the ability to procure and transport equipment and supplies without excessive costs or time delays. We do require readily available liquid cryogens (helium and nitrogen), compressed gas, chilled water, and humidity/temperature controlled rooms.

3.1.5 Proximity to Mission-Related Organizations. The greater Washington DC area has an abundance of Universities providing numerous formal and informal scientific exchanges. For advanced materials research the common exchange of ideas, samples, students, scientists, and facilities is mutually beneficial to all organizations. Also these Universities provide students to NRL for part time work and future employment potential, and NRL provides the students a wide range of valuable research/work experience.

While not R&D centers, the close proximity of the National Science Foundation, Advanced Research Projects Agency, Office of Naval Research, National Institutes of Health, and the Department of Energy provide NRL materials scientists with easy exposure to research programs in these organizations. Because of the recognized stature of NRL scientists, our scientists are frequently used as local reviewers of programs. This increases the breadth of knowledge for the NRL scientist while providing a valuable service to our overall national efforts.

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Common Support Functions	Name	Type of Organiations	Distance	WorkYears Performed by Your Activity	WorkYears Funded by Your Activity
Advanced Materials	National Inst. of Science & Tech*	Government	40 miles	1	0
Advanced Materials	Local Universities**	University	< 20 miles	2	0
Advanced Materials	Headquarters, S&T Org.	Government	<20 miles	2	0

* National Science Foundation, Office of Naval Research, Advanced Research Projects Agency, Air Force Office of Scientific Research, Defense Nuclear Agency, National Institutes of Health)

** George Washington University, George Mason University, University of Maryland, Georgetown University, Howard University, American University, Catholic University)

3.2 Personnel

3.2.1 Total Personnel.

Types of Personnel	NUMBER OF PERSONNEL Government		On-Site	On-Site
	Civilian	Military	FFRDC	SETA
Technical	277	3	0	179
Management	17	0	0	0
Other	0	0	0	0
Totals	**294**	**3**	**0**	**179**

3.2.2 Education.

Type of Degree	Number of Government Personnel by Position				
		Technical	Management	Other	Total
High School or less		29	0	0	29
Associates		6	0	0	6
Bachelor		25	0	0	25
Masters		25	1	0	26
Doctorates		192	16	0	208
Totals		**277**	**17**	**0**	**294**

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Common Support Functions	Name	Type of Organiations	Distance	WorkYears Performed by Your Activity	WorkYears Funded by Your Activity
Advanced Materials	National Inst. of Science & Tech*	Government	40 miles	1	0
Advanced Materials	Local Universities**	University	< 20 miles	2	0
Advanced Materials	Headquarters, S&T Org.	Government	<20 miles	2	0

* National Science Foundation, Office of Naval Research, Advanced Research Projects Agency, Air Force Office of Scientific Research, Defense Nuclear Agency, National Institutes of Health)

** George Washington University, George Mason University, University of Maryland, Georgetown University, Howard University, American University, Catholic University)

3.2 Personnel

3.2.1 Total Personnel.

Types of Personnel	NUMBER OF PERSONNEL Government		On-Site	On-Site
	Civilian	Military	FFRDC	SETA
Technical	277	3	0	179
Management	17	0	0	0
Other	37	0	0	2
Totals	**331**	**3**	**0**	**181**

3.2.2 Education.

Type of Degree	Number of Government Personnel by Position				
		Technical	Management	Other	Total
High School or less		29	0	37	66
Associates		6	0	0	6
Bachelor		25	0	0	25
Masters		25	1	0	26
Doctorates		192	16	0	208
Totals		**277**	**17**	**37**	**331**

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* National Science Foundation, Office of Naval Research, Advanced Research Projects Agency, Air Force Office of Scientific Research, Defense Nuclear Agency, National Institutes of Health)

** George Washington University, George Mason University, University of Maryland, Georgetown University, Howard University, American University, Catholic University)

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Associates		6	0	0	6
Bachelor		25	0	0	25
Masters		25	1	0	26
Doctorates		192	16	0	208
Totals		**277**	**17**	**37**	**331**

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3.2.3 Experience.

Position	Years of Government and/or Military Service					Total
	<3	3 - 10	11 - 15	16 - 20	> 20	
Technical	42	91	39	23	82	277
Management	1	2	2	2	10	17
Other	0	0	0	0	0	0
Totals	**43**	**93**	**41**	**25**	**92**	**294**

3.2.3. Accomplishments During FY91-93

3.2.4.1 Patent Disclosures and Patents Awarded.

Disclosures	Awarded	Total	Title
74	67	141	See Appendix 1

3.2.4.2. Publications in Peer Reviewed Journals.

Advanced Materials programs at NRL published 1239 articles in peer reviewed journals. See Appendix 3 for complete listing.

3.3. **Workload.**

3.3.1. FY93 Workload.

3.3.1.1. Work Year and Lifecycle.

Category	Fiscal Year 1993 Actual				Total
	Civilian	Military	FFRDC	SETA	
Science &Technology	235.1	1.7	0	116.5	353.3
Engineering Development	0	0	0	0	0
In-Service Engineering	0	0	0	0	0
Total	**235.1**	**1.7**	**0**	**116.5**	**353.3**

3.3.1.2. Engineering Development By ACAT. Not Applicable

3.3.1.3. In Service Engineering. No In-Service Engineering done

3.3.2. Projected Funding.

3.3.2.1. Direct Funding. None

3.3.2.2. Other Obligation Authority.

	FY94 ($K)	FY95 ($K)	FY96 ($K)	FY97 ($K)
Reimbursable	$50,051	$52,901	$55,512	$57,929
Direct Cite	$8,565	$8,968	$9,391	$9,769

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3.2.3 Experience.

Position	Years of Government and/or Military Service					Total
	<3	3 - 10	11 - 15	16 - 20	> 20	
Technical	42	91	39	23	82	277
Management	1	2	2	2	10	17
Other	4	11	8	3	11	37
Totals	**47**	**104**	**49**	**28**	**103**	**331**

3.2.3. Accomplishments During FY91-93

3.2.4.1 Patent Disclosures and Patents Awarded.

Disclosures	Awarded	Total	Title
74	67	141	See Appendix 1

3.2.4.2. Publications in Peer Reviewed Journals.

Advanced Materials programs at NRL published 1290 articles in peer reviewed journals. See Appendix 3 for complete listing.

3.3. **Workload.**

3.3.1. FY93 Workload.

3.3.1.1. Work Year and Lifecycle.

Category	Fiscal Year 1993 Actual				Total
	Civilian	Military	FFRDC	SETA	
Science &Technology	235.1	1.7	0	110.9	347.7
Engineering Development	0	0	0	5.2	5.2
In-Service Engineering	0	0	0	0.4	0.4
Total	**235.1**	**1.7**	**0**	**116.5**	**353.3**

3.3.1.2. Engineering Development By ACAT. Not Applicable

3.3.1.3. In Service Engineering. No In-Service Engineering done

3.3.2. Projected Funding.

3.3.2.1. Direct Funding. None

3.3.2.2. Other Obligation Authority.

	FY94 ($K)	FY95 ($K)	FY96 ($K)	FY97 ($K)
Reimbursable	$50,051	$52,901	$55,512	$57,929
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19 AUG 1994

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Total	**235.1**	**1.7**	**0**	**116.5**	**353.3**

3.3.1.2. Engineering Development By ACAT. Not Applicable

3.3.1.3. In Service Engineering. No In-Service Engineering done

3.3.2. Projected Funding.

3.3.2.1. Direct Funding. None

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	FY94 ($K)	FY95 ($K)	FY96 ($K)	FY97 ($K)
Reimbursable	$50,051	$52,901	$55,512	$57,929
Direct Cite	$8,565	$8,968	$9,391	$9,769

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3.4. **Facilities and Equipment.**

3.4.1. Major Facilities and Equipment. Major facilities, uniqueness, and replacement values are listed below. For a description of facilities, see Appendix 2. These materials are vital to our materials research as they provide the wide spectrum of capabilities necessary to conduct research on todays advanced materials. In addition they permit our scientists to respond to a wide variety of interdisciplinary and fleet related problems of immediate and long range concern. R

	Major Facility	Unique To			Replacement Cost ($K)
		DOD	Gov't	U. S.	
1	Materials Processing Facility	x			$15,000
2	Compu. Contr. Universal Mat. Test Syst.	x	x	x	$3,000
3	Magnetics & Superconducting Proc. Fac.	x	x		$8,800
4	Chem. & Str. Characterization Fac.	x	x		$15,000
5	Mech. & Therm. Characterization Fac.	x			$3,400
6	Non Destructive Eval. Exp. Fac.	x			$2,000
7	Electro-magnetic & Therm Char. Fac.	x			$11,600
8	IR Glass Fiber Drawing Facility	x	x		$650
9	Silica Glass Preform I Fiber Fab. Fac.	x	x		$750
10	Clean Room Facility				$1,500
11	IR Low Observable Signature Test Fac.	x	x	x	$1,250
12	3 MV Tandem Van De Graaff Accelerator				$2,500
13	Ion Implantation Facilities	x	x		$600
14	Synchrotron Radiation Facility	x	x	x	$4,500
15	Pulsed Laser Deposition Facility	x			$600
16	X-Ray Diffraction Facility	x			$400
17	Computational Facilities				$220
18	Protein and Peptide Facility	x			$250
19	Area Detector Facility	x			$320
20	Robot Crystallization Facility	x			$140
21	Polymer Coating & Synthesis Lab.	x			$10,000
	Total Replacement Value				**$82,480**

3.4.1 b. Major Facilities and Equipment. To emphasize the degree of interaction within NRL brought about by these facilities, and the scientists who operate these facilities, the following matrix tabulation is presented which shows major interactions with other programs at NRL, as they relate to a specific CSF facility. (It is to be understood that the degree of interaction between programs within the advanced materials CSF is indeed large, and not shown here.) The per cent estimates of interactions in some cases add up to more than 100% because the use of the facility often interacts with more than one program outside the CSF of advanced materials. Similarly some facilities which show low, or zero connectivity to programs outside the CSF, are indeed vital to the advanced materials CSF itself by providing the core of information from which other collaborative efforts are based. R

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3.4 Facilities and Equipment

3.4.1 a. Major Facilities and Equipment: Major facilities, uniqueness, and replacement values are listed below. For a description of facilities see Appendix 2. These materials are vital to our materials research as they provide the wide spectrum of capabilities necessary to conduct research on todays advanced materials. In addition they permit our scientists to respond to a wide variety of interdisciplinary and fleet related problems of immediate and long range concern.

	Major Facility	DOD	Unique to Gov	U.S.	Replacement value
1	Materials Processing Facility	x			$15,000
2	Compu. Contr. Universal Mat. Test Syst.	x	x	x	$3,000
3	Magnetics & Superconducting Proc. Fac.	x	x		$8,800
4	Chem. & Str. Characterization Fac.	x	x		$15,000
5	Mech. & Therm. Characterization Fac.	x			$3,400
6	Non Destructive Eval. Exp. Fac.	x			$2,000
7	Electro-magnetic & Therm Char. Fac.	x			$11,600
8	IR Glass Fiber Drawing Facility	x	x		$650
9	Silica Glass Preform I Fiber Fab. Fac.	x	x		$750
10	Clean Room Facility				$1,500
11	IR Low Observable Signature Test Fac.	x	x	x	$1,250
12	3 MV Tandem Van De Graaff Accelerator				$2,500
13	Ion Implantation Facilities	x	x		$600
14	Synchrotron Radiation Facility	x	x	x	$4,500
15	Pulsed Laser Deposition Facility	x			$600
16	X-Ray Diffraction Facility	x			$400
17	Computational Facilities				$220
18	Protein and Peptide Facility	x			$250
19	Area Detector Facility	x			$320
20	Robot Crystallization Facility	x			$140
21	Polymer Coating & Synthesis Lab.	x			$10,000
	Total Replacement Value				**$82,480**

3.4.1 b. Major Facilities and Equipment. To emphasize the degree of interaction within NRL brought about by these facilities, and the scientists who operate these facilities, the following matrix tabulation is presented which shows major interactions with other programs at NRL, as they relate to a specific CSF facility. (It is to be understood that the degree of interaction between programs within the advanced materials CSF is indeed large, and not shown here.) The per cent estimates of interactions in some cases add up to more than 100% because the use of the facility often interacts with more than one program outside the CSF of advanced materials. Similarly some facilities which show low, or zero connectivity to programs outside the CSF, are indeed vital to the advanced materials CSF itself by providing the core of information from which other colloaborative efforts are based.

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ENCLOSURE (13)

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Advanced Materials

NRL INTERACTIONS OUTSIDE CSF							
	Major Facility	NRL Organization Codes					CSF Code
		4000	5000	6800	7000	8000	
1	Materials Processing Facility	LOMS 15%	Acoustics Sensors 5%	Materials & Devices 30%	Acoustics 10%	NCST 30%	6300
2	Compu. Contr. Universal Mat. Test System	LOMS 10%			Acoustics 15%	NCST 10%	6300
3	Magnetics & Superconducting Proc. Facility	LOMS 15%	TEW & Radar 10%	Materials & Devices 50%	Sensors 35%	NCST 50%	6300
4	Chem. & Str. Characterization Facility	LOMS 15%	TEW & Radar 30%	Materials & Devices 25%		NCST 15%	6300 6100
5	Mech. and Therm. Characterization Facility	LOMS 5%				NCST 20%	6300
6	Non-Destructive Eval. Exp. Facility	LOMS 5%			Acoustics 20%		6300
7	Electro-magnetic and Therm. Char. Facility	LOMS 25%		Device Performance 70%	Sensors 40%	NCST 25%	6300
8	IR Glass Fiber Drawing Facility		Radar, TEW 20%	Materials & Devices 40%	Acoustics, Sensors 40%		5600
9	Silica Glass Preform I Fiber Fab. Fac.		Radar, TEW 20%	Materials & Devices 40%	Acoustics, Sensors 40%		5600
10	Clean Room Facility			Matls & Devs 50%			5600
11	IR Low Observable Signature Test Facility	LOMS 90%	Radar 10%				5600
12	3 MV Tandem Van de Graaf Accelerator			Matls & Devs 20%		NCST 40%	6600
13	Ion Implantation Facilities			Matls & Devs 30%	Acoustics 10%		6600
14	Synchotron Radiation Facility			Matls & Devs 10%		NCST 5%	6600
15	Pulsed Laser Deposition Facility	LOMS 5%		Matls & Devs 40%	Sensors 30%	NCST 25%	6600
16	X-Ray Diffraction Facility				Sensors 5%		6030
17	Computational Facilities						6030
18	Protein & Peptide Facility				Sensors 10%		6030
19	Area Detector Facility						6030
20	Robot Crystallization Facility						6030
21	Polymer Coating and Synthesis Laboratory	LOMS 10%		Processing 25%		NCST 10%	6100

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Advanced Materials

NRL INTERACTIONS OUTSIDE CSF

	Major Facility	NRL Organization Codes					CSF Code
		4000	5000	6800	7000	8000	
1	Materials Processing Facility	LOMS 15%	Acoustics Sensors 5%	Materials & Devices 30%	Acoustics 10%	NCST 30%	6300
2	Compu. Contr. Universal Mat. Test System	LOMS 10%			Acoustics 15%	NCST 10%	6300
3	Magnetics & Superconducting Proc. Facility	LOMS 15%	TEW & Radar 10%	Materials & Devices 50%	Sensors 35%	NCST 50%	6300
4	Chem. & Str. Characterization Facility	LOMS 15%	TEW & Radar 30%	Materials & Devices 25%		NCST 15%	6300 6100
5	Mech. and Therm. Characterization Facility	LOMS 5%				NCST 20%	6300
6	Non-Destructive Eval. Exp. Facility	LOMS 5%			Acoustics 20%		6300
7	Electro-magnetic and Therm. Char. Facility	LOMS 25%		Device Performance 70%	Sensors 40%	NCST 25%	6300
8	IR Glass Fiber Drawing Facility		Radar, TEW 20%	Materials & Devices 40%	Acoustics, Sensors 40%		5600
9	Silica Glass Preform I Fiber Fab. Fac.		Radar, TEW 20%	Materials & Devices 40%	Acoustics, Sensors 40%		5600
10	Clean Room Facility			Matls & Devs 50%			5600
11	IR Low Observable Signature Test Facility	LOMS 90%	Radar 10%				5600
12	3 MV Tandem Van de Graaf Accelerator			Matls & Devs 20%		NCST 40%	6600
13	Ion Implantation Facilities			Matls & Devs 30%	Acoustics 10%		6600
14	Synchotron Radiation Facility			Matls & Devs 10%		NCST 5%	6600
15	Pulsed Laser Deposition Facility	LOMS 5%		Matls & Devs 40%	Sensors 30%	NCST 25%	6600
16	X-Ray Diffraction Facility				Sensors 5%		6030
17	Computational Facilities						6030
18	Protein & Peptide Facility				Sensors 10%		6030
19	Area Detector Facility						6030
20	Robot Crystallization Facility						6030
21	Polymer Coating and Synthesis Laboratory	LOMS 10%		Processing 25%		NCST 10%	6100

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3.5.1. Laboratory Facilities.

Description	Type	Capacity (KSF)		
		Current	Used	Excess
Major Facilities	Technical	80.1	67	13.3
Labs & Offices (Other Than Fac.)	Technical	79.2	72	7.5
Administration Offices	Administration	21	20	0.9
Storage	Storage	6.2	5.3	1.9
Total		**186.5**	**164**	**23.6**

3.5.1.1. Capacity to Absorb Additional Similar Work Years. Only minor facility modifications would be required to permit a modest increase in work years.

3.5.1.2. What additional work years can be supported. Our total civilian workyears are 235. We estimate that an additional 35 scientists (increase of 15%) could be added without straining our space and facilities capacities.

3.5.1.3. Military Construction FY95 Impact. MILCON FY95 has no impact on the answers to 3.5.1.1 or 3.5.1.2.

3.5.1. Land use. Not separately reportable. See response to BRAC Data Call 4.

3.5.2. Utilities. Not separately reportable. See response to BRAC Data Call 4.

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3.5.1 Laboratory Facilities:

Description	Type	Capacity (KSF) Current	Used	Excess
Major Facilities	Technical	80.1	67	13.3
Labs & Offices (Other Than Fac.)	Technical	79.2	72	7.5
Administration Offices	Administration	21	20	0.9
Storage	Storage	6.2	5.3	1.9
Total		**186.5**	**164**	**23.6**

3.5.1.1 Capacity to Absorb Additional Similar Work Years: Only minor facility modifications would be required to permit a modest increase in workyears.

3.5.1.2 What additional work years can be supported: Our total civilian workyears is 235. We estimate that an additional 35 scientists (increase of 15%) could be added without straining our space and facilities capacities.

3.5.1.3 Military Construction FY95 Impact: MILCON FY95 has no impact on the answers to 3.5.1.1 or 3.5.1.2.

~~**3.5.1 Land use:** Expansion potential not applicable within CSA. Requires NRL decision.~~

~~**3.5.2 Utilities:** Not applicable within CSA. Requires NRL decision.~~

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3.4. **Facilities and Equipment.**

3.4.1. Major Facilities and Equipment. Major facilities, uniqueness, and replacement values are listed below. For a description of facilities see Appendix 2.

	Major Facility	Unique To			Replace-ment Cost ($K)
		DOD	Gov'	U. S.	
1	Materials Processing Facility	x			$15,000
2	Compu. Contr. Universal Mat. Test Syst.	x	x	x	$3,000
3	Magnetics & Superconducting Proc. Fac.	x	x		$8,800
4	Chem. & Str. Characterization Fac.	x	x		$15,000
5	Mech. & Therm. Characterization Fac.	x			$3,400
6	Non Destructive Eval. Exp. Fac.	x			$2,000
7	Electro-magnetic & Therm Char. Fac.	x			$11,600
8	IR Glass Fiber Drawing Facility	x	x		$650
9	Silica Glass Preform I Fiber Fab. Fac.	x	x		$750
10	Clean Room Facility				$1,500
11	IR Low Observable Signature Test Fac.	x	x	x	$1,250
12	3 MV Tandem Van De Graaff Accelerator				$2,500
13	Ion Implantation Facilities	x	x		$600
14	Synchrotron Radiation Facility	x	x	x	$4,500
15	Pulsed Laser Deposition Facility	x			$600
16	X-Ray Diffraction Facility	x			$400
17	Computational Facilities				$220
18	Protein and Peptide Facility	x			$250
19	Area Detector Facility	x			$320
20	Robot Crystallization Facility	x			$140
21	Polymer Coating & Synthesis Lab.	x			$10,000
	Total Replacement Value				**$82,480**

3.5.1. Laboratory Facilities.

Description	Type	Capacity (KSF)		
		Current	Used	Excess
Major Facilities	Technical	80.1	67	13.3
Labs & Offices (Other Than Fac.)	Technical	79.2	72	7.5
Administration Offices	Administration	21	20	0.9
Storage	Storage	6.2	5.3	1.9
Total		**186.5**	**164**	**23.6**

3.5.1.1. Capacity to Absorb Additional Similar Work Years. Only minor facility modifications would be required to permit a modest increase in work years.

3.5.1.2. What additional work years can be supported. Our total civilian workyears are 235. We estimate that an additional 35 scientists (increase of 15%) could be added without straining our space and facilities capacities.

3.5.1.3. Military Construction FY95 Impact. MILCON FY95 has no impact on the answers to 3.5.1.1 or 3.5.1.2.

3.5.1. Land use. Not separately reportable. See response to BRAC Data Call 4.

3.5.2. Utilities. Not separately reportable. See response to BRAC Data Call 4.

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

23. **ADVANCED MATERIALS**

Enclosure (12) is a revised Section 3.0 to the Advanced Materials CSF.

24. **ADVANCED MATERIALS QUESTION 3.4.1**

The question asks you to "describe major facilities and equipment to support **each CSF**." The question further asks **If the facilities and equipment are shared with other functions, identify those functions and the percentage of total time used by each of these functions**." (Note: The response to SPACE does a good job of allocating percentage usage to CSF).

RESPONSE: See enclosure (13).

25. **ADVANCED MATERIALS QUESTIONS 3.5.2, 3.5.3**

Please provide a response to these questions, for each CSF in which you are performing work. Citing Data Call #4 is not acceptable.

RESPONSE

a. **3.5.2**: NRL has 11.2 acres available for unrestricted expansion located at its Chesapeake Bay Detachment. Parking would have to be included as part of any expansion project. Utilities, while available, are aged and would be required to be upgraded to accommodate any expansion.

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The building space (class 2 property) currently available for growth opportunities at the NRL DC site, either constrained or unconstrained, represents a total of multiple small areas located throughout the Laboratory which cannot be effectively utilized by any other functions other than the primary occupant of the facility. It is important to note, however, that NRL facilities can be re-configured, e.g., demolished and rebuilt, altered, fitted with capital equipment, etc. to accommodate new or expanded mission assignments. However, accurate quantification of the maximum amount of space available for expansion is not practical without the benefit of revised mission/program planning guidance. For planning purposes, a rough order of magnitude estimate of the minimum class 2 space available for expansion is 10 percent. This would involve minimal reconfiguration.

b. 3.5.3: Utility service capacities are depicted in the following table:

	On Base Capacity	Off Base Long Term Contract	Normal Steady State Load	Peak Demand
Electrical Supply (KWH)	N/A	54,000 KWH	13,098 KWH	17,280 KWH
Natural Gas (CFH)[1]	N/A	2,961 CFH	141 CFH	1,868 CFH
Sewage (GPD)	N/A	Unlimited	847,583 GPD	1,017,100 GPD
Potable Water (GPD	N/A	9,740,978 GPD	1,118,911 GPD	1,342,693 GPD
Steam (PSI & lb/Hr)[2]	190,000 lb/Hr	N/A	116,000 lb/Hr	125,000 lb/Hr

1 The availability of natural gas is controlled by the Washington Gas Light Company. It cannot be relied on as a primary fuel.

2 Production plant owned by PWC, Washington.

R.M. Cassidy

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APPENDIX 1 PATENT DISCLOSURES AND PATENT AWARDS 1991-1993

	DISCLOSURES (Navy Case #)	DATE FILED	AWARDED (Patent #)	DATE ISSUED	TITLE
1	70070		5,043,693	8/27/91	Heterogeneous Magnetrostrictive Layer
2	70280		5,137,776	8/11/92	Metal-Coated, Ordered Void Piezoelectric Ceramic Material
3	70303		5,103,174	4/7/92	Magnetic Field Sensor and Device for Determining the Magnetostriction of a Material Based O
4	70358		4,992,244	2/12/91	Films of Dithiolene Complexes in Gas-Detecting Microsensors
5	70421		5,139,871	8/18/92	Thermochemically Treated Oligomeric and/or Polymeric Derived Silicon Carbide Fibers
6	70430		5,003,039	3/26/91	Amino Phenyl Containing Curing Agent for High Performance Phthalonitrile
7	70634		5,162,235	11/10/92	Method for Assessing Distillate Fuel Stability by Oxygen Overpressure
8	70671		5,003,078	3/26/91	Synthesis of Phthalonitrile Resins Containing Ether and Imide Linkages
9	70672		5,262,514	11/16/93	Polymer from Diimido-Di-Phthalonitrile
10	70810		5,015,353	5/14/91	Method for Producing Substoichiometric Silicon Nitride of Preselected Proportions
11	70860		5,051,353	9/24/91	Preservation and of Hemoglobin in Blood Substitutes
12	70876		5,079,220	1/7/92	Process for Single Crystal Growth of High Tc Superconductors
13	70941		5,098,588	3/24/92	New Class of Lubricants Derived from Archaebacterial Lipids
14	70998		5,211,733	5/18/93	Plasma Chemical Vapor Deposition of Halide Glasses
15	71027		5,045,345	9/3/91	Energy Beam Treatment for Improved Adhesion of Coatings to Surfaces
16	71049		4,990,291	2/5/91	Method of Making Lipid Tubules by a Cooling Process
17	71127		5,145,435	9/8/92	Method of Making Composite Field-Emitting Arrays
18	71222		5,208,318	5/4/93	Phosphazene-Containing Amine Ascuring Agent for Phthalonitrile-Based Polymer
19	71223		5,242,755	9/7/93	High Temperature Adhesive
20	71224		5,132,396	7/21/92	Phthalonitrile Monomers Containing Imide and/or Phenoxy Linkages

21	71262		5,151,407	9/29/92	Method of Producing Bi-Sr-Ca-Cu-O Superconducting Materials in Cast Form
22	71270		5,104,850	4/14/92	Preparation of High Temperature Superconducting Wires by Dipping and Post Annealing
23	71553		5,079,600	1/7/92	High Resolution Patterning on Solid Substrates
24	71580		5,171,790	12/15/92	Elastomer Blend for Sound and Vibration Damping
25	71593		5,049,382	9/17/91	Coatings and Composition Containing Lipid Microstructure Toxin Dispensers
26	71603		5,186,854	2/16/93	Composites Having High Magnetic Permeability and Method of Making
27	71608		5,073,409	12/17/91	Environmentally Stable Metal Powders
28	71614		4,988,205	1/29/91	Reflectometers
29	71641		5,126,674	6/30/92	Planar Imaging by Nuclear Magnetic Resonance
30	71647		5,110,334	5/5/92	Method of Producing Glass Fiber with Cores of a Different Material
31	71674		4,981,941	1/1/91	Fluroinated Epoxy Resins with High Glass Transition Temperatures
32	71694		5,183,740	2/2/93	Flow Immunosensor Method and Apparatus
33	71714		5,141,312	8/25/92	Fiber Optic Photoluminescence Sensor
34	71728		4,982,019	1/2/91	Volatile Divalent Metal Alkoxides
35	71785		5,193,383	3/16/93	Mechanical and Surface Force Nanoprobe
36	71786		5,120,704	6/9/92	Method of Making TlSrCaCu-Oxide Superconductors Comprising Heating at Elevated Pressures in a Sealed Container
37	71878		5,062,939	11/5/91	Selective Metallization of Carbonyl-Containing Polymer Films
38	71930		5,043,251	8/27/91	Process of Three Dimensional Lithography in Amorphous Polymers
39	71993		5,215,961	6/1/93	Machinable Oxide Ceramic
40	71999		5,272,131	12/21/93	Method for Forming Aligned Superconducting Bi-SR-CA-CU-O
41	72033		5,051,493	9/24/91	Metal Phthalocyanines as Catalysts for Curing Phthalonitrile Prepolymers
42	72120		5,242,792	9/7/93	Method for the Preservation of Red Blood Cells by Lyophilization Using Gylcerol or Inositol with Disaccharides
43	72143		5,075,094	12/24/91	The Use of Diamond Coatings for protection Against Environmental D
44	72363		5,202,786	4/13/93	Optical Switching Devices
45	72440		5,158,933	10/27/92	Phase Separated Composite Materials
46	72484		5,227,724	7/13/93	Pulsed-Gradient Spin Diffusion NMR Method

47	72497		5,061,857	10/29/91	Waveguide-Binding Sensor for Use with Assays
48	72535		5,242,563	9/7/93	Molten Salt Reactor for Potentiostatic Electroplating
49	72556		5,078,768	1/7/92	Hot Isostatic Pressing of Fluoride Glass Materials
50	72593		5,245,660	9/14/93	System for Producing Synchronized Signals
51	72680		5,091,799	3/17/92	Metallized Tubule-Based Artificial Dielectric
52	72761		5,227,725	7/13/93	Nuclear Magnetic Resonance Imaging with Short Gradient Pulses
53	72793		5,191,559	3/2/93	Piezoelectric Ceramic Hydrostatic Sound Sensor
54	72965		5,264,511	11/23/93	Polymers of Bis (Ethynylstyryl) Benzene and Related Monomers
55	73008		5,174,983	12/15/92	Flame or Plasma Synthesis of Diamond in Turbulent and Transition Flow Conditions
56	73114		5,106,829	4/21/92	Method of Making Substantially Single Phase Superconducting Oxide Ceramics Having a Tc Above 85 Degrees
57	73174		5,247,060	9/21/93	Curing Phthalonitriles with Acid
58	73184		5,202,414	4/13/93	Pyrolzed Amine Cured Polymer of Dithioether-Linked Phthalonitrile Monomer
59	73188		5,213,844	5/25/93	Volatile CVD Precursors Based on Coper Alkoxides and Mixed Group llA-Copper Alkoxides
60	73252		5,242,706	9/7/93	Laser-Deposited Biocompatible Films and Methods and Apparatuses for Producing Same
61	73309		34,322	7/27/93	Preparation of Hard Magnetic Alloys of a Transition Metal and Lanthanide
62	73345		5,159,054	10/27/92	Synthesis of Phthalonitrile Resins Containing Ether and Imide Linkages
63	73567		5,293,218	3/8/94	Interferometric JFTOT Tube Deposit Measuring Device
64	73614		5,282,936	2/1/94	Decomposition of Halogenated and Polyhalogenated Organic Materials by Electrified Microheterogeneous Catalysis
65	73796		5,292,927	3/8/94	Fluorinated Resins with Low Dielectric Constant
66	73827		5,234,758	8/10/93	Nonlinear Optical Composites of Metal Cluster Laden Polymers
67	74119		5,225,374	7/6/93	Method of Fabricating a Receptor-Based Sensor
68	74267		5,230,848	7/27/93	Method of Thermochemically Treating Silicon Carbide Fibers Derived from Polymers

69	74307		5,290,960	3/1/94	Diacetylenic Phospholipids Containing Heteroatom Near Diacetylenic Functionality for Modulation of Microstructure Morphology
70	74327		5,238,610	8/24/93	Method of Detecting Oxidizing Agents in Aqueous Media Through the Use of Chemiluminescent Microemulsions
71	74344		5,298,484	3/29/94	High Tc Copper Oxide Superconductors Comprising TlSrCaCu-O
72	74792		5,252,695	10/12/93	Fast Switching Ferroelectric Liquid Crystalline Polymers
73	74797		5,292,854	3/8/94	Synthesis of Phthalonitrile Resins Containing Ether and Imide Linkages with Aromatic Diamine Curing Agent
74	74948		5,292,779	3/8/94	Carborane-(Silane or Siloxaned)-Unsaturated Hydrocarbon Based Thermosetting Polymers
75	69868	11/29/90			CLASSIFIED
76	70723	4/2/92			Formation of Corrosion Resistant EMI Shielding and Hermetic Sealing GA
77	71079	9/30/91			Replacements for Hydrogen Peroxide for use with Horseradish Peroxidaze in Immunoassay
78	71962	6/7/91			Color of Polarization Indicator of High Tc Superconductors used at Room Temperature
79	72144	1/31/92			Preparation of Superstrength Alloys of High Volume Fraction of Par
80	72234	4/11/91			Methods for the Isolation of Gene Activation Factors
81	72557	1/22/92			Method and Apparatus for Generating High Energy Nuclear Reaction Low Energy Ion Bombardment of Solids
82	72578	5/10/91			Production and Use of Metal Matrix Composites Using Diamond or Diamond Coated Reinforcement Materials
83	72593	2/19/91			Synchronization of Chaotic Systems
84	72806	7/6/90			Epitaxial Growth of Diamond Crystals at High Growth Rates
85	72823	11/5/91			Improved Electrostatic Fiber Spreader
86	73100	11/5/91			High Strength Parts from Superplastic Metal Powder or Flake
87	73175	9/25/92			Oriented Thin Films of Potassium Tantalum Niobate and Potassium Nioba
88	73258	2/18/93			Synthesis and Polymerization of Oligomeric Multiple Aromatic Ethe Containing Phthalonitrile
89	73286	5/8/91			High Temperature, High Rate, Epitaxial Synthesis of Diamond in a Laminar Plasma

90	73375	1/8/92			Detection of Toxins
91	73394	4/30/92			Liquid Flow Reactor and Method of Using
92	73518	9/30/92			High Temperature Substrate Mount for Chemical Vapor Deposition
93	73520	8/3/92			New Glass Composition for Low-Loss Mid-IR Wavelength Transmission
94	73546	8/20/91			Method for Synthesizing High Quality Doped Diamond Films, Crystals and Devices
95	73798	4/21/93			Improved Process for Making PBSCCO Parts
96	73856	6/23/92			Surface Modificaiton of Diene Rubbers
97	73865	9/30/92			Plasma Treatment of Glass Surface
98	73912	5/11/92			Pseudoperiodic Driving Using Chaos
99	74104	1/15/93			Xon Modification for the Improved Corrosion Performance of Carbon-Reinforced Metal Matrix Composites
100	74122	2/23/93			Polymerizable Lipids in the Development of Controlled Release Carri
101	74222	9/30/93			Synchronization of System to Input from Another System Based on Cascaded System Design
102	74261	4/7/93			A Design for a Catheter Device Comprising a Biocompatible Ceramic Coating by Pulsed Laser Deposition Directly onto the Catheter Tubing at the Wound Exit Site
103	74278	8/21/92			Methods for Modification of Diamond Surfaces
104	74339	7/30/93			A Process for the Preparation of Headgroup-Modified Phospholipids Using Phosphatidylhdroxyalkanols as Intermediates
105	74399	3/31/92			Flow Immunosensor
106	74407	7/3/92			A Device for Low Electric-Field Induced Switching of Ferroelectric Liquid Crystal Layered Films Using a Single Substrate
107	74741	6/29/93			Polarized Optical Emission Due to Decay or Recombination of Spin-Polarized Injected Carriers
108	74772	11/16/92			Nucleic Acid Reagents for the Inhibition of Malaria Infections
109	74791	6/28/93			Phthalonitrile Repolymer as High Temperature Sizing Material for Composite Fibers
110	74848	8/21/92			DNA-Based Fluorescent Sensor
111	74854	6/23/93			Global Tracker and Choas Buster of Unstable Phenomena in Nonlinear System

112	74904	6/9/93			Composite Transducer Assembly
113	75053	6/28/93			Material for Protection Against High Temperature Corrosion
114	75059	2/26/93			Aromatic Acetylenes as Carbon Precursors
115	75086	11/19/92			Hard Magnetic Material of a Transition Metal and a Lanthanide
116	75121	12/30/93			Mode-Matched Combination Tape Fiber Optic Probe
117	75140	12/18/92			Polymer of Dithioether-Linked Phthalonitrile
118	75152	5/18/93			Substrate Temperature Control Technique for CVD Reactors
119	75196	1/21/93			Electrified Microheterogeneous Catalysis
120	75211	1/27/93			Fluorinated Resins with Low Dielectric Constant
121	75225	2/7/94			Pressure Converter for 1-3 and 1-1-3 Composite Transducer
122	75245	2/19/93			Phosphazene-Containing Amines as Curing Agents for Phthalonitrile-Base Polymers
123	75304	3/10/93			Volatile CVD Precursors Based on Copper Alkoxides and Mixed Group llA Copper Alkoxides
124	75315	8/6/93			Optical Immunoassay for Microbial Analytes Using Non-Specific Dyes
125	75374	4/9/93			In-Situ Formation of Hardening Elements by Electrochemical Techniques
126	75407	10/1/93			Magneto-Resistive Linear Displacement
127	75411	4/29/93			Nonlinear Optical Composites of Metal Cluster Laden Polymers
128	75412	4/29/93			Nanochannel Glass
129	75421	3/29/94			Double Network Elastomers and Method for Making Same
130	75677	3/30/94			Non-Covalent Immobilization of Proteins on Polymerized Lipid-Assemblies
131	75694	11/15/93			Process for Preparing Oxidation Resistant Cu Nanoparticles
132	75752	11/24/93			Apparatus for Electrified Micrometerogeneous Catalysis
133	75784	9/30/93			Fluorinated Resins with Low Dielectric Constant
134	75943	11/29/93			Carborane - (Siloxane or Silane) - Unsaturated Hydrocarbon Based Polymers
135	75944	11/29/93			Carborane - (Siloxane or Silane) - Unsaturated Hydrocarbon Based Thermosetting Polymers

136	75955	12/21/93			Aligned Bismuth, Strontium, Calcium Cuprate Coatings on Polycrystalline Substrates
137	76041	8/20/93			Selective Metallization Process
138	76044	2/7/94			Efficient Chemistry for Selective Modification and Metallization of Substrates
139	76048	2/18/94			India-Stabilized Zirconia Coating for Composites
140	76109	4/7/94			Medical Device with Infection Preventing Feature
141	76163	3/28/94			Nontoxic Antifouling System
141	**= TOTAL NUMBER OF PATENT DISCLOSURES AND PATENT AWARDS**				

Appendix 2. Facility Descriptions: Advanced Materials

1. Materials Processing Facility

Materials Processing Facility provides a full spectrum capability to synthesize and process materials, from small to large sizes, by a variety of methods and under varying thermal, mechanical, pressure, and rate sensitive processes.

Fully instrumented materials synthesis and processing capability include facilities for powder production by gas atomization, thermal evaporation, and rapid quenching. These facilities offer potential to create small particle sizes, from 10 nanometers to 50 micrometers. The powder synthesis capabilities include a physical vapor deposition system designed to produce and coat submicron powders, in-situ. Other powder producing facilities include rapid oil bath quenching to produce small uniform size micrometer particles. Facilities to process powder into bulk specimens by hot (temperatures to 2000°C, pressures to 3 ksi, size 4 x 6 inches) and cold isostatic pressing permit a variety of consolidation possibilities. Isothermal heat treatment facility and quenching dilatometer permit accurate determinations of phase relationships in metals. Arc melting capabilities, vacuum induction furnaces, reaction metal melting facilities, and rapid quench melt spinners exist for metals synthesis. Included in the facility are rolling mills, swaggers, and wire drawing facilities. Metal matrix composites and surface coatings are produced in a variety of computer controlled, physical vapor deposition systems for coating fibers and surfaces. Ceramic and ceramic matrix composites processing facilities include a wide variety of conventional, controlled atmospheric furnaces, hot presses, ball milling apparatus and particle size determination, and sol-gel and organometallic coating processing capability.

2. Computer-Controlled Universal Material Test System

Determines material properties and the structural response of components under a wide variety of loading conditions and temperatures by using computer-controlled servo hydraulic load frames.

The system consists of a Micro PDP 11/23 with 512K bytes of memory interfaced to a 12-channel A/D module, a 4-channel D/A module, and a test machine interface unit. These modules allow the computer to monitor the test conditions and make control decisions depending on the test programming. Also, the response of the test specimen is recorded at the same time on an 11-M byte hard disk. This system can operate any servo hydraulic load frame, and allows complicated and difficult material or component tests to be automated for greater accuracy and efficiency.

Load frames available for use with this system are as follows:

* 250,000-lb capacity, four-column load frame for compression testing;
* 150,000-lb capacity, high-rate portable load frame for testing the laser vulnerability of materials and components; this load frame is designed to fit into the test areas of the laser facilities, and is equipped with a portable hydraulic power supply;
* 55,000-lb capacity, high-rate portable load frame for testing the particle beam vulnerability of materials and components- this load frame is configured so that it can fit into the shielded areas at the LINAC facility and the radiation effects facility at Brookhaven National Laboratory;
* 55,000-lb capacity, standard load frame for general materials testing;
* 20,000-lb capacity, platform-type load frame for component testing; this load frame has a 34 by 54-in. table with T-slots for the mounting of test specimens-, and
* two 10,000-lb load frames for general materials testing.

The computer-controlled universal materials test system can perform any of the common mechanical property tests such as tension, compression, fatigue, fracture toughness, and creep rupture, depending on the load frame and fixtures used. The

automation that results from the use of a computer to control the test rather than the more common analog methods allows materials testing to be more efficient and, in some cases, is the only feasible method for complex load histories.

The system is equipped with a 12-channel A/D module to monitor the response of the test specimen. A data acquisition system is also interfaced with the computer that can support temperature measurements and additional A/D channels. In addition to the computer system that controls the load frames, a Digital MINC-23 modular instrument computer is also available for data collection independent of that contained in the control system. This computer can be configured by adding various modules to support a wide variety of data collection and manipulation.

3. Magnetic and Superconducting Processing Facilities

Produces thin film and multilayer magnetic and superconducting materials for development of new materials, new structures, and new effects related to the two dimensional or layered structure of the materials.

Various thin film deposition systems are dedicated to magnetic and superconducting materials fabrication and processing. These systems include ultra-high vacuum systems fully instrumented with in-situ diagnostic tools to grow films atomic layer by atomic layer and to observe their growth pattern. Ultra high vacuum permits slow growth rates which produce minimal damage to the film produced, offers potential growth at lower temperatures, provides opportunity to create metastable structures, and creates growth procedures compatible with a variety of alternate materials. Deposition temperatures are controlled from over 1000°C to liquid nitrogen temperatures to produce a variety of different microstructures in the films.

Instruments include; i) an "epi-facility" for growing multilayer magnetic and semiconducting films epitaxially using thermal evaporation and electron beam techniques with a full complement of in-situ surface diagnostics such as RHEED, XPS, Auger spectroscopy, etc. ; ii) a superconducting deposition system consisting of E-beam sources, thermal evaporators, and sputtering heads for producing cuprate superconducting compounds and multilayer structures with a full complement of in-situ diagnostics including RHEED, XPS....; iii) a magnetic multi-layer deposition facility for producing multilayers which high degrees of magnetic anisotropy; iv) a magnetic deposition system for growing thin films epitaxially on semiconducting surfaces while monitoring grow and physical properties in-situ; and v) a scanning tunneling microscope for observing surface patterns on superconducting and magnetic films.

4. Chemical and Structural Characterization Facilities

Chemical characterization, atomic structure, microstructure information, and surface properties are determined by a variety of techniques with resolution ranging from a few nanometers to millimeters.

Various high resolution instruments are dedicated to characterization of materials from the atomic level to the macro level. X-Ray facilities of various types permit atomic structure information on powders, single crystals and thin films. High resolution scanning transmission electron microscopes permit chemical and structural determination of with a resolution down to 0.2 nanometers. Scanning electron microscopes permit surface characterization including surface morphology and chemistry. Scanning Auger microscopy permits surface chemical characterization determination with high lateral resolution. An X-Ray Fluorescence spectrometer permits chemical determination of solids, powders, and liquids. A surface characterization facility is

dedicated to electron spin polarization studies. A fully equipped metallography laboratory permits sample preparation for the various facilities as well as optical microscopy.

Instruments include: i) a Philips Transmission Electron Microscope, CM-30, with EDS and a JOEL Scanning Transmission microscope, Model 200 CX with ELS; ii) a Hitachi S-800 scanning electron microscope with 2 nanometer resolution; iii) a Perkin Elmer PHI 6660 scanning auger microscope with SEN and EDS capabilities; iv) an X-Ray laboratory with a Philips powder diffractometer, Blake Industries double crystal diffractometer, and a Philips texture goniometer (All instruments are fully computer controlled with a larger complement of associated software); v) a Kevex X-Ray Fluorescence Spectrometer (Z>11), vi) and a metallography laboratory with a full complement of polishing apparatus, optical microscopes, chemical etching supplies, micro-hardness testers, and photography supplies

5. Mechanical and Thermal Experimental Facilities

Determines multi-axial bulk materials properties at static and dynamic conditions with elevated temperature capability. The comprehensive data acquired serves as input failure and fatigue analysis of new and existing materials, lifetime predictions, and to the structural response simulators.

There are a number of systems which have several levels of auto-mation. The Composites Testing Laboratory 6-degree of freedom test facility has the most complete automation including specimen loading, full data acquisition/reduction and contains a software writing engine. Other thermal/mechanical systems and materials characterization laboratories include the more standard servo hydraulic frames (fatigue and tensile capability with chambers for vacuum and temperature range up to 1500C), creep facilities and combined electro-chemical-mechanical testing capabilities. Many of the equipments are extensively modified to provide data in a controlled environment, specifically the marine environments. Included as part of these facilities are numerical modeling stations, a surface imaging facility and special measurement capabilities such as non-contact laser extensometers. The load, temperature and fatigue capability is representative of standard laboratory materials needs.

Most facilities are modified versions of commercially purchased equipment.

6. Non Destructive Experimental Facilities

Determine and monitor non destructively the elastic, magnetic and thermal properties of materials due to changes related to manufacturing or service conditions. Instrumentation used can probe materials at the micro/macro scale. Analysis of this data is used to ultimately predict the remaining life (retirement-for-cause) or current capability (serviceability) of a specific structure.

The several facilities are comprised of advanced commercial instrumentation, modified to meet specific goals, or are uniquely designed and built to meet the data acquisition needs. The magnetic properties facility is comprised of a specially designed three axes Squid Magnetometer, a non-magnetic scanning and load frame and is fully automated for experiment and data acquisition purposes. The precision ultrasonic instrument has been assembled from special commercially available instrumentation with modifications made and software developed for the unique high precision requirements. The acoustic wave simulator and tomographic reconstruction computational facility is a unique add-on feature which is under development (currently partially functional) and provides orders of magnitude enhancement to the analysis of the data. General capabilities of instrumentation: i) Specimen size: 24" X 36" maximum; ii) Resolution and Sensitivity: spatial .0001", amplitude 12 Bit, S/N100dB, time 1 nanosecond; iii)Frequency range: 250Khz to 25Mhz; iv) Image display capability: A, B & C scan. Volumetric reconstruction. v) Data analysis: From standard analysis of raw data (fft's, mean, variance etc.) to image analysis of scanned data. Platforms include 486 based cpu's, Silicon Graphics and NeXt workstations.

Instrumentation includes: Caldata and Metrotek standard systems, Tektronix digitizers, Quantum Design SQUID magnetometers, Connection Machine analysis platform, AVS and Explorer software.

7. ElectroMagnetic and Thermal Characterization Facility

Characterizes the electro-magnetic response of materials from dc to 100 giga hertz under a wide variety of thermal, magnetic, electric field extremes as well as processing conditions.

Nuclear magnetic resonance, paramagnetic resonance, ferromagnetic resonance, and moss-bauer facilities permit characterization of atomic specific response to magnetic fields and electro-magnetic radiation. High frequency resonator cavities, con-focal resonators, line terminators, and strip-line techniques provide surface loss determinations for superconducting and magnetic materials. Static magnetic moments are measured with SQUID and vibrating coil magnetometers. Electrical transport measurements are acquired with computer controlled systems capable of taking data over wide temperature extremes ($0.02\ K < T < 1500\ K$) and wide magnetic field extremes ($0 < H < 15$ tesla). Chaotic phenomena in materials and electronic circuits is monitored as a function of control parameters. Thermal electric and piezoelectric response are determined for a variety of materials, material geometry's, and processing conditions. Heat capacity determinations to temperatures as high as 1000 ^{o}C can be made with a specially constructed facility

Instrumentation is a collection of commercial facilities, most of which have been modified for specific research and development tasks. Among the more specialized apparatus are i) a dilution refrigerator capable of producing continuous cooling to 0.02 K; ii) a Quantum Design SQUID magnetometer; iii) a Princeton Applied Research vibrating sample magnetometer; iv) a Varian E-9 Magnetic Resonance Spectrometer; and v) an NRL-designed Electron-Conversion Mossbauer Spectrometer.

8. IR Glass Fiber Drawing Facility

This facility is used for the fiber drawing of infrared transmitting fluoride glasses. The 11 foot tall tower is equipped with a feed mechanism, an RF induction furnace, operating from 300° to 600° C, an optical micrometer, a coating and curing assembly, and a fiber take-up system.

9. Silica Glass Preform and Fiber Fabrication Facility

This facility is used for fabrication of silica glass optical fibers. The modified chemical vapor deposition process (MCVD) is used to fabricate optical fiber preforms. The process involves the chemical reaction of vapors of liquid reagents, such as $SiCl_4$, $GeCl_4$ and $POCl_3$, and oxygen inside of a rotating glass substrated tube by heating with an external, traversing oxyhydrogen torch. Computer control of the process allows the preform parameters to be tailored for the fiber's intended use. The existing system is capable of fabricating multimode, single mode, and specialty optical fiber preforms.

10. CLEAN ROOM FACILITY

This facility is used for the preparation of high purity glass precursors and high purity glasses, the analysis of materials for heavy metals via atomic absorption spectrometry and the preparation of high purity infrared optical fibers. The clean room facility consists of a bank of three class 100 clean rooms with a total of approximately $2000ft^2$ of working space. Clean Room #1 is used primarily for the preparation and analysis of glass precursors and glasses for heavy metals as well as preparation of standards for heavy analysis in water. This clean room also contains three class 100 clean hoods for ultrahigh purity processing. Clean Room #2 contains a double dry box system

and is used primarily for preparation of infrared transmitting glasses under clean, inert atmosphere conditions. This clean room also contains three class 100 clean hoods for processing various high purity materials which are used in infrared transmitting glass preparations. Clean Room # 3 is devoted to the preparation of infrared transmitting optical fibers. The back half of this clear room accommodates a two story state-of-the-art optical fiber drawing tower. All clean rooms are connected by internal doors with access to the clean room bank afforded by a small antechamber (60 ft^2) located in the front of Clean Room #1.

11. INFRARED LOW OBSERVABLE SIGNATURE TESTING FACILITY

This facility is used for the measurement of infrared signature of low observable treatments, panels and scale models. An indoor chamber with a temperature controlled skydome, temperature controlled earth/sea plane, and a sample mount with 360° azimuth rotation, ±10° elevation tilt, power freedthrus and coolant feedthrus. A MWIR solar simulator and simulated sea surface are also available.

12. MV TANDEM VAN DE GRAAFF ACCELERATOR

The Naval Research Laboratory three million volt tandem Van de Graaff accelerator produces beams of energetic ions for research on material modification, analysis, radiation effects, and device fabrication. Atoms, each with one surplus electron , enter the tandem and are accelerated to the high voltage terminal in the accelerator's center. There they are stripped of the excess electron and q more electrons, to form positively charged ions, and accelerate from the terminal and out of the tandem. The energy (E) of an ion will then be approximately $V(q+1)$, where V is the terminal potential. A magnet deflects ions of the desired E/q ratio into the desired experimental beamline.

There are other facilities in the area that are somewhat like ours, but less inclusive in capabilities. The University of Maryland - College Park and the Naval Academy have facilities that are used to train students; NSWC has a somewhat limited facility that has a similar Van de Graaff to ours.

Our facility does elemental material analysis for many researchers at NRL. The capability fits in well with the many thin-film research programs in the Branch and the Laboratory. We also have an active effort in radiation damage studies for satellite applications. We will have the only DoD AMS facility and the only AMS facility in the DC metropolitan area. We expect to have many users from the local research medical community as well as from the local law enforcement agencies such as the FBI.

13. ION IMPLANTATION

The Naval Research Laboratory possesses a 200 kV ion implanter that has been modified to produce intense ion beams of virtually any element in the periodic table. The implanter is housed in the "clean room" within building 74. The ion implanter modifies the surface properties of materials by bombardment with energetic ions of any elemental species. Modifications include doping and patterning of semiconductors, surface alloying to protect against wear and corrosion, formation of metastable materials, and changes on the optical constants. The 200 kV ion implanter consists of the standard target vacuum chamber which is cryogenically pumped and equipped with a rotating water-cooled feed-through to implant cylindrical geometry specimens up to 10 inches in diameter, a cryogenic feed-through to cool samples down to a temperature of 77°K, and a hot stage to warm samples up to a temperature of 700°C. Three other mobile target chambers can be attached to rear of the standard target chamber.

There are no facilities in the immediate area that are similar to ours. There are similar commercial facilities in the New England Area. The NRL facility is unique in its flexibility; a number of different techniques are routinely available to produce ions of

nearly any element in the periodic table. Implantations are routinely performed as a service for other researchers inside NRL and elsewhere. As an example, the Electronics Division at NRL uses our facility to implant Si^{29} into silicon wafers at 600 C, as part of their radiation hardening program. The Navy invested in a major facility at Spire Corp. to transfer some of the NRL-developed techniques to commercial products.

14. SYNCHROTRON RADIATION FACILITY

The Naval Research Laboratory developed three intense x-ray beam lines at the National Synchrotron Light Source (NSLS) which is located at Brookhaven National Laboratory in Upton, New York, near the center of Long Island. The beam lines contain instrumentation for x-ray reflectance, photoemission measurements diffraction, and absorption. The monochromatic radiation produced is tunable from 10 eV to over 10 keV. Polychromatic radiation extending over the 10 - 100 keV range is also producible. Primary objectives are the characterization of electronic and optical materials, phase transformations, and laser-solid interactions. Beam line X24C provides synchrotron radiation in the spectral range from the ultraviolet to soft x-ray for physical characterization of bulk materials, thin films, surfaces, and microstructures. Beam line X23B was designed for hard x-ray absorption fine structure measurements, crystallography and other x-ray scattering experiments, x-ray fluorescence analysis, and detector calibration experiments. Beam line X17C was developed for high-pressure research, principally using diamond-anvil pressure cells.

This facility is fixed in place and unique. It incorporates major scientific and technological capabilities which are not duplicated anywhere in the U.S., including industry, universities, and government. There is no site other than the NSLS where this facility can function. There is no DoD laboratory other than NRL where the scientific and technical program is sufficiently broad and deep and where the staff and support are adequate to produce and to apply to defense needs the vast array of data which this facility is capable of producing. Considering the high productivity and current scientific importance of this facility, its loss would have a major negative impact on a broad range of electronic and optical materials development of improtance to the DoD, including wide-band-gap (and high temperature semiconductors, carbon based materials, x-ray lithographic processes, optical and x-ray imaging devices, x-ray optics, IR sensor materials, biomaterials, laser induced/enhanced process technology, laser induced degradation, high-temperature superconductors, surface passivation, photovoltaic technology, and surface photochemistry. Technologies developed from these areas will play a major role in future defense systems.

15. PULSED LASER DEPOSITION FACILITY

The Naval Research Laboratory has the capability to produce films or thin layered materials through the use of pulsed laser deposition (PLD). The pulsed laser deposition systems are designed to deposit or provide thin films, multilayers, or superlattices of single and multicomponent materials *in situ* in high pressure, ambient gas environments with film stoichiometries faithfully reproducing the targets. Films crystallinity can be controllably varied from purely epitaxial as-deposited, requiring no post-deposit anneal, to amorphous depending on the deposition conditions. Films can be deposited on substrate wafers as large as 4" diameter. The pulsed laser depositon laboratory is centered around two Lambda Physik LPX 305i KrF excimer lasers each capable of 1.3 Joules per pulse and a 50 Hz repetition rate. There are currently four thin film deposition chambers:

- The prototype chamber which is used to test a new material:
- The large area deposition chamber which has been used to deposit HTS thin films over 1" square areas for the HTSSE II program;
- The computer-controlled superlattice chamber; and

- A new "disposable" chamber to be used for noxious materials.

There are two similar local facilities, one at NIST and one at the University of Maryland - College Park. The NRL facility is unique in that it makes high-quality, high-temperature superconducting (HTSC) films for researchers in the DoD at NRL and elsewhere, and for researchers outside of the DoD. NRL HTSC films are used for Navy satellite experiments. Significant work is ongoing on ferroelectric, ferrite and hydroxyapatite films. The hydroxyapatite (a bone-like material) film work has led to major collaborations with the medical research community, inside and outside DoD.

16. X-Ray Diffraftion Facility (Siemons)

Computer controlled automated diffractometer used to determine atomic resolution molecular structure. Systems provide data acquisition and analysis of 'single crystal' materials.

17. COMPUTATONAL FACILITIES

a. Compute/file servers: multiprocessor Silicon Graphics System and RS6000 System.

b. High resolution graphics workstations: Evans & Sutherland system, Silicon Graphics Indigo systems (2)

c. Single user workstations: RS6000 (4), Macintosh (8) and PC's (10)

d. Provide computational and graphics for LSM scientists

18. PROTEIN AND PEPTIDE FACILITY

Primary purpose: Support on-going studies on proteins and peptides by providing sufficient quantities of highly purified material for x-ray crystallographic studies and characterize samples prior to initiation of x-ray crystallographic studies.

19. AREA DETECTOR FACILITY

Primary purpose: Electronic data collection of x-ray diffraction from protein crystals for 3-dimensional structure determination.

20. ROBOT CRYSTALLIZATION FACILITY

Primary purpose: Development of an automated system for the preparation of protein crystals for x-ray diffraction crystallography

21. POLYMER COATING AND SYNTHESIS LABORATORY

This laboratory consists of an aggregate for equipment for handling, synthesizing, and processing chemicals and polymers for the primary purpose of developing coatings for protection against environmental degradation, marine corrosion, wear, etc. Commercially purchased equipment is extensively modified to meet specific needs of research and development for naval applications

1. Materials Processing Facility
Fig. 1. Quenching Dilatometer

1. Materials Processing Facility
Fig. 2. Sputter coating equipment

1. Materials Processing Facility
Fig.3. Induction Melter

1. Materials Processing Facility
Fig 4. Processing furnaces

2. Computer Controlled Universal Materials Test System
Fig. 1. Computer-Controlled Universal Material Test Machine

2. Computer Controlled Universal Materials Test System
Fig. 2. Material Response Simulator

3. Magnetics and Superconducting Processing Facility
Fig. 1. Epi-Center facility

3. Magnetics and Superconducting Processing Facility
Fig 2. UHV film deposition and diagnositic facility

4. Chemical and Structural Characterization Facilities
Fig. 1. Powder X-Ray facility

4. Chemical and Structural Characterization Facilities
Fig. 2. High Resolution Transmission Electron Microscope

4. Chemical and Structural Characterization Facilities
Fig 3. Scanning Electron Microscope

4. Chemical and Structural Characterization Facilities
Fig 4. Scanning Auger Microscope

Atomic Emission Spectrometer
Cary Ulta-Violet and Visible Light Spectrophbotometer
Ion Chromatograph
Fourier Transform Infrared Spectrometer
Fourier Transform Infrared and Raman Microscope
Thermal Gravimetric and Differential Scanning Calorimeter

5. Mechanical and Thermal Characterization Facilities
Fig. 1. High Temperature mechanical test machines

5. Mechanical and Thermal Characterization Facilities
Fig. 2. Stress-Corrosion Fatigue test machine

5. Mechanical and Thermal Characterization Facilities

Fig 3. Fiber strength test machine

5. Mechanical and Thermal Characterization Facilities
Fig 4. Fracture surface visualization apparatus

6. Non Destructive Evaluation Experimental Facilities
Fig.1. Ultra-sonic test facility

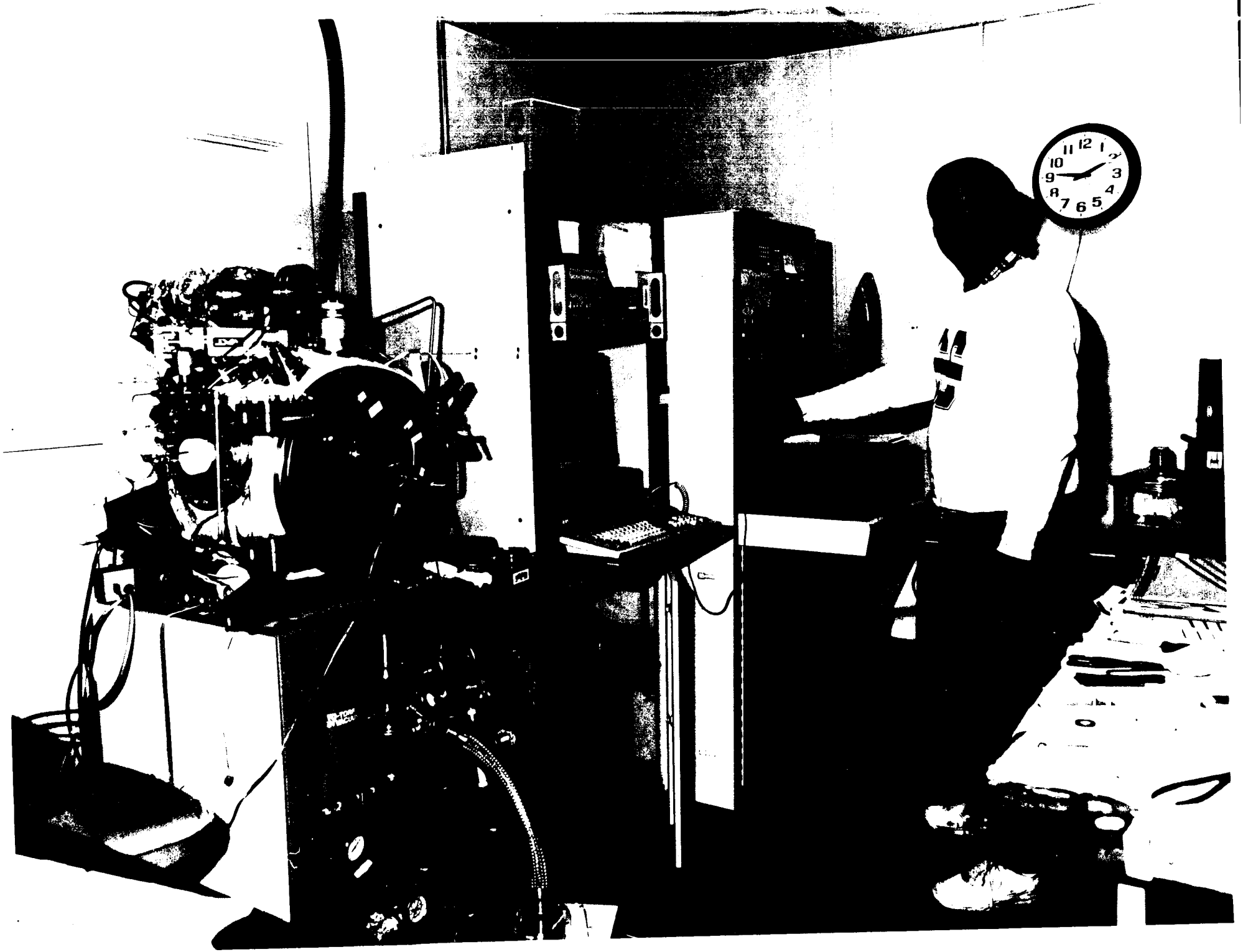
6. Non Destructive Evaluation Experimental Facilities
Fig 2. Magnetic test facility

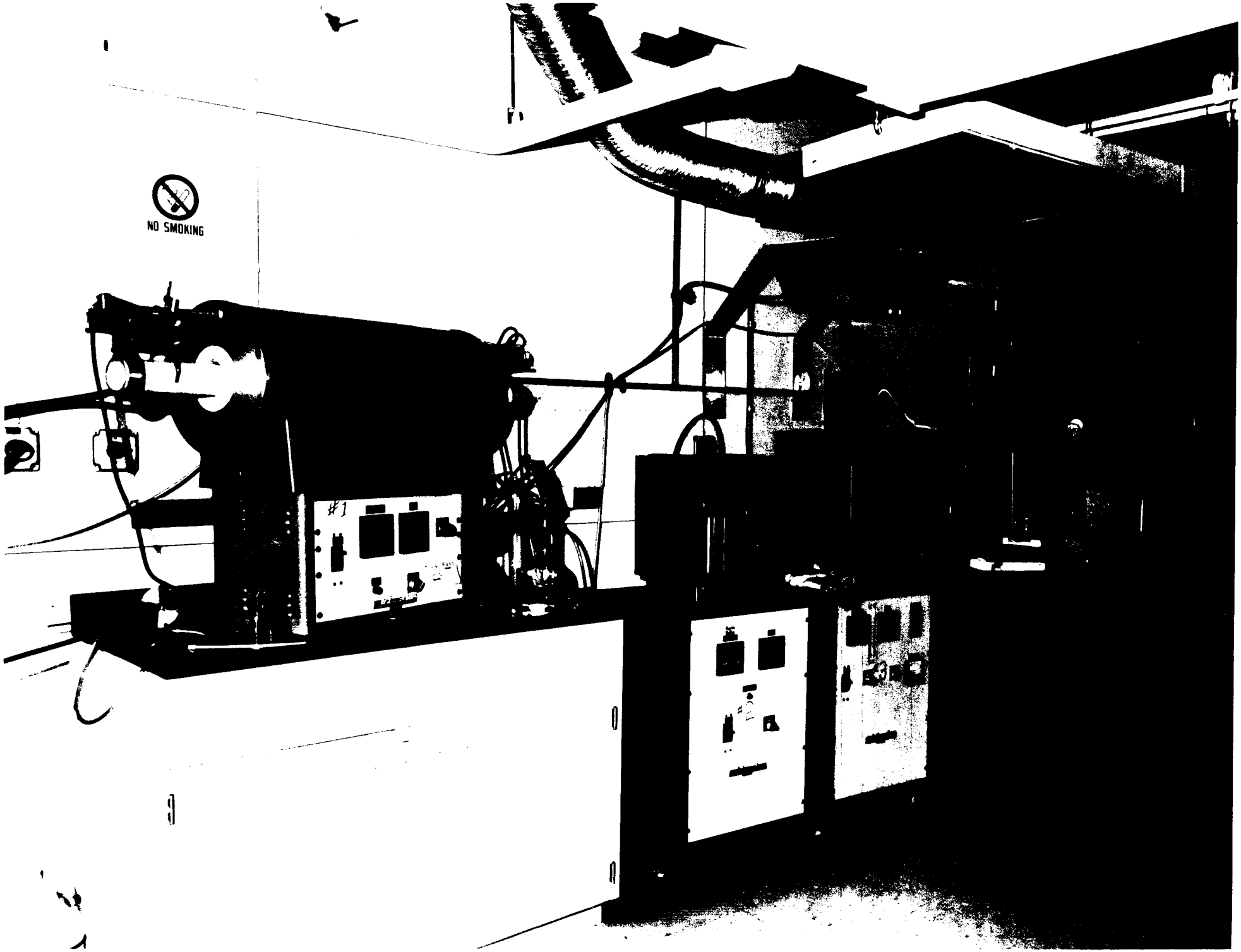
7. Electro-Magnetic and Thermal Characterization Facilities
Fig. 1. High magnetic field, low temperature sample measuring apparatus

7. Electro-Magnetic and Thermal Characterization Facilities
Fig. 2. Superconducting Magnetometer

7. Electro-Magnetic and Thermal Characterization Facilities
Fig. 3. Superconducting Magnet

21. Coating Synthesis and Characterization
Fig. 1 Glass Vacuum Rack for Chemical Synthesis
Fig. 2 Glove Box for Controlled Atmosphere Chemical Processing
Fig 3. Instron Universal Testing Instrument
Fig 4 Brabender Plasticorder Mixer
Fig 5 Press and Calendar for Materials Processing
Fig 6. Bohlin VOR Dynamic Mechanical Spectrometer
Fig. 7 Coating Spray Booth

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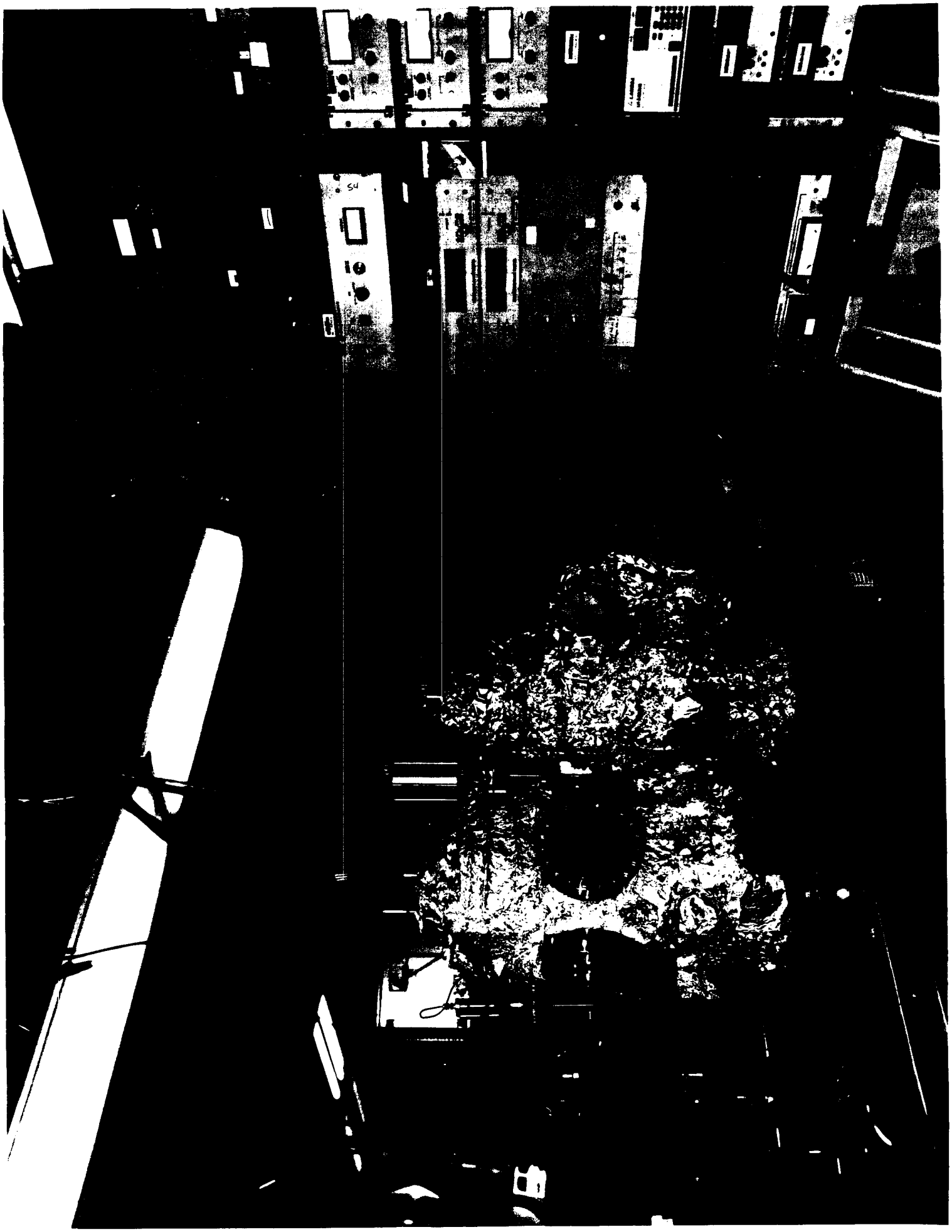

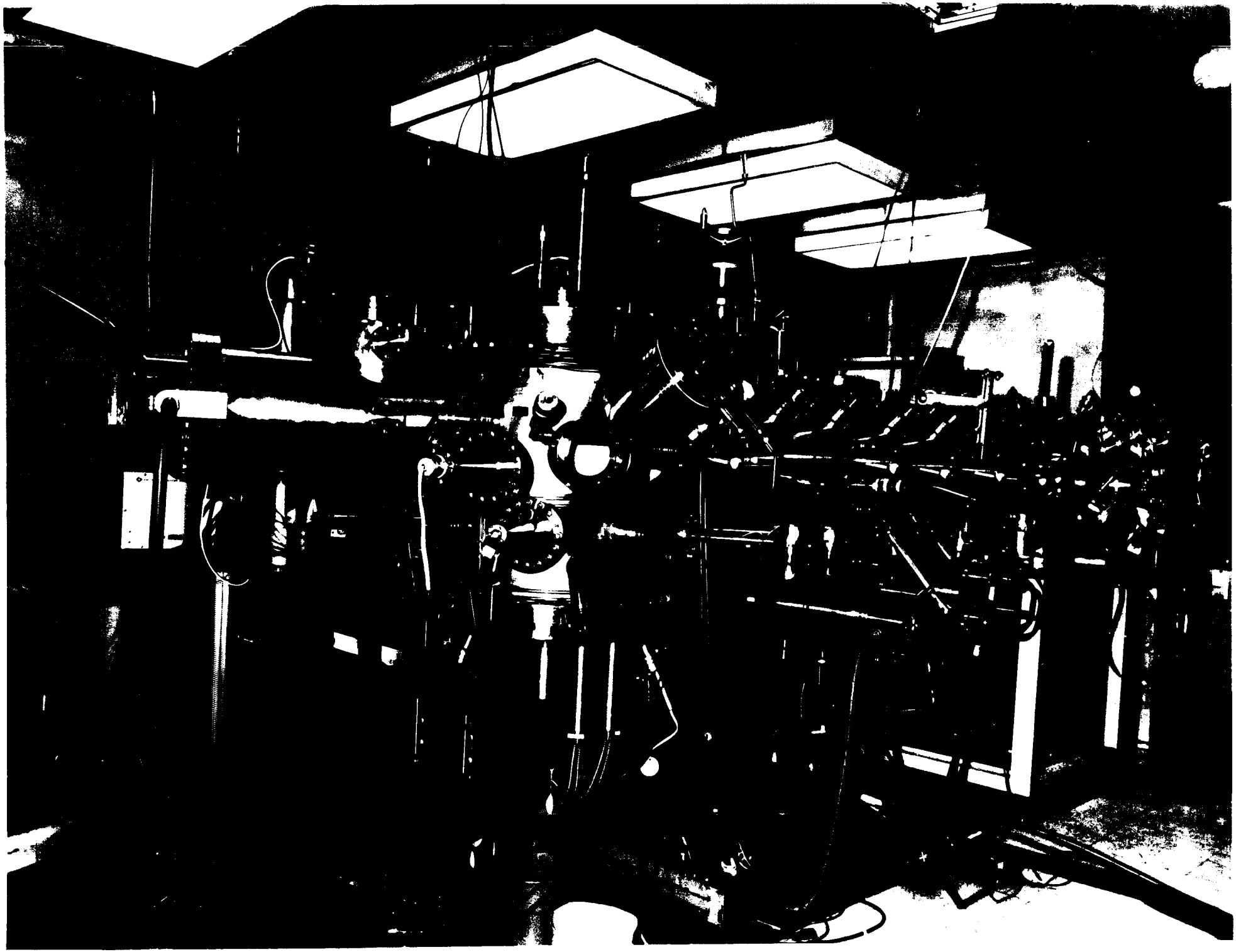

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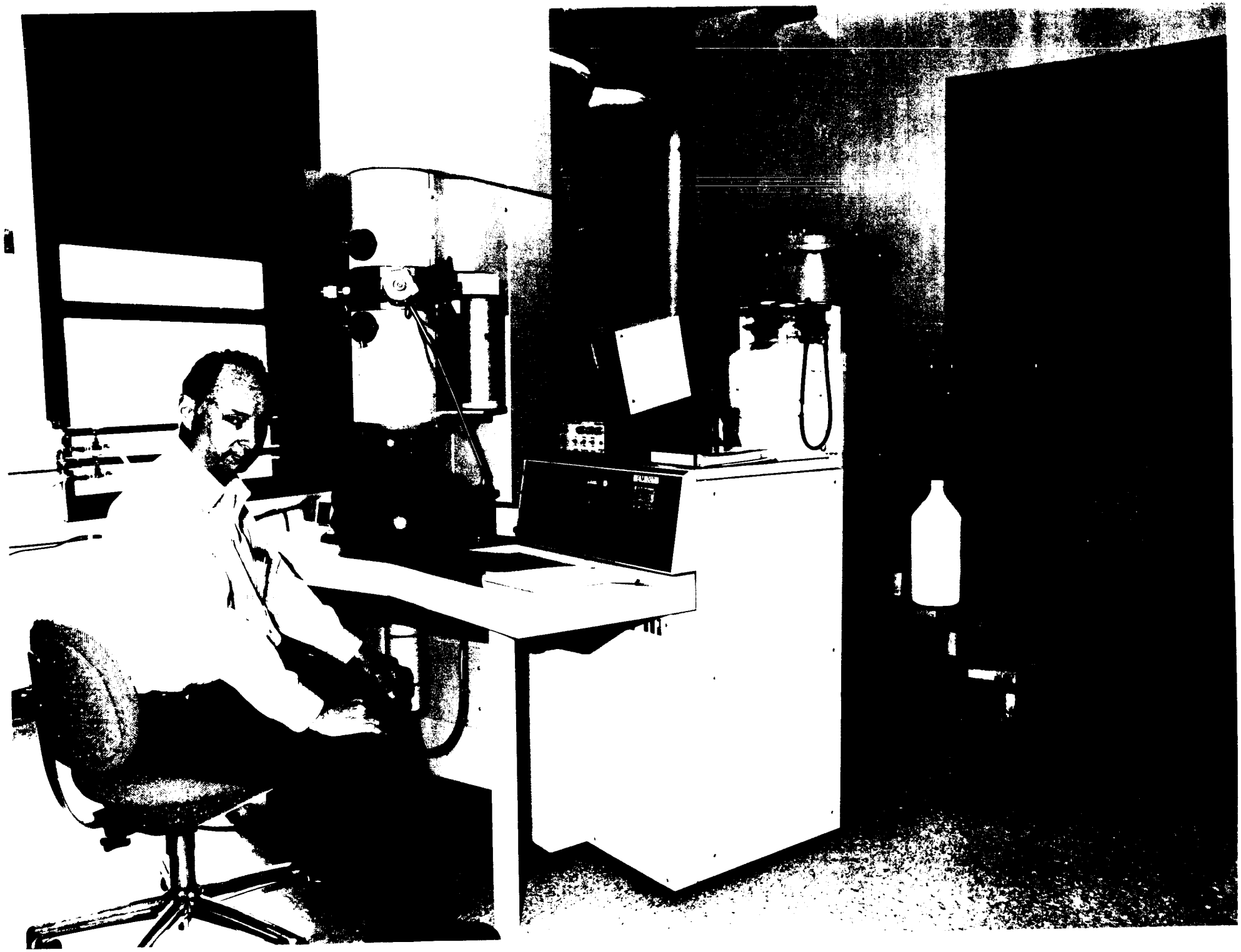

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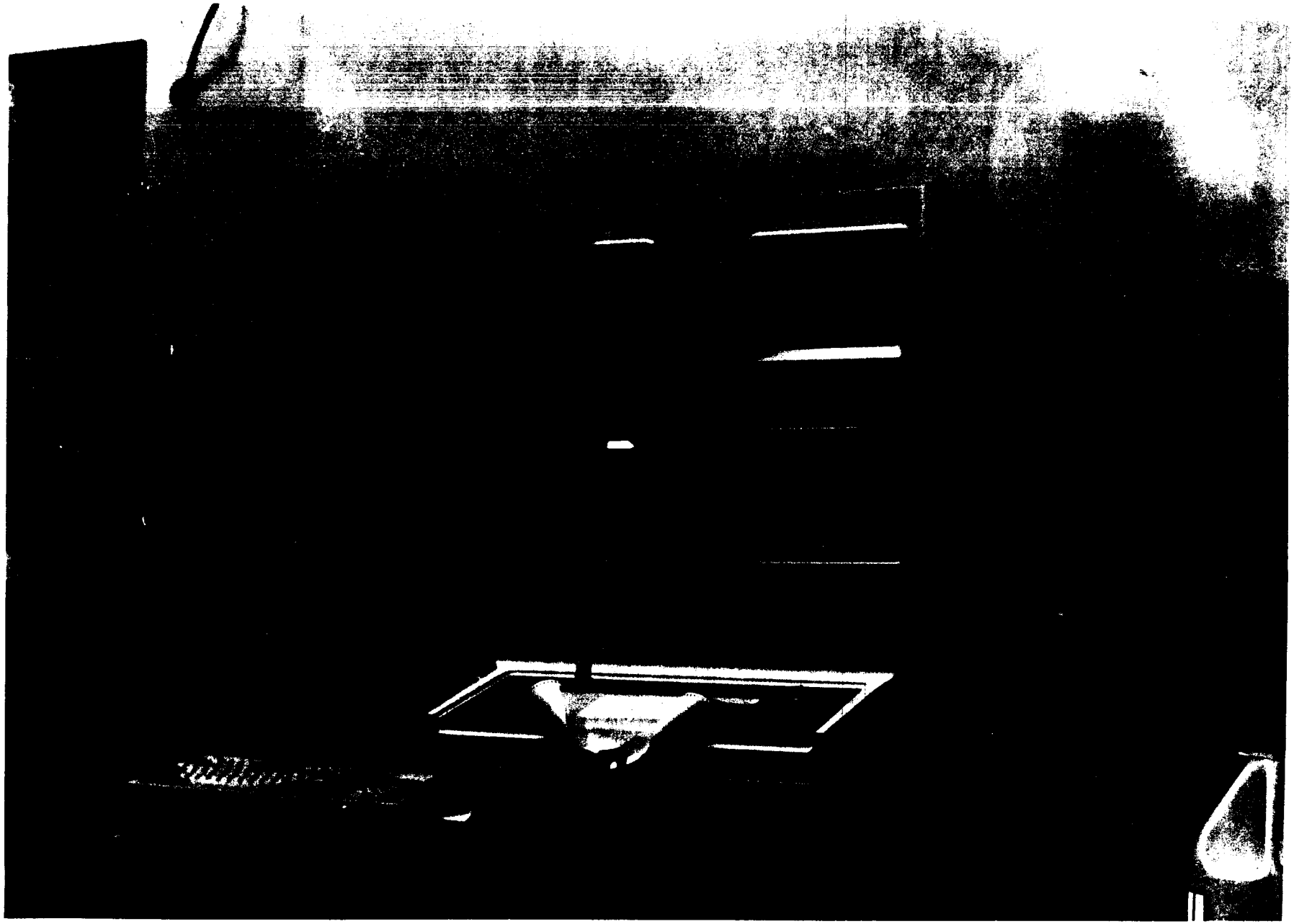

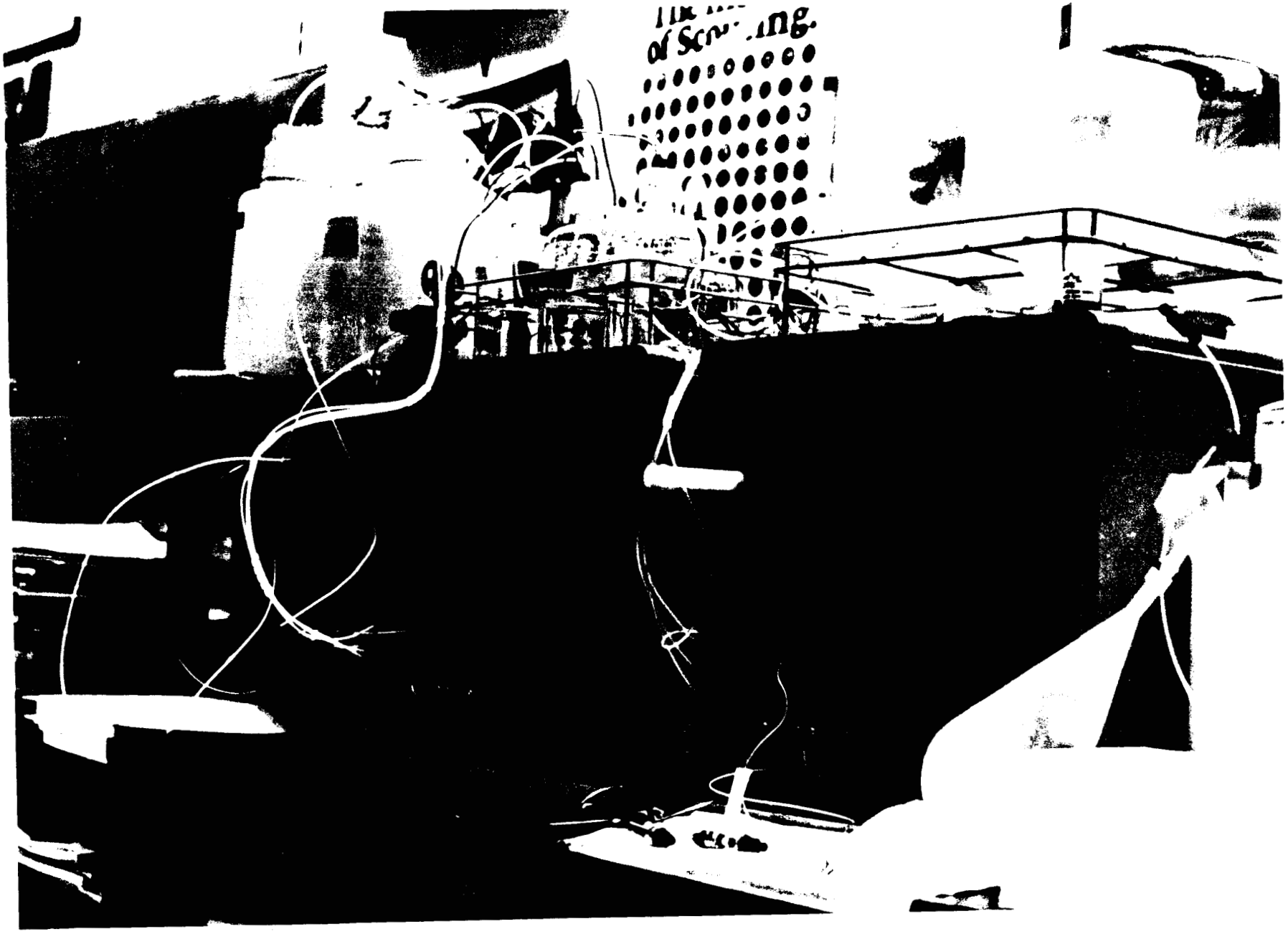

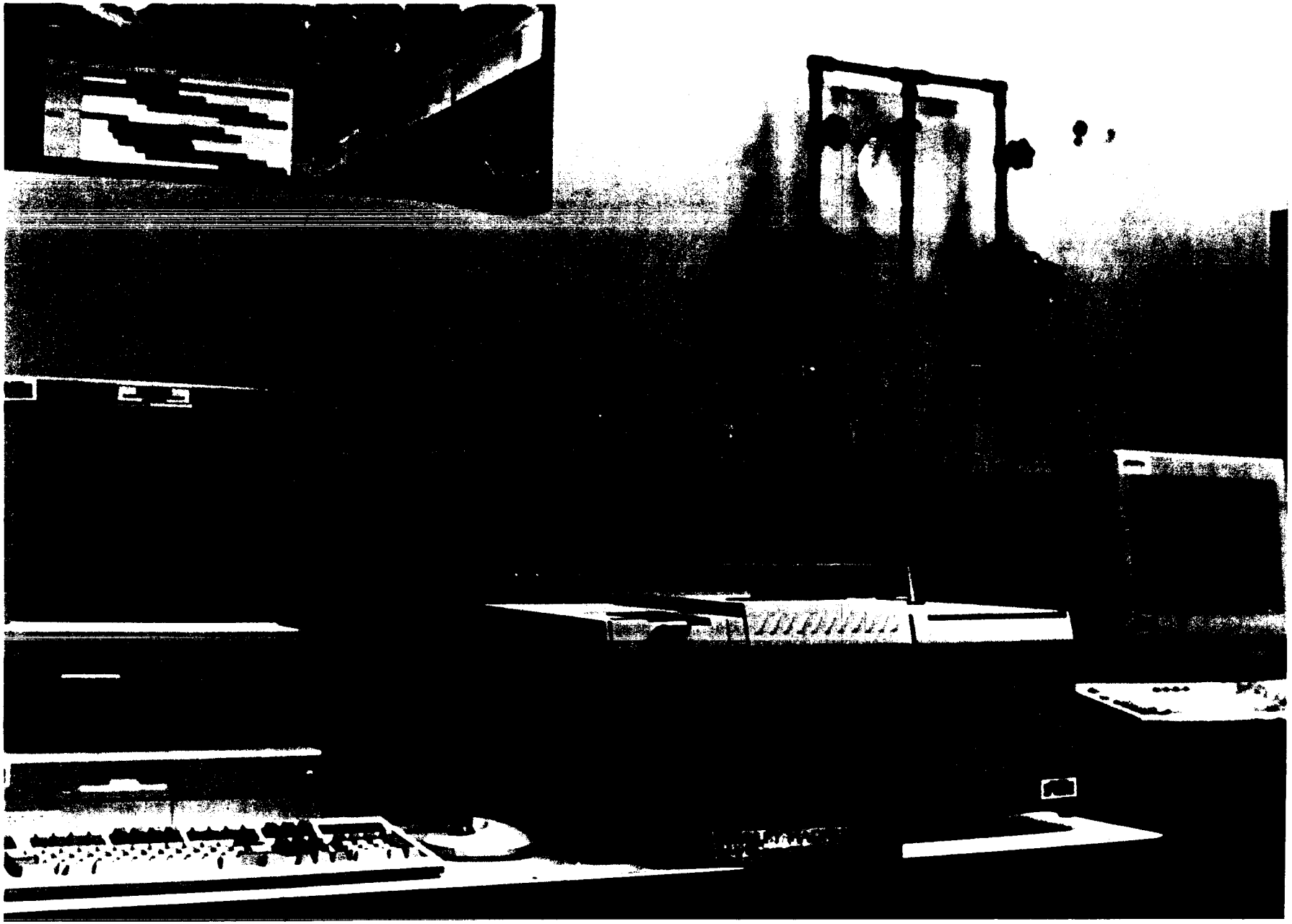

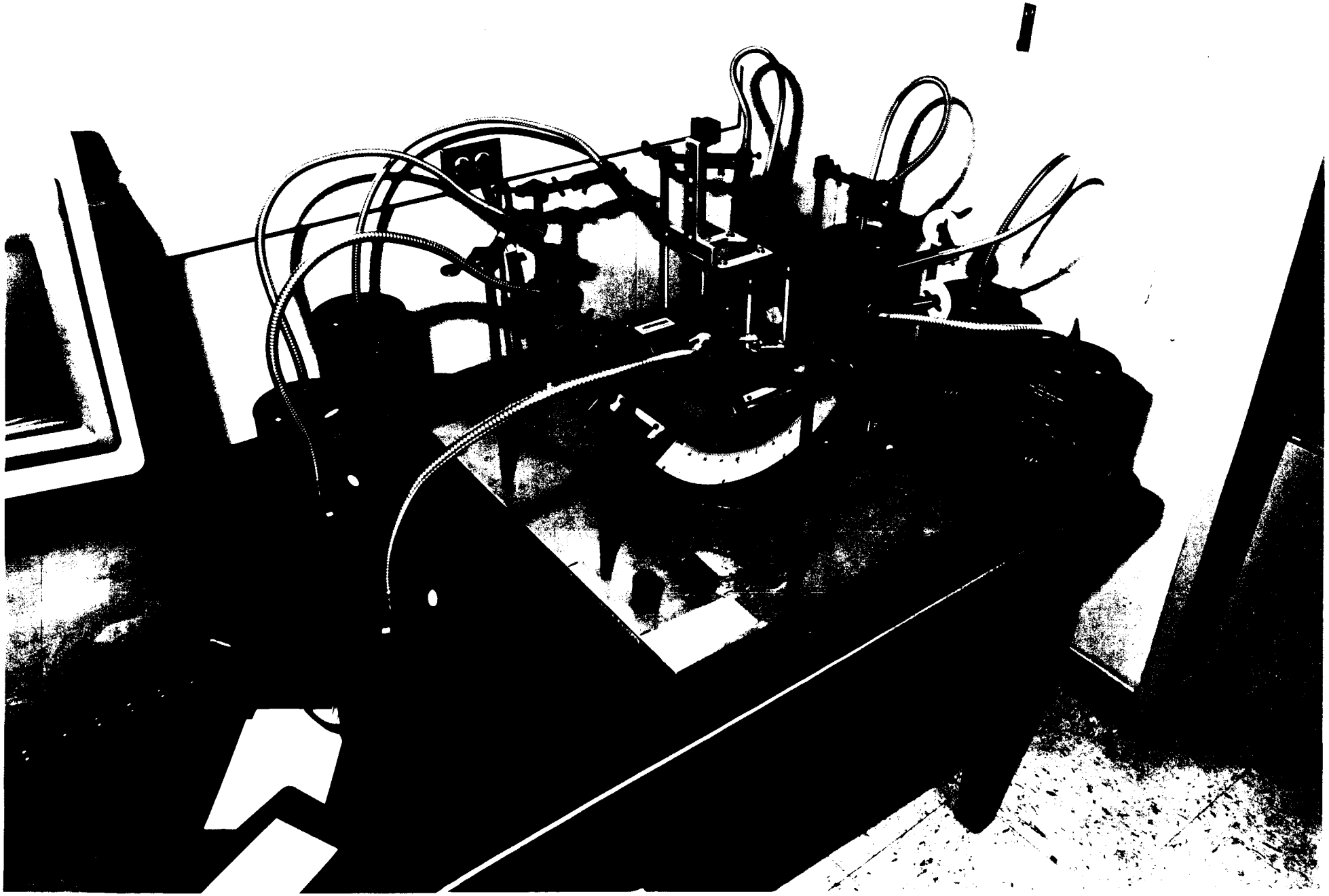

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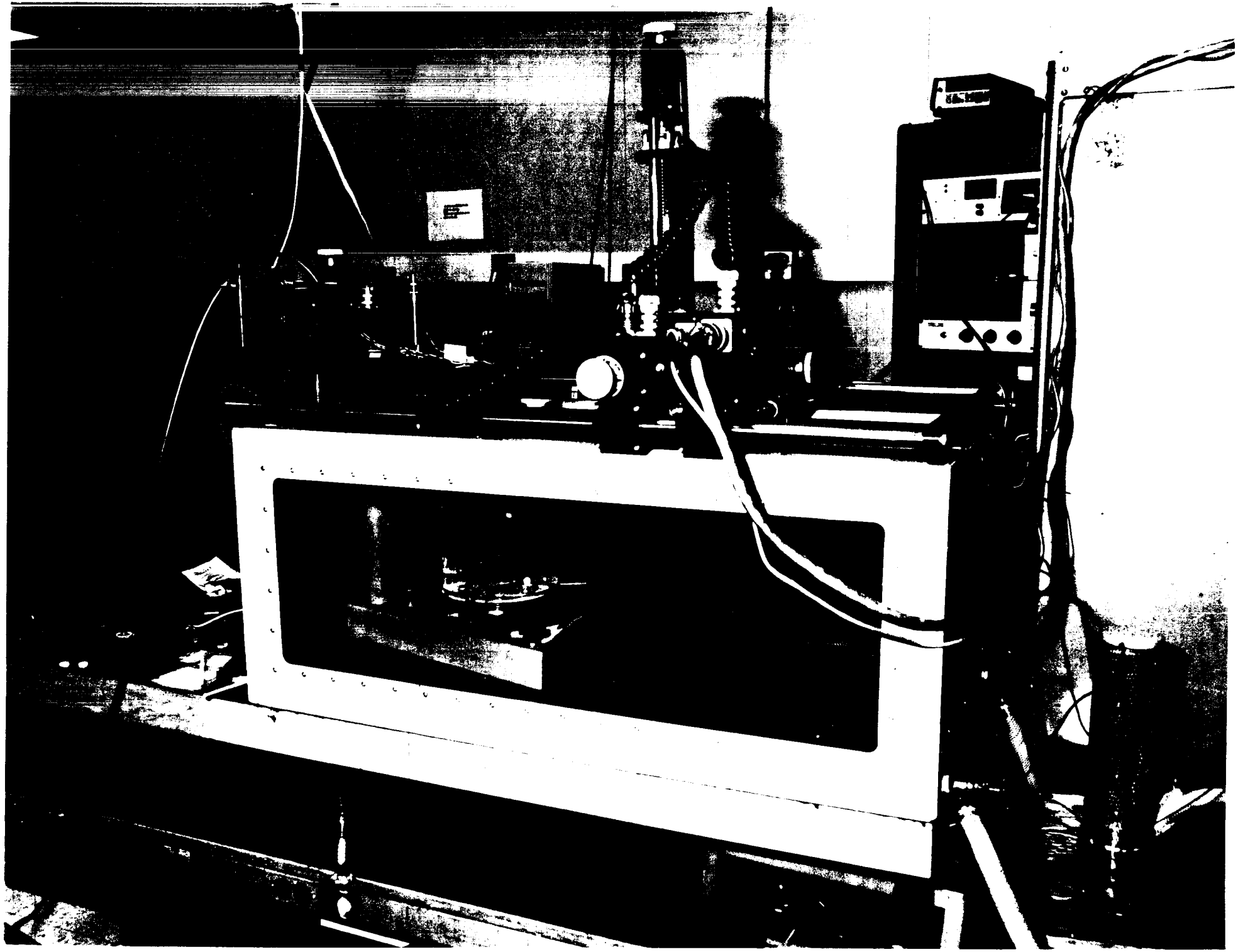
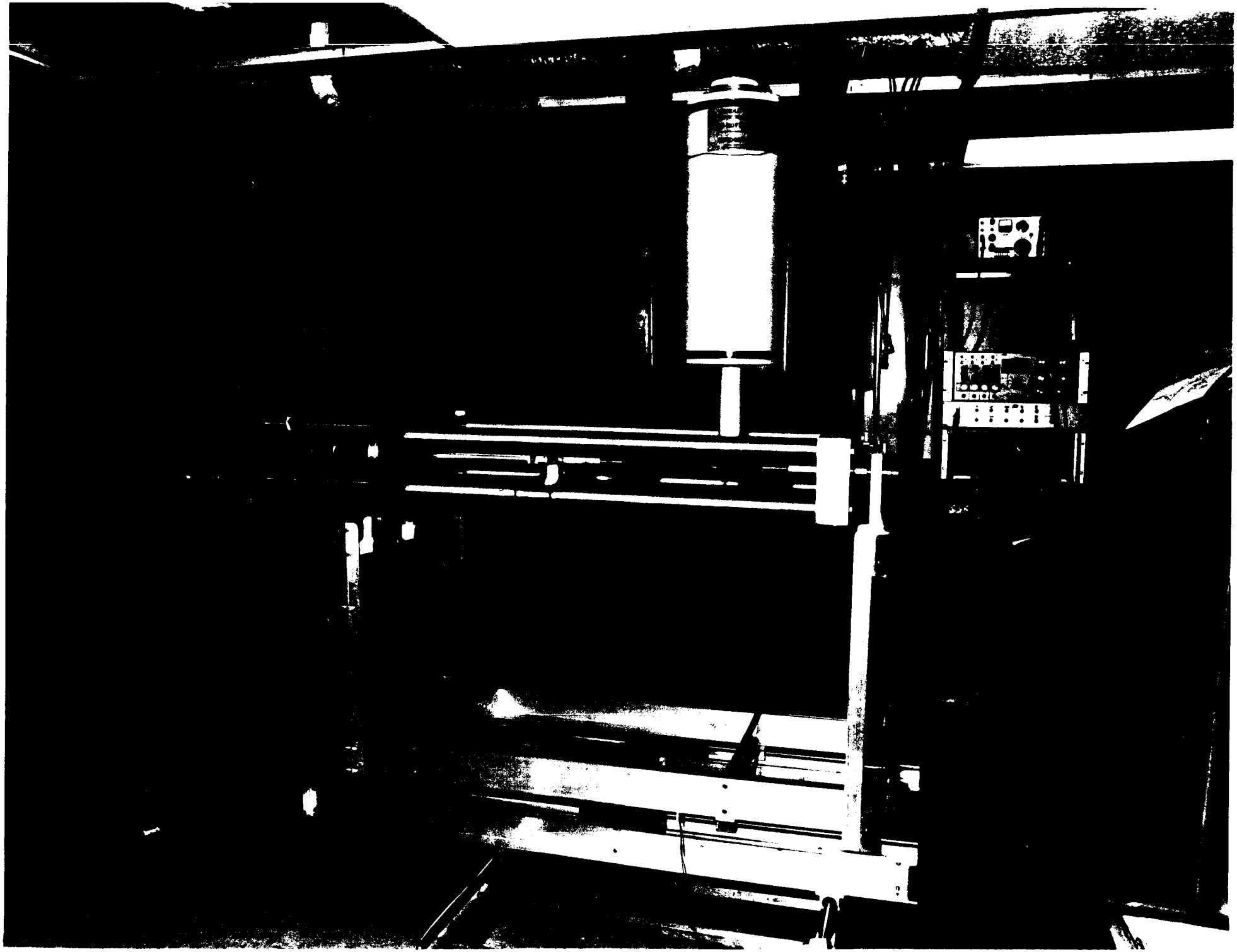
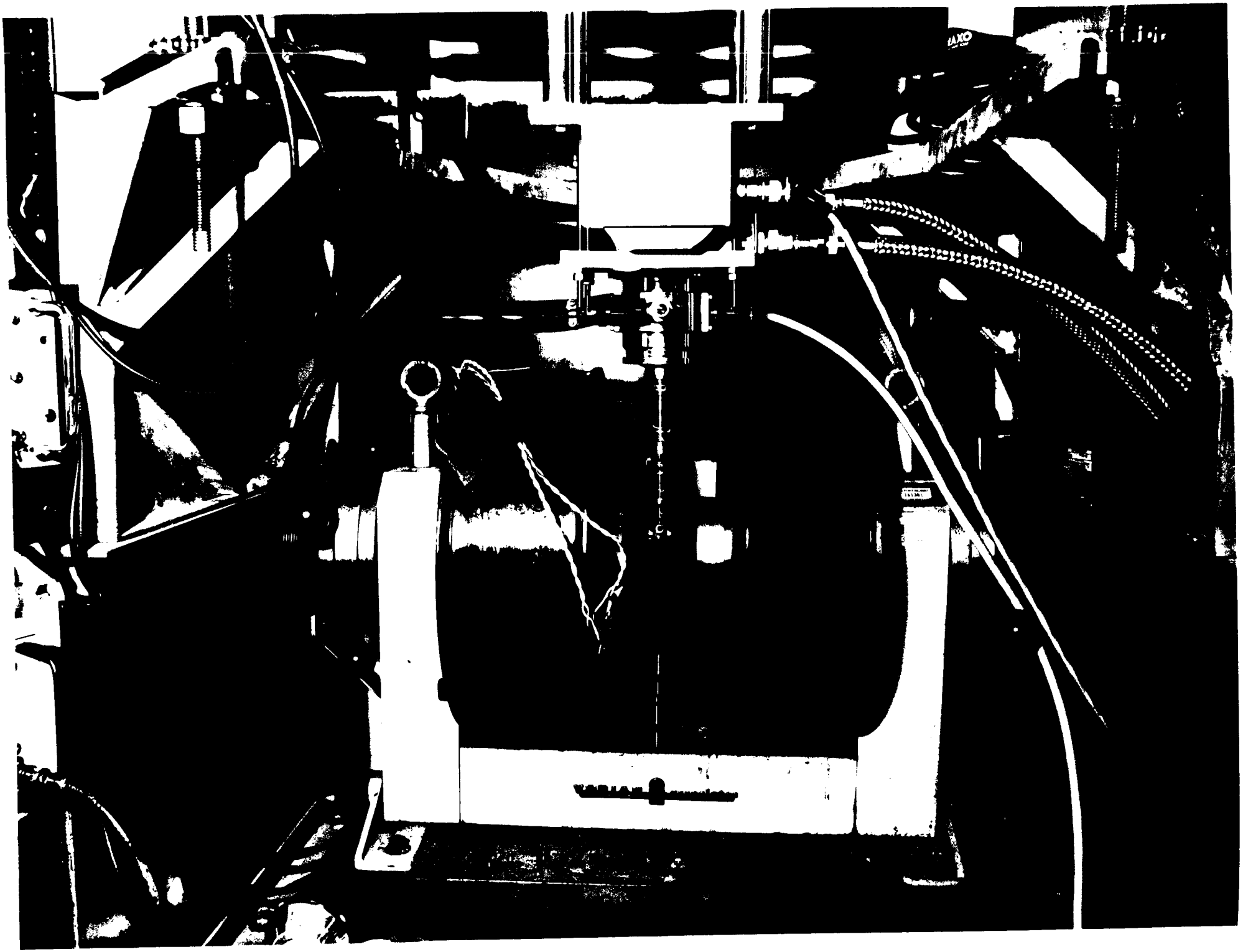
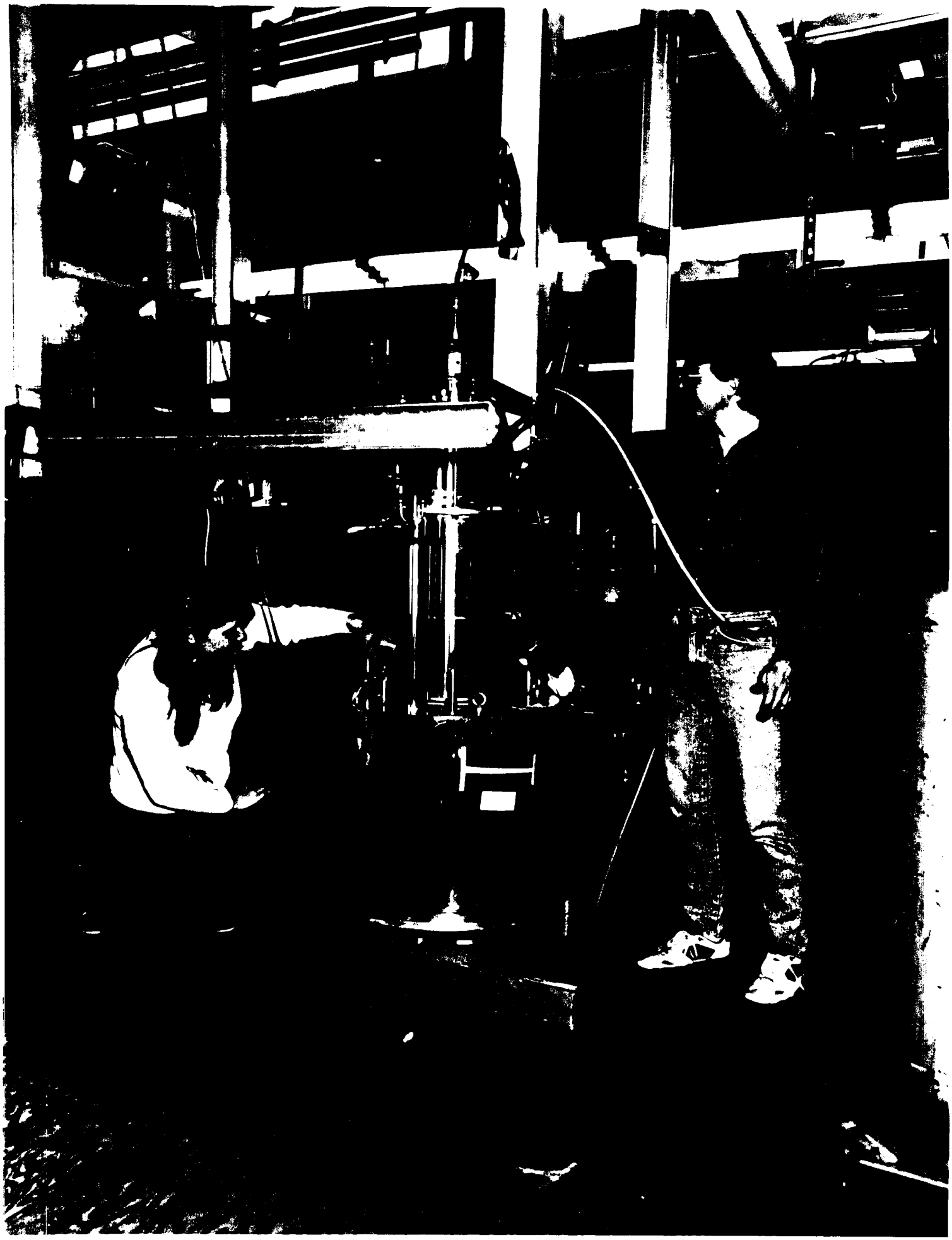
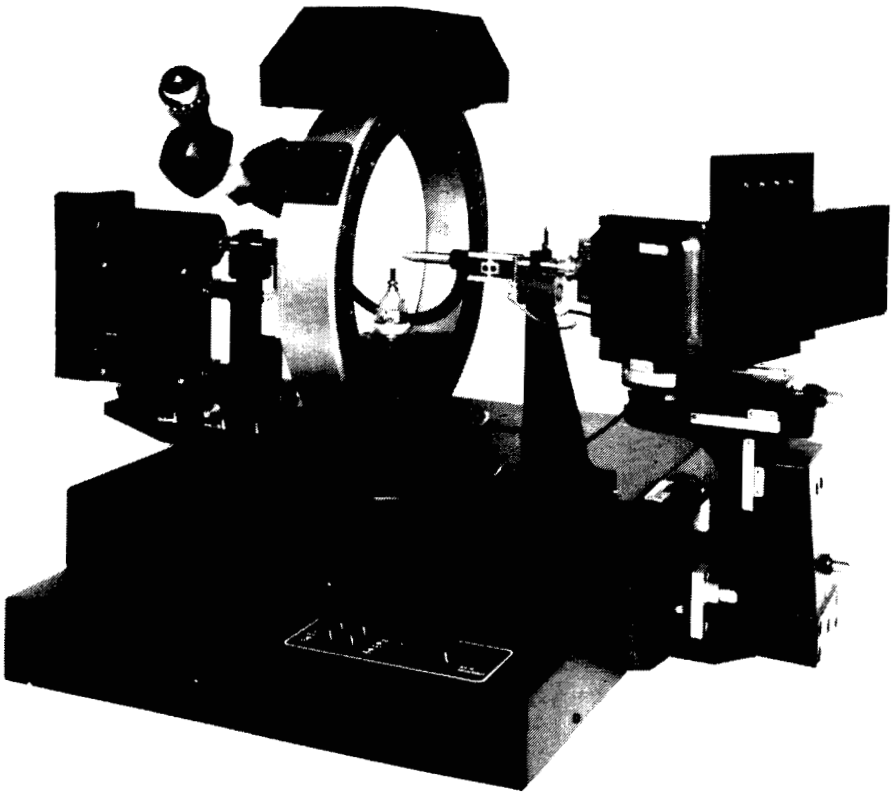




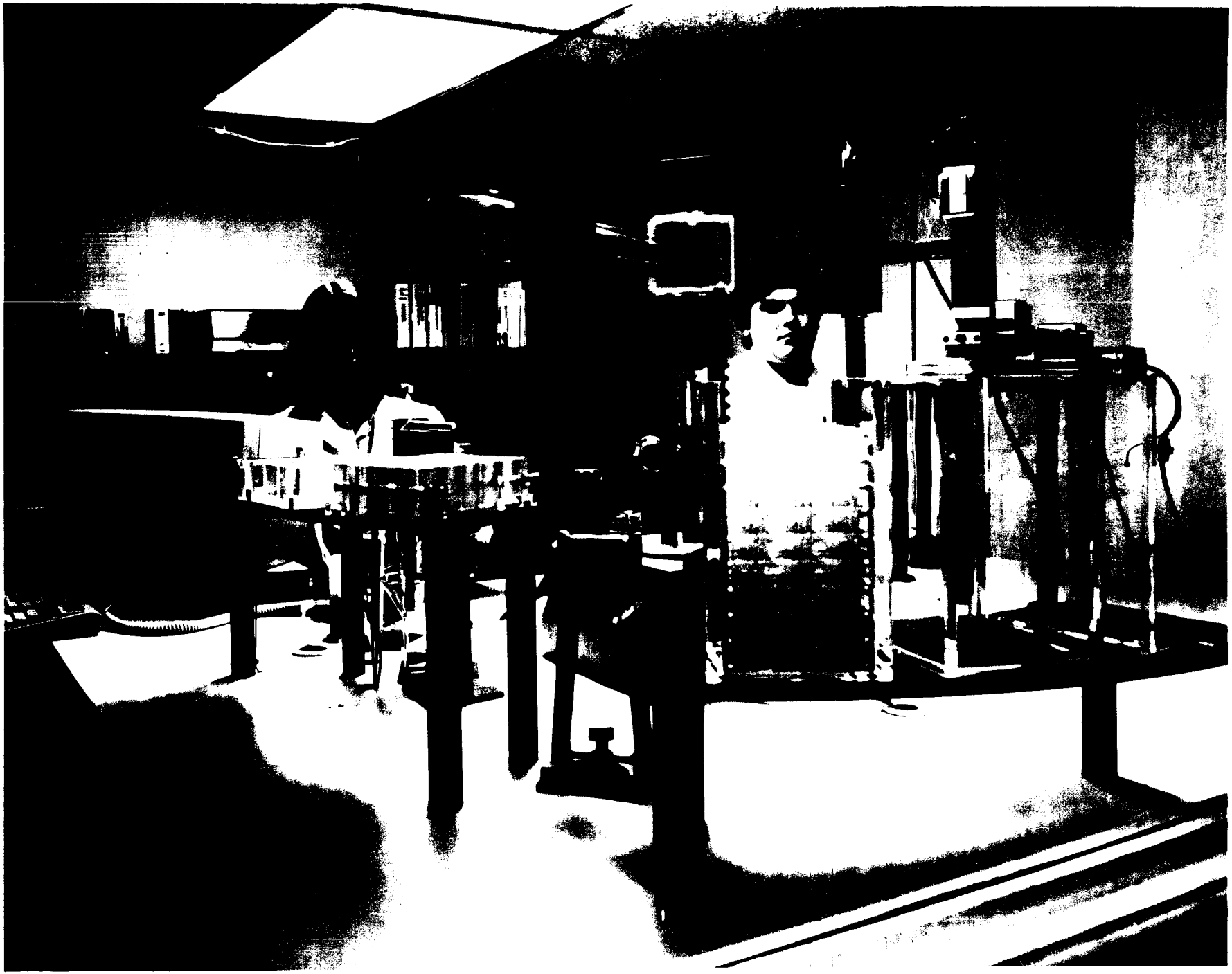


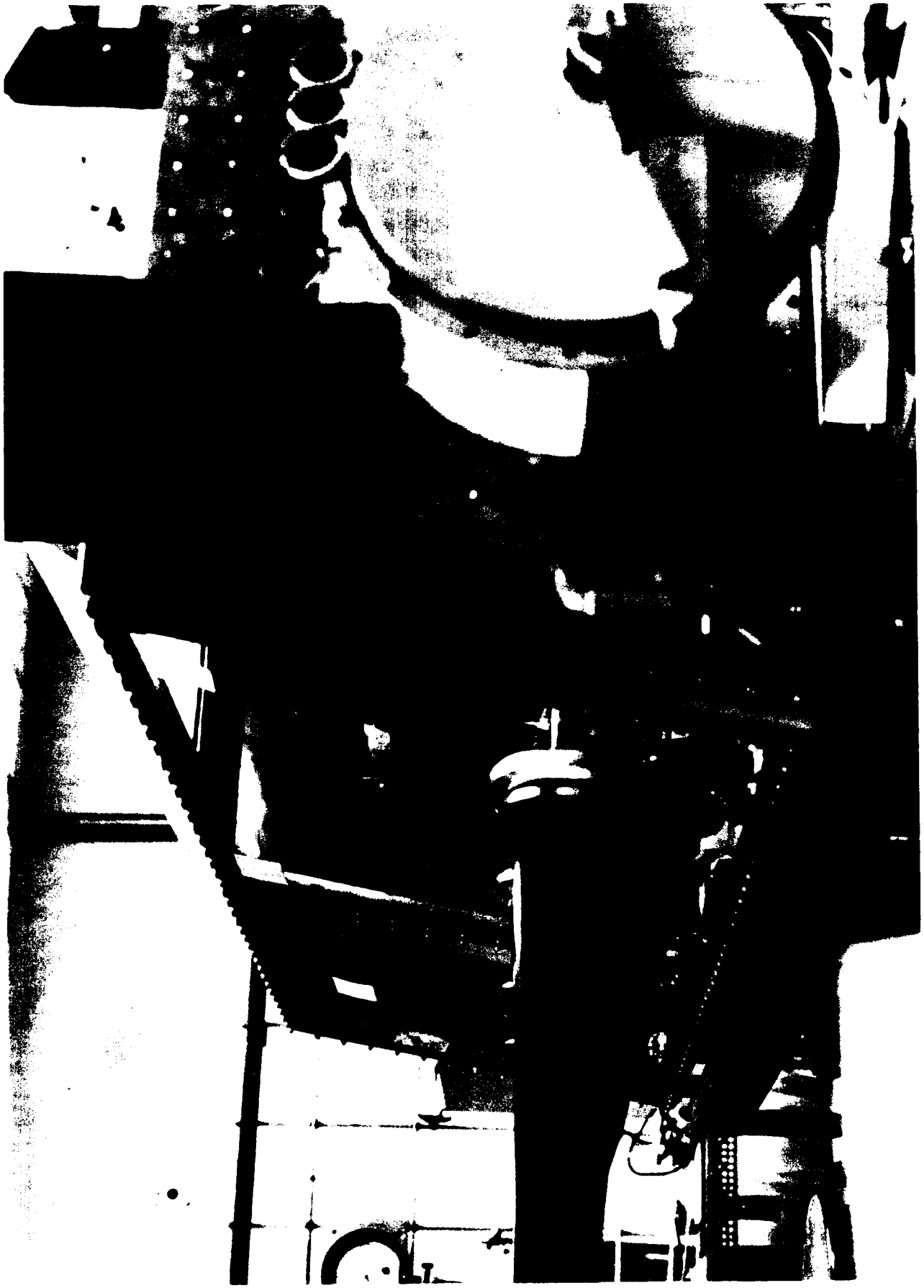


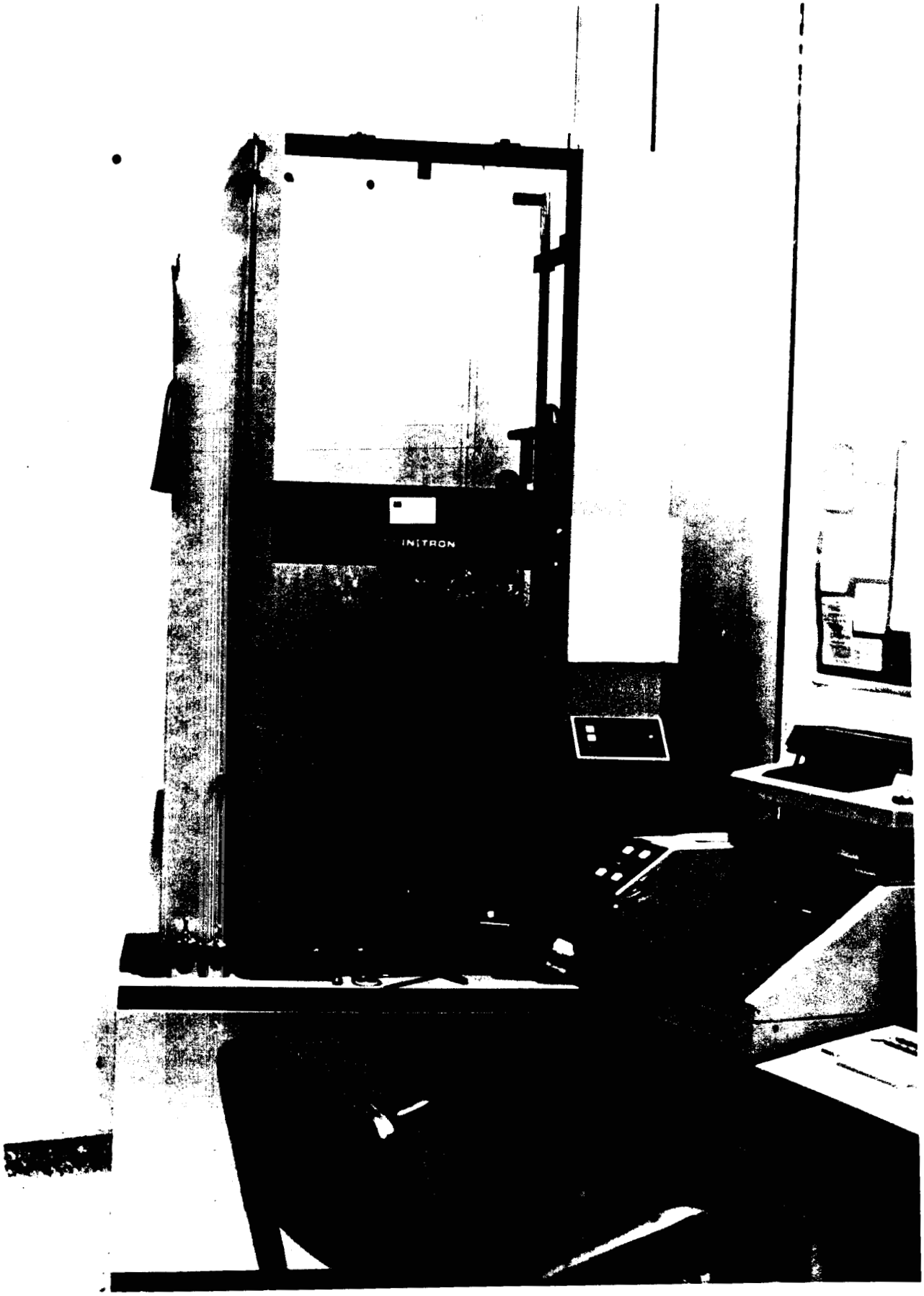
16. X-Ray Diffraction Facility



BUSINESS MEASUREMENT



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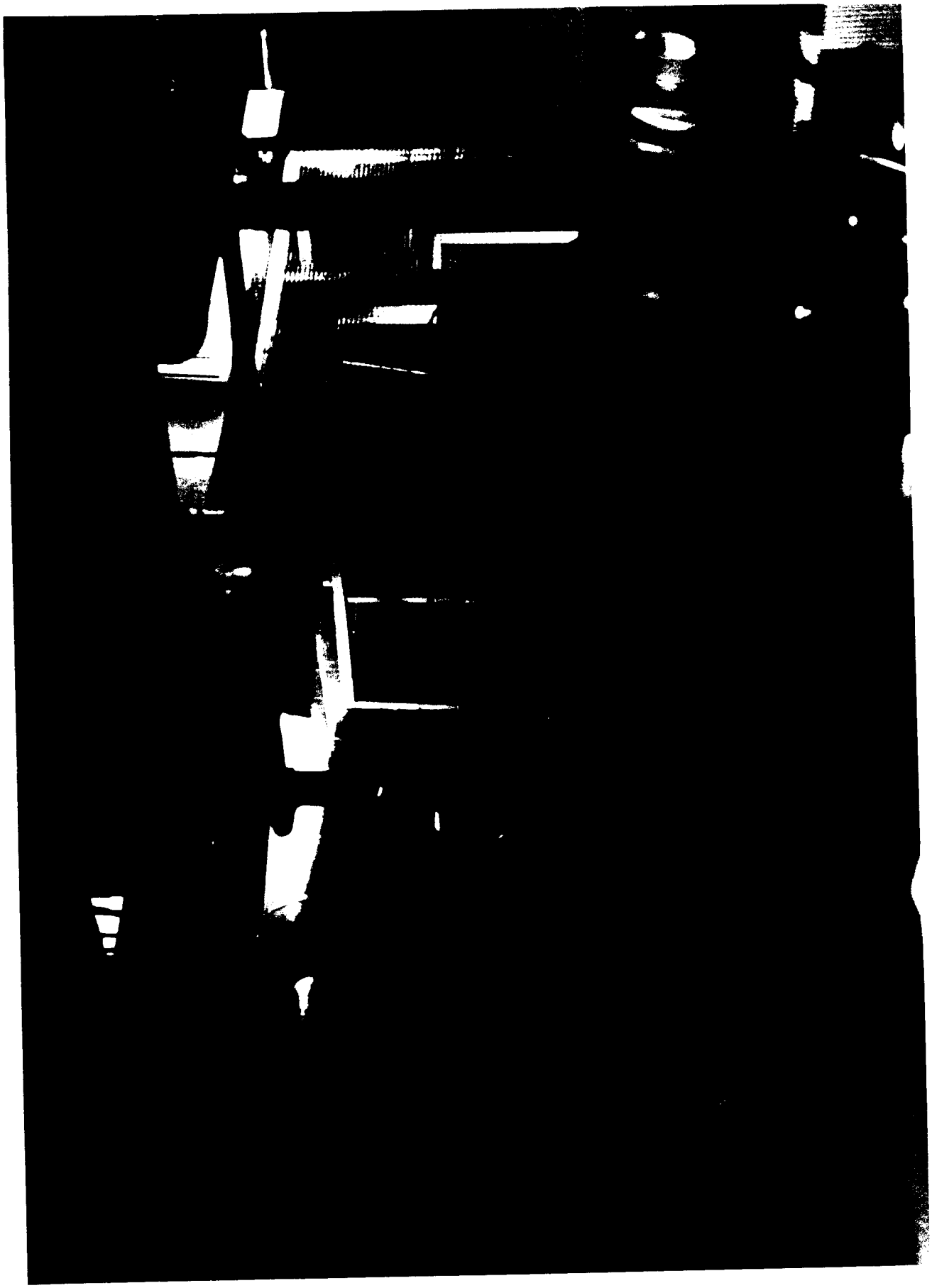

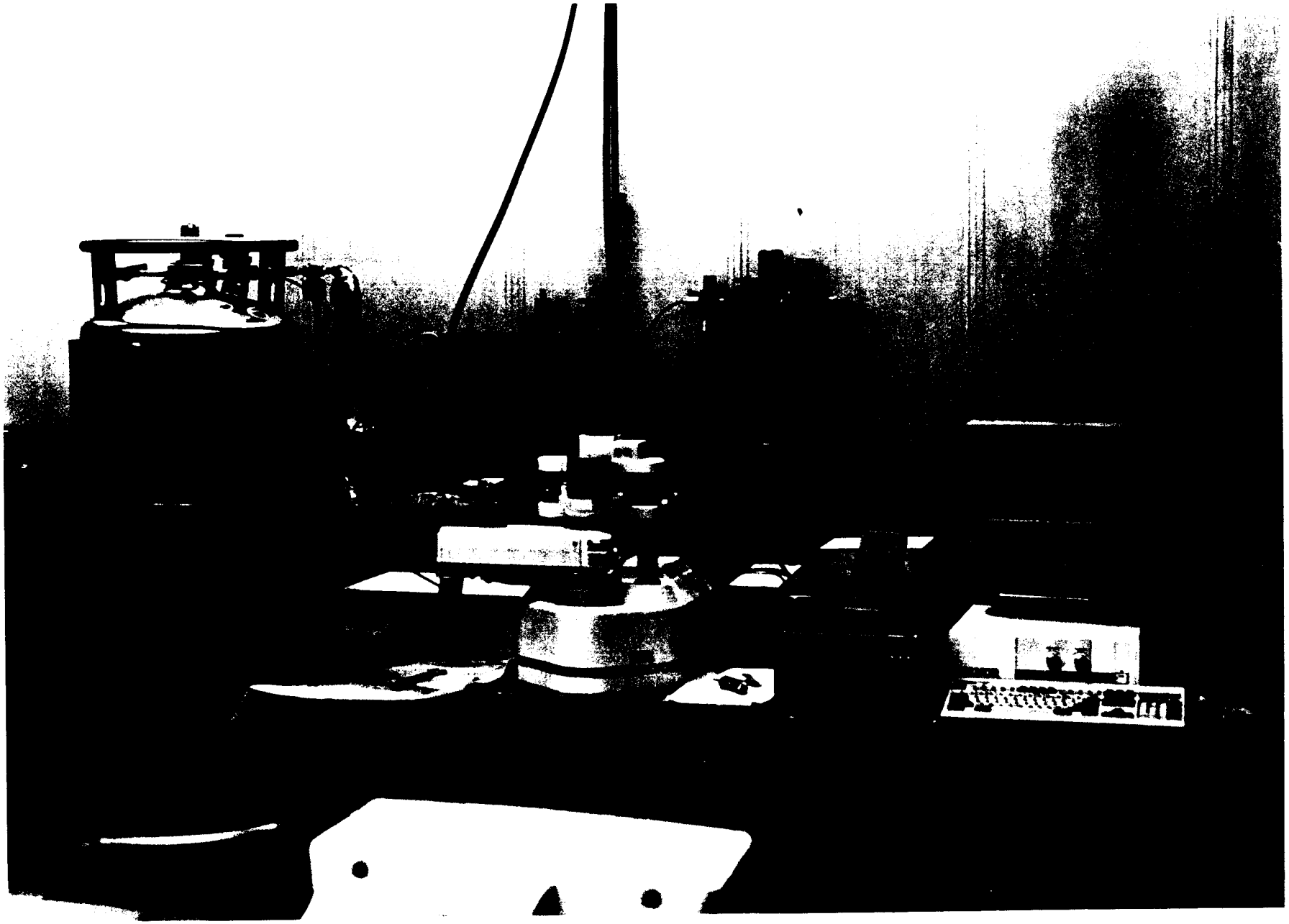

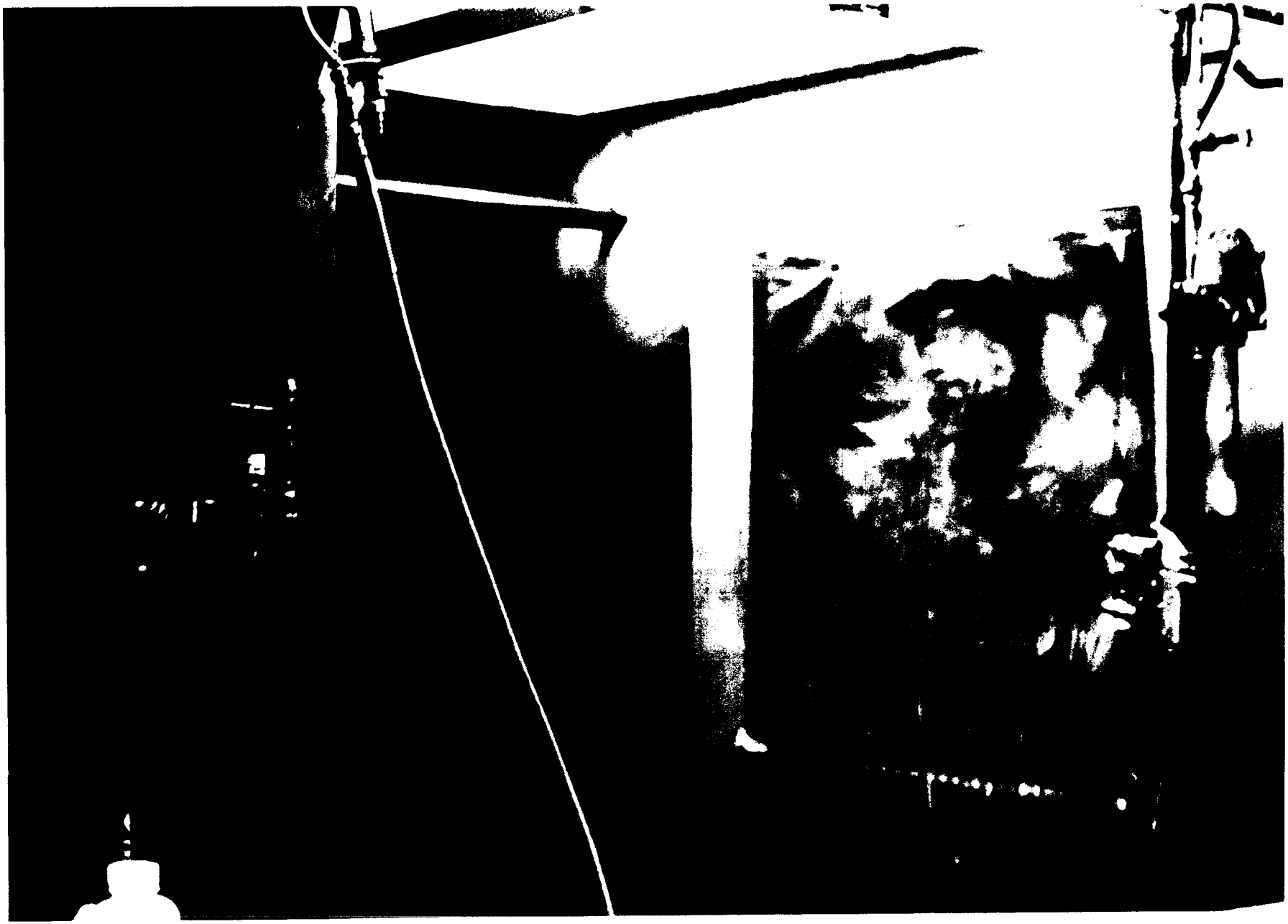

APPENDIX 3 Advanced Materials Publication List Code 5600

Complete replacement of old Appendix 3 R

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APPENDIX 3 Advanced Materials Publication List Code 6900

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APPENDIX 3 Advanced Materials Publication List Code 6100

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APPENDIX 3 Advanced Materials Publication List Code 6300

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APPENDIX 3 Advanced Materials Publication List Code 6900

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APPENDIX 3 Advanced Materials Publication List Code 6600

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