Hydrologic Instrumentation Facility of the U.S. Geological Survey Annual Report for Fiscal Year 1992

By VITO J. LATKOVICH and DEBRA C. TRACEY

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By Vito J. Latkovich *and* Debra C. Tracey

INTRODUCTION

The Hydrologic Instrumentation Facility (HIF) of the U.S. Geological Survey (USGS) has nationwide responsibility for all aspects of hydrologic field instrumentation in support of USGS data-collection programs. The HIF has 36,000 square feet of office, laboratory, and warehouse space at the John C. Stennis Space Center (SSC) on the Mississippi Gulf Coast, approximately 50 miles northeast of New Orleans, Louisiana. With the National Aeronautics and Space Administration (NASA) serving as host agency, 19 other Federal and State agencies located at SSC benefit from contractor-supplied technical and facility-support services and technology-exchange opportunities available at SSC.

The Instrumentation Committee (ICOM) serves as a senior advisory group for policy, projects, and budget that meets periodically to provide the HIF with guidance on the instrumentation needs of the U.S. Geological Survey. The ICOM met in Denver, Colorado, in January and August 1992. Committee membership is listed in appendix 1. The Instrumentation Management Advisory Committee (IMAC) serves as a Water Resources Division (WRD) senior staff advisory group which interfaces between ICOM and the senior staff for policy, manpower, and budgets. The IMAC met March 10-11, 1992, at the HIF and September 23, 1992, in Williamsburg, Virginia.

The Instrumentation Technical Advisory Subcommittee (ITAS), an advisory subcommittee of the ICOM, is composed of individuals involved in field-level data collection. This subcommittee makes recommendations to the ICOM concerning instrument needs and assists HIF staff with the formulation of functional requirements for new instrumentation. Resource persons from other organizational units are available to ITAS as requested by the subcommittee chairperson. The ITAS met in Denver, Colorado, in January and August 1992. Both meetings were held in conjunction with those of the ICOM. Committee membership as of September 30, 1992, is listed in appendix 1.

A staff of 57 professional, technical, and clerical USGS personnel at the HIF is organized into 5 sections: Technical Services Section (TSS), Administrative Services Section (AS), Applications and Development Section (ADS), Test and Evaluation Section (TES), and Field Service and Supply Section (FSS). Organization of the HIF staff is shown in figure 1. In addition to HIF personnel listed in figure 1, approximately 12 onsite contractor employees worked on HIF projects during the year.

The primary purpose of this annual report is to inform WRD personnel of progress made by the HIF in fulfilling its mission to improve instrumentation services to the Division. This report describes the activities of the HIF during fiscal year 1992 (FY92).

Fiscal Year 1992 Overview

Fiscal year 1992 was the 13th and most prosperous year of operation for the HIF. Warehouse sales were $1.829 million—about $329,000 more than the average sales for previous years of operation. The total HIF budget exceeded $8.2 million.

The reorganization of the HIF, which occurred as a result of the 1987 Management Review, has been in place for 5 years. Since the reorganization, the HIF has focused on two major objectives. First, the HIF strives to be more responsive to the wide variety of hydrologic field instrumentation needs and requirements. Second, the HIF makes use of commercially

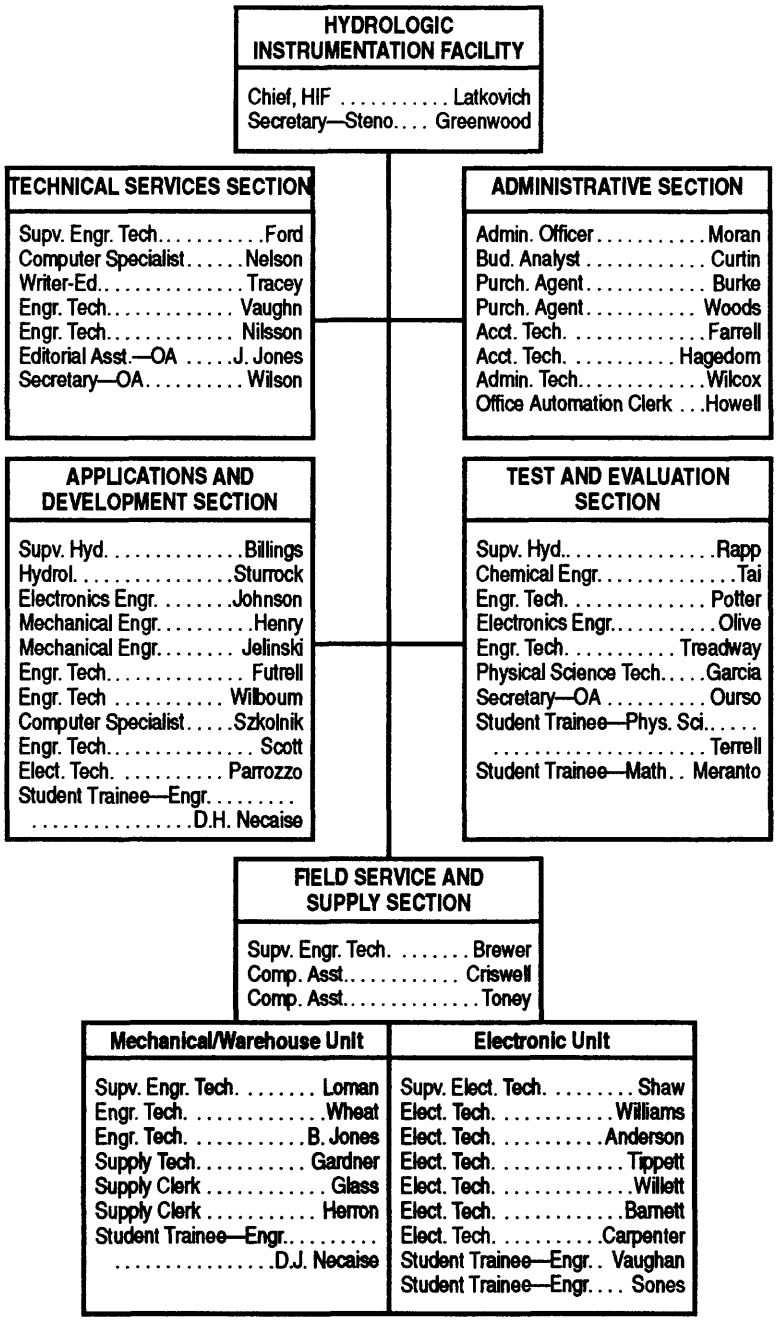

Figure 1. Hydrologic Instrumentation Facility organizational chart.

available products when possible, by direct use or use after minor modification, before undertaking any research and development efforts. Field applications and technical support have ranged from advice and guidance given over the telephone to onsite visits in the field by one or more HIF personnel for instrument installation and calibration and personnel training.

During FY92, HIF personnel visited 80 WRD offices, 37 of which were district and field offices (appendix 2), and attended 23 professional and technical meetings (appendix 3). Instrumentation briefings were presented at 26 WRD offices, and 9 presentations were made at professional and technical meetings. Visitors to the HIF included 148 USGS employees, 292 representatives from vendors, 22 representatives from various college and universities, and numerous onsite agency, local government, and other Federal agency (OFA) personnel. HIF personnel visited 15 vendors (appendix 4). The HIF hosted several conference and ad hoc committee meetings as well as training courses. Employees of the HIF are active in numerous professional and technical societies and associations.

Major Accomplishments for Fiscal Year 1992

- Organized two instrumentation workshops:
  - — Pressure Sensor Workshop, July 28-31, 1992
  - — Ultrasonic Velocity Meter Workshop, August 11-13, 1992
- Procured, supported, and field-tested the new broadband acoustic Doppler current profiler and discharge measurement system for use in streamflow measurements and estuary studies.
- Completed 40 percent of the new HIF Computerized Support System (CSS) that links the HIF to the field for instrumentation procurement, repair, and rental. It is scheduled to be operational in April 1993.
- Procured the following:
  - — 130 data-collection platforms
  - — 100 CR10's
  - — 28 ultrasonic velocity meters (UVM's)
  - — 100 SM192's
  - — 56 transducers for UVM's
  - — 25 436A encoders
  - — 250 pressure sensors (PS-2's)
  - — 150 436B encoders
  - — 150 AA current meters
  - — 30 CR10 keyboards
- Completed lab tests and reports on the following water-quality instrumentation:
  - — Specific conductance probes and meters
  - — pH probes and meters
  - — Alkalinity test kits
  - — Minimonitor probes (DO and pH)
  - — Four-parameter submersible monitor

  These results are reported to help guide the field user in the selection of the best types of instrumentation.
- Completed a water-quality instrumentation requirements for FY93-94 questionnaire that will assist the HIF in future procurements.
- Completed the first annual HIF Customer Survey to gather information concerning the need for improved or expanded HIF services and support.
- Established a Systems Application Team that provides direct assistance exclusively to the field in connection with instrumentation needs, applications, troubleshooting problems, and projects within the HIF's purview.
- Improved communication links between the HIF and the field. Two HIF field coordinators now interface with the field responding to requests for assistance and guidance.
- Completed market search for and lab tests of single-channel data loggers that could be used as alternatives to the ADR. Data will be available to the WRD by fall 1992.
- Conducted WRD training courses both at the HIF and NTC (National Training Center) on:
  - — Basic data recorders
  - — CR10 data loggers and peripheral equipment
  - — Troubleshooting electronic instrumentation
  - — Ultrasonic velocity meter installation and operation
- Implemented the QIC (Quality Improvements Concepts) Program at the HIF and set up five process action teams (PAT's), two of which have completed their work. The HIF Quality Coordinator and the Chief, HIF, conducted briefings for WRD offices initiating QIC programs.
- Established a new Hydrologic Instrumentation Test Data Base that allows and encourages WRD personnel to identify instrumentation for or to submit actual instrumentation for informal HIF lab testing and evaluation. The program is operated through the ITAS and is a high-priority issue. The field can tap into this new data

base that contains all the information on tested instrumentation, past and present.

- Completed contracts for one hand-held and two laptop computer procurements. These units are to be used in the field under various environmental conditions. The hand-held unit will have removable data storage and program cards.
- Completed software version 2.01 for the field computers.
- Upgraded the HIF's computer-aided drafting system to the latest programs and workstation hardware.
- Upgraded and reorganized the following HIF warehouse operations:
  - — Economic ordering quantity system
  - — Equipment tracking system
  - — Inventory check system
  - — Item location system
- Completed 50 percent of the new Bar Code Implementation project for all HIF property. A HIF representative chairs the WRD bar-code effort, which interfaces with the USGS Administrative Division Property Control Branch. The HIF bar-code project should be operational in FY93.
- Fabricated two exhibits for the National Center.
- Established criteria and determined site for disposal of obsolete and unusable mercury manometers.
- Established a new Commercial Products Utilization and Support project at the HIF. Information will be sent to each district on available instrumentation with prices and GSA schedule information. This information will be updated every 6 months.
- Conducted extensive lab and field tests on pressure sensors that are potential alternatives to the mercury manometer. Test data have been presented and circulated to the field on those sensors tested to date.
- Implemented 100 percent repair and maintenance capability for Handar and Synergetics DCP's. Turnaround time has been reduced to an average of 15 days.
- Completed a GSA waiver so that the field can procure a commercially available submersible pressure sensor that meets USGS standards. (The sensor is not on GSA schedule and is therefore difficult to procure in small quantities without the waiver.)
- Completed contract implementation and field capability for UVM system with responders. Responders enable acoustic signals to be relayed without the use of cables between the transducer units on each stream bank, which makes them very useful in channels with heavy ship traffic and dredging that could tear cables loose.
- Procured moderate to large quantities of high-ticket and priority instrumentation, such as pressure sensors, flumes, DCP's, encoders, data loggers, and meters for sale and rental.
- Worked directly with National Water Quality Assessment (NAWQA) Project personnel and procured instrumentation needed early in FY93 for data-collection activities.
- Procured 15 lightweight, portable ice augers for drilling 6- and 8-inch holes.
- Provided funding to Office of Ground Water to procure a portable, digital-format, four-parameter geophysical borehole logger to use in the WRD.
- Completed a video tape, in conjunction with the Iowa District, on the use of a Kevlar boat tagline.
- Open-filed the HIF Annual Report for the first time.
- Reorganized Test and Evaluation Section. A Quality Control Unit was formed to improve acceptance testing turnaround for the warehouse and repaired products.
- Conducted acceptance tests on 225 shipments for the HIF warehouse during the first 11 months of the fiscal year (about 85 shipments more than an average year).
- Provided calibration support for 80 items (about 50 more than last year) to the Yucca Mountain project.
- Provided 4-day instruction on power-supply protection and grounding of data-acquisition equipment to the Water Survey of Canada in Calgary and Guelph.
- Completed 180 new engineering drawings. Twenty new three-dimensional drawings of WRD field equipment were completed for the continuing update of the WRD Instrumentation Catalog.
- Transferred the engineering drawings of sediment samplers for the St. Anthony Falls Sediment

project to the Waterways Experiment Station in Vicksburg, Mississippi.

- Installed 18 Data General work stations and one file server.
- Processed the following publications: 7 Open-File reports, one chapter to be included in a college textbook, 9 Technical Information Sheets, 8 abstracts, 16 in-house reports, 6 reprint jobs, 3 Office of Surface Water publications, 1 Branch of Instrumentation publication, and 4 issues of the *WRD Instrument News* (circulation 2,700).
- Served as the management and technical interface between the National Water Quality Laboratory (NWQL) and the onsite contractor for the development of data-base applications software required by NWQL.
- Assisted the Indiana District and the Environmental Protection Agency (EPA) with tests of ground-water samplers for volatile organic compounds (VOC's) in the HIF's 100-foot standpipe.
- During FY92, the HIF rented the following:
  - — Analog-to-digital recorders (ADR's) ..... 10,052 units
  - — Monitors, flow-through ..... 46 units
  - — Minimonitors ..... 472 units
  - — DCP's ..... 660 units
  - — DCP shaft encoders ..... 757 units
  - — Data loggers ..... 964 units
  - — Data-logger storage modules ..... 703 units
  - — Special equipment .....83 items
  - — Hazardous-waste equipment .....12 items
  - — UVM's (5 units sold; 1 unit on loan) .. 69 units
  - — Pressure sensor/recorder systems ..... 147 units
- The 10 most active districts in procuring equipment and instrumentation from the HIF in FY92 were
  1. Texas
  2. California
  3. Colorado
  4. New York
  5. Washington-Oregon
  6. North Carolina
  7. New Mexico
  8. Arizona
  9. Ohio
  10. Idaho

For purposes of comparison, the activities of the Field Service and Supply Section at the HIF for 1987, 1990, 1991, and 1992 are listed below. The list clearly indicates that activities have increased substantially in recent years.

Item	1987	1990	1991	1992
Work orders	963	2,028	2,079	2,163
Minimonitor repairs—base unit	61	NA	423	436
Minimonitor repairs—cables and probes	165	NA	1,464	1,339
DCP repairs—Synergetics	-	137	308	385
DCP repairs—Handar	-	73*	142*	150*

*Includes numerous Handar 524's that the HIF repairs for WRD and other Federal agencies.

Operational Actions

- *Bar-Code System.*—A HIF process action team (PAT) was formed to develop the requirements for bar coding at the HIF and to oversee its implementation. A parallel effort to bar-code controlled personal property WRD-wide was initiated by the Assistant Chief Hydrologist for Operations with the formation of the WRD Bar Code Committee. The WRD Bar Code Committee is chaired by the Chief, TSS. The HIF team developed written performance specifications for the bar-code effort at the HIF and forwarded them to the WRD committee to be included as part of the WRD requirements. The HIF bar-code effort will be included in a proposed Divisionwide contract for bar-code hardware, software, and labels. The anticipated award date for the WRD bar-code contract is October 1993.
- *New Warehouse Procedures and Operations.*—New HIF pricing and inventory control procedures were completed in June 1992. The success of these new controls has been verified by the annual warehouse inventory, which was completed in September 1992.
- *Equipment Tracking System.*—A new Equipment Tracking System (ETS) was developed under contract with Sverdrup Technology and was completed in July 1992. The new ETS program allows for simultaneous multiple-user inputs and was written in a language compatible with the present Hydrologic Instrumentation Facility Computerized Support System (HIF-CSS). The implementation of this system will benefit the ETS component of HIF-CSS II when it comes online in March 1993. When completed

and implemented, the bar-coding system will be an integral part of the ETS.

- *New Systems Application Team.*—In January 1992, the HIF Systems Application Team (SAT) was established to handle field requests for assistance in applications of data loggers, data-collection platforms, and related electronic instrumentation. The SAT hopes to streamline the manner in which applications assistance is provided and to promote unity of action on the part of HIF personnel. Team members come from the various HIF sections so that all aspects of service, support, and applications are covered.
- *New Instrument Test Program.*—In January 1992, the HIF initiated the New Instrument Test Program as approved by ITAS and ICOM. The HIF will do informal testing of new products that are proposed by WRD personnel and prioritized by ITAS at its semiannual meeting. Results will be published in the *WRD Instrument News*, the Instrument Continuum, and the HIF Information Data Base.
- *New Field Coordination Capability.*—The field coordination capability underwent the following changes:
  - — Sammy Wilbourn replaced Jack Hardee as primary HIF Field Coordinator.
  - — James Futrell assumed the role of Alternate HIF Field Coordinator.
  - — The HIF field coordination activity was transferred to the Applications and Development Section.
  - — A new internal assistance process was put into action so that field coordination and assistance requests will be answered the day the request is received, if possible.
- *Design of HIF-CSS II.*—The design phase of the software project was completed and the construction phase is approximately 45 percent complete. Testing of the software is scheduled to begin in December 1993. HIF-CSS II is scheduled for release to the WRD on March 31, 1993. Training for users throughout the Division will be provided by HIF and contractor staff in February and March 1993 at sites selected by the Chief, HIF, and the Regional Hydrologists.

Planned Activities for Fiscal Year 1993

- Complete implementation of bar-code system for property control.
- Complete reorganization of the warehouse and implementation of new procedures.
- Complete HIF-CSS II development and implementation.
- Bring to an end the work of three Quality Improvement Concepts (QIC) process action teams (PAT's) and initiate two or three new PAT's.
- Continue development of PFC software for laptop and hand-held computers.
- Conduct 4 to 6 instrumentation training courses at the HIF and NTC.
- Continue to provide instrumentation and procurement service and support for NAWQA, National Trends Network (NTN), Hydrologic Benchmark Network (HBN), and the National Research Program (NRP).
- Continue to support the acoustic Doppler current profiler moving-boat measurement system operational activities.
- Investigate the possibility of upgrading the gas-purge conoflow system for nonsubmersible pressure sensor.
- Continue to support the upgrade and operations of the cableway and cable cars used by WRD.
- Develop, test, and warehouse a new "Sand Point" cable-car brake.
- Conduct priority informal test and evaluation of suggested instrumentation through the new HIF hydrologic instrumentation test data base system.
- Continue to market search, test, and evaluate pressure and acoustic sensors, both submersible and nonsubmersible, that would be acceptable alternatives to the mercury manometer.
- Develop and circulate a video tape on installing and operating a BDR/PS-2 encoder system.
- Prepare a 3-year strategic plan for the HIF.
- Develop an interface that allows the use of the USGS minimonitor conductivity and temperature probes together with electronic data loggers and DCP's equipped with analog sensor inputs.
- Modify the wire-weight gage for security reasons.
- Conduct market searches for the following items:
  - — New or improved sounding cable
  - — Nonmercury thermometers

— Automatic Resetting Ground Fault Interrupters

— Electric measuring tapes for deep wells (500 ft)

- Continue to repair and maintain borehole logger probes.
- Develop a PC-based software program to enable UVM-generated data to be computed and entered into WRD files.
- Continue to implement DIS-II hardware and software into the HIF Operating System.
- Procure additional quantities of SDI-12-based data loggers, pressure sensors, shaft encoders, ultrasonic velocity meters, and data-collection platforms.
- Provide instrumentation marketing and procurement support services to the field.
- Complete formal field comparison tests of Water Gage I and II, H-310 (submersible) and H-350 (nonsubmersible), and HIF's pressure sensor 2 (PS-2). The PS-2 is the standard for comparison of all units in the test project.
- Award a contract for pressure sensors under the new accuracy standards.
- Complete the quality assurance procedures and standard operating procedure documentation for quality acceptance of warehouse products.
- Work to find a location for disposal of all radiation sources currently stored at the HIF.

TECHNICAL SERVICES SECTION

The Technical Services Section (TSS) provides in-house technical support to other HIF Sections. Drafting and graphics services are provided to create and maintain engineering drawings of WRD equipment. A computerized file of specifications for WRD equipment is maintained, and specifications for existing equipment are written. Assistance in the preparation of specifications is provided to the HIF staff during product development. Computer operation and support is provided in programming, training, and user assistance. TSS administers the HIF's warehouse management system. Editorial assistance is provided in the preparation of all HIF publications. The TSS staff was augmented by contractor support in drafting and computer operations.

Engineering Documentation

The Drafting Unit completed 195 new drawings in FY92. The Unit also completed 42 of the 48 work requests received during the year and 26 of the 28 engineering change requests (ECR's) received. The microfilm drawing file and the index of drawings were routinely updated throughout the year as new or revised drawings were completed. The Unit filled 148 requests for copies of drawings and artwork, distributing 1,617 copies. Unit personnel created 25 new pieces of artwork to replace photographs of WRD field equipment in the WRD Instrument Catalog. This artwork consisted of three-dimensional and exploded three-dimensional artwork such as that shown in figures 2 through 5.

Computer Support

Computer support for the HIF's 50-plus personal computers, local area network, and Prime minicomputer was provided throughout the year. The section installed 24 workstations with software applications ranging from FrameMaker to INGRES. HIF-CSS II, the new DIS-II version of HIF-CSS, is currently in the construction phase; the completion date is scheduled for March 31, 1993. The section also helped obtain support for the development of an inventory and safety computer software system to be written on the DIS-II platform for the National Water Quality Laboratory.

Publications

Editorial support was provided to the HIF staff throughout the year. Work processed during the year included 3 completed and 4 pending Open-File Reports, 1 college textbook chapter, 9 Technical Information Sheets, 8 abstracts, 1 proceedings paper, 16 in-house reports, 6 reprint jobs, and 4 issues of the *WRD Instrument News* (circulation 2,700). The Publications Unit also provided editorial support in connection with three Open-File Reports prepared by the Office of Surface Water and one report for the Federal Coordinating Council for Science, Engineering, and Technology, an interagency group in which USGS participates.

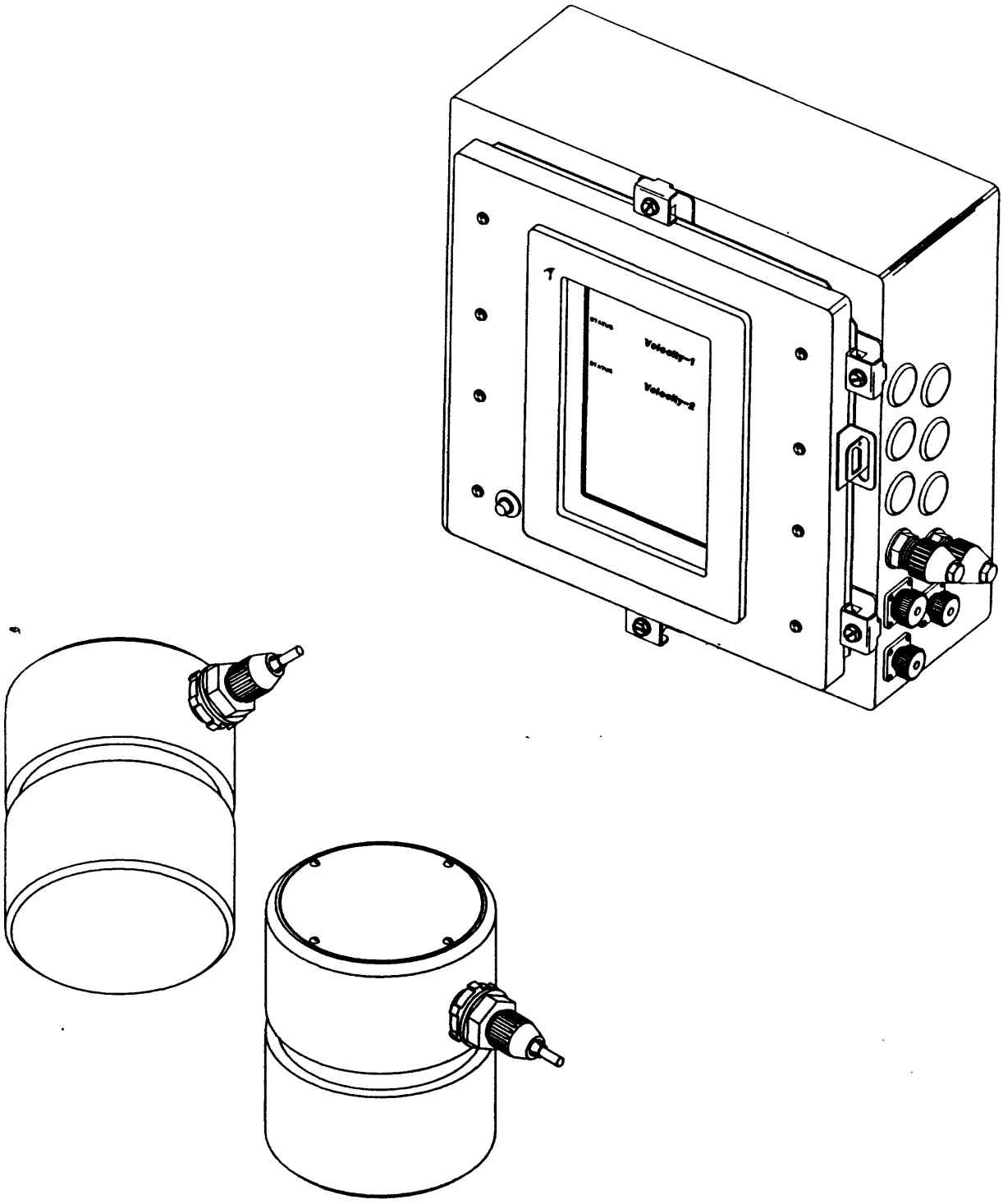

Figure 2. Ultrasonic velocity meter and two views of transducer.

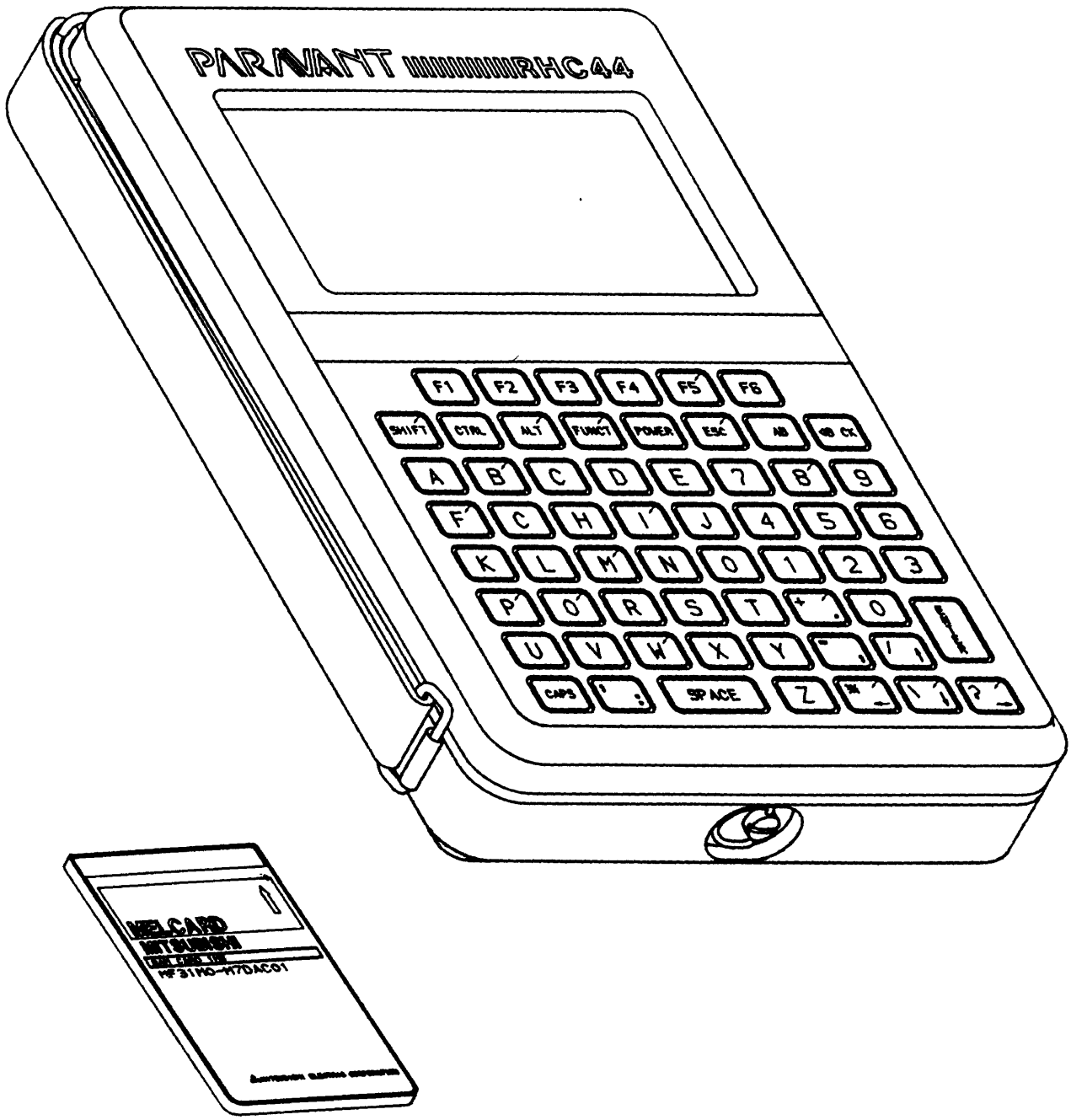

Figure 3. Hand-held computer and memory card.

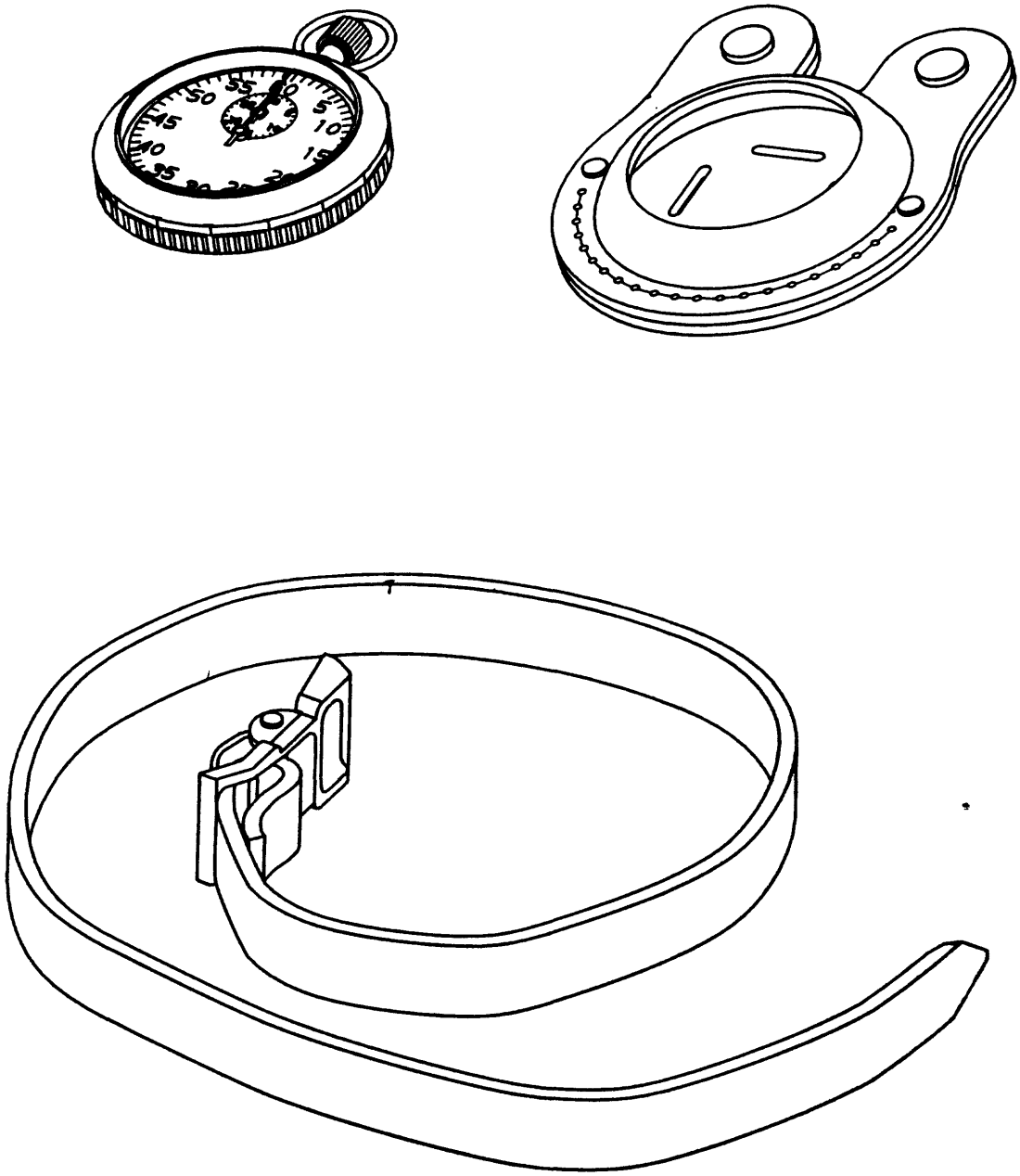

Figure 4. Stopwatch, holder, and strap.

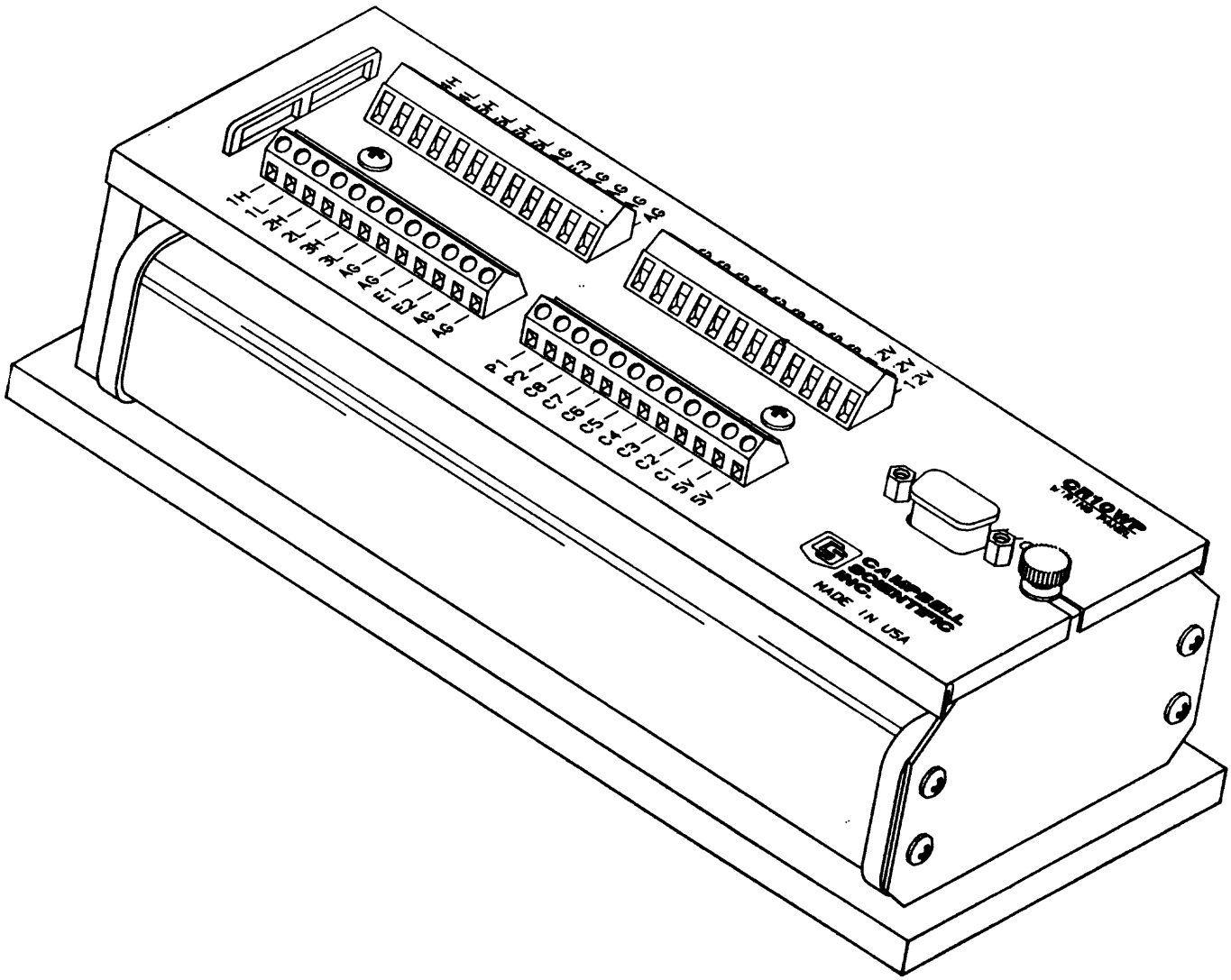

Figure 5. Campbell Scientific CR10 basic data recorder.

FIELD COORDINATION

Coordination of HIF programs and activities for field personnel is the responsibility of the HIF Field Coordinator. The major duties of the Field Coordinator are to provide assistance and technical support to the field and to provide training in the application, operation, and maintenance of field instrumentation.

Field Assistance and Technical Support

During FY92, the HIF received more than 1,200 requests for assistance in the application and support of field instrumentation. About one man-year of effort, contributed by the Field Coordinator and personnel of the Applications and Development, Test and Evaluation, and Field Service and Supply Sections, was expended in responding to these requests. Assistance was provided in the following categories.

Category	Number of requests	Percent of effort
Data logger/sensor systems	152	12
Miscellaneous instrumentation	459	36
Availability of warehouse items	492	38
Pressure sensor systems	132	10
Ultrasonic velocity meters	57	4

The Field Coordinator also contacts field personnel who order data-logger systems from the HIF to ensure that the systems ordered are suitable for the intended applications and to determine whether technical support is needed.

HIF Training Program

The Field Coordinator organized or otherwise participated in the following HIF-sponsored instrumentation workshops and training courses:

- Operating and Troubleshooting Hydrologic Electronic Instrumentation (HIF)
- Operation and Maintenance of Acoustic Velocity Metering Systems (HIF)
- Data-Collection Platforms (Mounds View, Minnesota)
- Pressure Sensors (Denver, Colorado)
- Ultrasonic Velocity Meter (Tampa, Florida)
- Basic Data Recorder Systems (National Training Center, Denver, Colorado)
- CR10 and PFC (National Training Center, Denver, Colorado)

QUALITY IMPROVEMENT CONCEPTS PROGRAM

The Quality Improvement Concepts (QIC) Program was one of the HIF's focal points during the past year. The HIF had a busy year in its attempt to give the Survey increased quality service. The following is a synopsis of QIC activities during FY92:

October 1991.—Quality Council members Rick Billings, Vito Latkovich, Gail Moran, Bob Brewer, Cheryl Nelson, Betty Ourso, and Paul Tippett discussed the status of the QIC Program with the general staff. The Council solicited nominations for staffing the first three problem-solving teams—the Quality of Work Life (QWL) Team, the Documentation Team, and the pH Probe Team. The Quality Council appointed the team members and then met with each of the teams to provide direction and begin the organizing process. Facilitators were chosen for the teams. Each team was asked to send a representative to one Council meeting each month so that the Council could provide direction and support. The Quality Council selected Betty Ourso as Quality Coordinator for the HIF. The third 2-day QIC training session was held.

November 1991.—Hank Svehlak, who is with the National Mapping Division at Stennis Space Center, agreed to serve as facilitator of the Quality Council. The Council began to develop a mission statement for the HIF. The Documentation Team agreed to have its meetings videotaped for use in QIC training. The fourth QIC training session was held. The Quality Coordinator and Berwyn Jones, Branch of Quality Assurance (BQA), Denver, conducted the initial training for facilitators.

December 1991.— The Quality Coordinator visited BQA. The Quality Coordinator and facilitator for the Council attended a 1-week facilitator training seminar. The Chief, HIF, addressed the Southeastern Regional District Chiefs' meeting.

January 1992.—The Quality Coordinator, with assistance from the Council facilitator, conducted a 2-hour training session for team facilitators. The Coordinator also conducted a 3-hour training session on teambuilding. Berwyn Jones met with the QIC participants to answer questions and provide additional teambuilding training. William B. Mann IV, Assistant Chief Hydrologist for Operations, and William G. Shope, Jr., Chief, Branch of Instrumentation, met with each of the teams to review their progress and express support for the quality improvement effort at HIF. Jeffrey T. Armbruster, Assistant Regional Hydrologist for NAWQA, presented an overview of the book *The 7 Habits of Highly Effective People*, by Stephen R. Covey. The Bar Code Team was established.

February 1992.—The Quality Council established groundrules for its operation and finalized the mission statement for the HIF. The pH Probe Team submitted its final report to the Council. The Council reviewed the team's findings and recommended that some training on the need for pH probe care and special handling be added to the HIF's course on Instrumentation Troubleshooting; that a simplified instruction sheet be shipped with the probes; and that the Chief, HIF, write an *Instrument News* article on how the HIF is investigating pH probe problems.

March 1992.—Berwyn Jones reviewed actions that should be taken by the Council and the related documents that should be generated.

April 1992.—As a direct result of the efforts of the pH Probe Team, a pH probe instruction sheet was approved and will be included with each probe shipped from the HIF. The Council reviewed and prioritized a list of prospective teams. Council members identified the WRD Instrumentation Catalog Team as the next to be formed and proposed its membership. A 2-hour facilitator training session was held.

May 1992.—The Technical Coordination Group, which is a product of the HIF's QIC Program, was tasked with finding a way to ensure that field offices receive everything needed when ordering equipment from the HIF. The HIF staff joined together with the pH Probe Team to celebrate the successful conclusion of that team's efforts.

June 1992.—In furtherance of its mission, the Documentation Team completed development of a questionnaire and mailed it to 329 USGS field employees.

July 1992.—The Instrumentation Catalog Team was established and chartered. A QIC library and meeting room was set up. Training was held for those at the HIF who had not previously received QIC training. The film "Speed is Life" was shown to approximately 25 employees. A 2-hour facilitator training session was held. The Chief, HIF, and the Quality Coordinator attended the second "Lessons Learned" meeting. The Chief, HIF, and the Coordinator attended the 1992 Southeastern Regional Total Quality Management Conference in Atlanta. The Secretary, Psychiatry Service, Veterans' Administration Medical Center, spent 1 day with the Coordinator to learn about QIC.

August 1992.—The Bar Code Team completed specifications for submission to the WRD Bar Code Team. The Instrumentation Catalog Team is working with the contract staff developing HIF CSS-II to meet the March 31, 1993, deadline to have the catalog online and reissued. Brenda Scott of the Southeastern Regional Office visited the Coordinator to share QIC information.

September 1992.—A new team to address a possible alternate work schedule (recommended by the Quality of Work Life Team) will be established. The Council established a formal procedure for handling complaints from process action teams.

During the past year, the Coordinator routinely assisted the Branch of Quality Assurance in training in Quality Improvements Concepts. An article on QIC has appeared in each issue of the *WRD Instrument News*.

QIC plans for FY93 include the making of a videotape documenting the stages of a process action team, the provision of additional QIC training for all staff members, and the development of new procedures to ensure that all HIF operations are adequately documented with Quality Assurance Procedures or Standard Operating Procedures. The Quality Coordinator will continue to network within the WRD and with Government and industry QIC representatives in the Gulf Coast area. The Coordinator will also con-

tinue to assist the Branch of Quality Assurance in efforts to promote QIC throughout the Survey.

HIF SAFETY AND RADIATION SAFETY

Safety is an ongoing concern at the HIF. It is the policy of the HIF to comply with the safety and health standards of the Occupational Safety and Health Act of 1970. *Management takes those standards seriously and makes every attempt to ensure safe and healthful working conditions for all HIF employees.*

During the year, significant activities of the HIF's Safety Officer included the following:

- Developed and coordinated with USGS headquarters personnel a safe means of mercury disposal. Small quantities of mercury, residue from mercury cleanups, and equipment purged of mercury have been received and disposed of satisfactorily.
- Conducted quarterly safety inspections for HIF facilities and work areas.
- Reported no duty days lost as a result of on-the-job injuries during the fiscal year.
- Attended the National Safety Conference in San Francisco, California, May 18-21, 1992.

The HIF's Radiation Safety Officer arranged the following activities and training efforts to ensure safe working conditions for all HIF personnel who work with or around radioactive materials at the HIF.

- Accepted eight radioactive source transfers. Sixteen sources are currently stored onsite.
- Amended the HIF's Nuclear Regulatory Commission (NRC) license to allow acceptance of a Troxler Model 3222 Soil Moisture probe from a USGS Florida location.
- Coordinated quarterly assessment of HIF's Radiation Safety Program.
- Ensured that radiation accumulation badges were evaluated monthly to ensure HIF personnel not exceed maximum permissible doses of radiation while working on or around radioactive sources at the HIF.
- Worked to find a location for disposal of all radiation sources currently stored at the HIF.

ADMINISTRATIVE SERVICES SECTION

The Administrative Services Section (AS) is responsible for the formulation and execution of the budget, accounting, procurement, personnel, and office management necessary to support the operating needs of the HIF and Office of Surface Water Programs at SSC. The AS staff consists of eight employees: an administrative officer, a budget analyst, two accounting technicians, an administrative technician, two purchasing agents, and an office automation clerk.

In Fiscal year 1992, the AS staff administered a budget of approximately $8.3 million. Much of this budget was generated as income to the Field Service and Supply Section, by the Analog-to-Digital Recorder Rental Program, the Water-Quality Monitor Program, the Borehole Equipment Support Project, and the Special Equipment Rental Program in the form of fees charged for services rendered, goods supplied, and equipment leased to WRD projects. (ADS and TES operated with direct Federal program funding.) Support of the Administrative Services Section was funded by assessment of the operating sections.

Approximately 6,000 documents were transmitted through AS for verification, processing, and monitoring. In addition, the AS staff processed about 400 documents for the Office of Surface Water programs at SSC.

In FY92, AS procured supplies and services totaling $5,912,864 as listed below.

Procurements submitted to Procurement and Contracts ..... 23 totaling $1,729,964
Procurements processed at the HIF ..... 1,024 totaling $3,853,455
Type A laptop computers..... 20 totaling $61,027
Type B laptop computers.... 76 totaling $257,196
Hand-held field computers.....1 totaling $11,222

AS provided administrative support for approximately 50 full-time employees, 6 part-time employees, and 2 intermittent employees. Seventy-three personnel actions for these employees were processed by AS during the year. Support included training documentation for HIF employees who attended approximately 40 training courses and job-related college-credit courses.

APPLICATIONS AND DEVELOPMENT SECTION

The Applications and Development Section (ADS) is the WRD's principal engineering resource for developing, acquiring, and providing application support for field instrumentation and related software. With a staff of six professional scientists and engineers

and four technicians, the section has a capability in surface-water hydrology, hydrometeorology, electrical and mechanical engineering, computer science, and technical support. The section's capabilities are augmented with contractor support in computer science.

The section provides procurement support to the WRD. Support includes all activities needed to define WRD users' requirements, translate them into specifications and procurement packages, oversee the procurement cycle, and accept and validate final products. Procurement support is provided primarily for the development and (or) purchase of new and modified instrumentation products that are intended for use on a divisionwide basis. Support is also provided for special-purpose products for which significant interest exists. When requirements cannot be met through commercial procurement, the section develops engineering designs for new and modified instrumentation products and provides engineering support for such products. Responsibilities include all activities needed to define WRD users' requirements and to produce proven prototypes with design and manufacturing documentation. Development is undertaken only for products that are of value to the WRD but for which no commercial interest can be found. Where the products have potential commercial viability, transfer of the technologies to industry is promoted.

The section develops software used to control and support the operation of data-collection instrumentation and to handle the data to point of entry into the data base. Responsibilities include all activities needed to define WRD users' requirements and produce proven software, with documentation, for execution in field and office computer systems.

The section coordinates the HIF field assistance and technical support program and provides the primary engineering and technical resources required to conduct the program. Support includes determining availability and applicability of instrumentation, providing training and documentation for the operation and maintenance of instrumentation, assembling and interfacing instrument subsystems and developing unique instrumentation to meet localized needs, and purchasing and leasing specialized equipment and instrumentation.

Fiscal Year 1992 Project Highlights

- Provided technical assistance and support to field personnel. Assembled and programmed operational systems, assisted in the application and use of instruments and software, assisted in locating and procuring products.
- Established and administered division-level procurement contracts for laptop and hand-held computers.
- Released laptop version 2.01 of Personal Field Computer (PFC) software, with support provided for operation of CR10, BDR 301, ESC 80, 21X, and SM192 data loggers and for converting and plotting data records. Began development of version of PFC software for use in hand-held computer.
- Conducted market searches for products to be used as replacements for bubble-gage manometers, ADR's, and R200 downhole recorders. Purchased and evaluated four candidate ADR-replacement products and organized a testing program for a candidate manometer-replacement product.
- Performed extensive hardware and firmware modifications to HIF rental program basic data recorders and ultrasonic velocity meters.
- Established development contracts for an SDI-12 interface verification instrument and for engineering improvements with regard to shallow-water operation of a prototype broadband acoustic Doppler current profiler.
- Organized and conducted several training courses at the HIF, NTC, and district offices dealing with basic data recorders, CR10 data loggers, ultrasonic velocity meters, and operation and troubleshooting of hydrologic instrumentation. Organized and conducted workshops dealing with surface-water applications of pressure sensors and applications of acoustic instrumentation.

Project Status

There were 21 active projects in the Applications and Development Section in FY92. Brief descriptions of these projects are presented in table 1, and accomplishments during the year and plans for FY93 are described in the project summaries that follow.

Table 1. Applications and Development Section projects active in FY92

Number	Name	Chief	Period
78-001	Current Meter Technical Support	Futrell	Oct. 1980 and continuing
78-005	Evapotranspiration Instrumentation	Sturrock	Oct. 1978 and continuing
81-014	Ultrasonic Velocity Meter (UVM)	Futrell	Jan. 1981 and continuing
84-032	R200 Downhole Recorder	Johnson	July 1984 to Oct. 1993
87-041	Personal Field Computer (PFC)	Henry	Jan. 1987 and continuing
87-042	Basic Data Recorder Systems	Billings	July 1987 to Oct. 1993
88-005	PS-2 Pressure Sensor	Henry	Oct. 1988 to Oct. 1992
89-005	Pesticide Sampler	Jelinski	Jan. 1989 to Dec. 1991
89-006	Minimonitor Interface	Johnson	Oct. 1988 to Oct. 1992
90-001	Plastic Float Wheel	Jelinski	Oct. 1989 to Oct. 1992
90-003	P-61 Sampler	Jelinski	Apr. 1990 to Dec. 1991
90-004	Hydrologic Benchmark Program	Sturrock	Oct. 1989 to Apr. 1993
91-001	Gas-Purge Regulator Improvement	Jelinski	Jan. 1991 to Dec. 1991
91-002	Acoustic Doppler Instrumentation	Henry	Oct. 1990 to Oct. 1993
91-003	Bank-Operated Cableway	Jelinski	Apr. 1991 to Apr. 1994
91-004	ADR Replacement Systems	Henry	July 1991 to Feb. 1993
91-005	Static Tube for Pressure Sensors	Futrell	Oct. 1991 to July 1992
92-001	Cable-Car Improvements	Jelinski	Apr. 1992 to Oct. 1993
92-002	Manometer Replacement Systems	Henry	Jan. 1992 and continuing
92-003	Commercial Product Utilization and Support	Henry	Apr. 1992 and continuing
93-001	Conductivity-Temperature System	Johnson	Oct. 1993 to Apr. 1994

Current Meter Technical Support

PROJECT NUMBER.—ADS78-001

OBJECTIVE.—To provide technical support to the Office of Surface Water (OSW) current-meter study and to perform other tasks related to current-meter technology.

RESULTS OF FY92.—No support was requested by the OSW current-meter study. A recall program was conducted to correct a firmware problem in the HIF current meter digitizer (CMD). A final development contract for a low-velocity current-meter swivel (without an integrated compass) was completed.

PLANS FOR FY93.—Final evaluations of the swivel will be completed and notice will be issued to the field regarding its features and commercial availability. Technical support will be provided to the OSW current-meter study as requested.

Evapotranspiration Instrumentation

PROJECT NUMBER.—ADS78-005

OBJECTIVE.—To develop and update instrumentation used to determine evaporation losses from lakes and vegetated surfaces.

RESULTS OF FY92.—Nonventilated thermistor psychrometers were furnished for a multisite evaporation study in the South Carolina and Nevada Districts and surface-water temperature probes were furnished to the North Dakota, Alaska, and Wisconsin Districts. Psychrometers were installed in the Idaho District to measure vapor pressure of the air at two levels above the ground. Anemometer calibrations were completed for lake evaporation study sites in the Nebraska, North Dakota, and Minnesota Districts. The report "Energy Budget Evaporation from Williams Lake" was completed. Colleague reviews of reports on evaporation from a seepage lake in Florida and testing of open-channel current meters were performed. Analysis of lake evaporation data from Hubbard Brook, New Hampshire, for the period 1982-1987 were performed.

PLANS FOR FY93.—The first draft of the report "Empirical Methods to Determine Evaporation" will be completed. Data analysis support will be provided for the Hubbard Brook study. Continuing technical support will be provided to ongoing and proposed studies.

Ultrasonic Velocity Meter (UVM)

PROJECT NUMBER.—ADS81-014

OBJECTIVE.—To provide technical support to the WRD in establishing an operational data- collection capability based on the ultrasonic time-of-travel measurement technique.

RESULTS OF FY92.—Development of a modification kit for converting 7300 UVM's to operate in responder mode was completed to the prototype stage. HIF rental-program UVM's were upgraded with the latest hardware and firmware modifications. Construction of a UVM demonstration and calibration site at

the HIF was completed and a 7300 series UVM was installed and rated at the site. Operational evaluations of an AFFRA Acoustic Flowmeter (Stedtnitz Maritime Technology) were conducted at the HIF site. A smart acoustic current meter (EG&G Instruments) and a cable insulation tester were acquired for use in supporting field installations and calibrations of UVM sites. A UVM training class and an acoustics workshop were conducted. Operational support was provided to the field.

PLANS FOR FY93.—Field evaluations of UVM responder kits will be completed and, if the results are satisfactory, the kits will be added to the HIF warehouse stock. Evaluations of the AFFRA flowmeter at the HIF site will be completed and the results will be reported to the field. An interim UVM data-processing program for use on PC's will be developed. Operational support will be provided to the field and additional UVM training courses will be conducted.

R200 Downhole Recorder

PROJECT NUMBER.—ADS84-032

OBJECTIVE.—To provide suitable commercial products that can be used in 2-inch well casings to measure and record water-level data. The WRD Instrumentation Committee redirected this project toward the use of commercial alternatives to the R200.

RESULTS OF FY92.—Integration of the R200 retriever program into the personal field computer software was started, but this work was discontinued when the project was redirected. A market search for alternative commercial products was conducted and one product that is still in the development stage was identified for future testing.

PLANS FOR FY93.—When it becomes available, the commercial product identified for consideration will be purchased and evaluated. Results of the evaluation will be issued to the field. If the results are sufficiently positive, support for the product will be added to the PFC family of programs.

Personal Field Computer (PFC)

PROJECT NUMBER.—ADS87-041

OBJECTIVE.—To provide standardized personal field computers with which field personnel can service the variety of electronic data recorders and transmission systems used in the WRD's evolving data- collection network.

RESULTS OF FY92.—Support was provided for the administration of types A and B laptop computer procurement contracts, but, because of their low projected use in FY93, the contracts were allowed to expire at the end of FY92. Assistance was provided to field personnel in locating and procuring alternative laptop computers. An unsuccessful contract for hand-held computers was terminated and a new contract was issued. An initial order of four units was received from the new vendor, the units were successfully acceptance tested, and an information packet on the contract was sent to the field.

A version of the PFC program for use on laptop computers was released and about 60 copies were furnished to the field. The laptop PFC program supports the CR10 (with SM192), BDR 301, BDR320, ESC 80, and 21X data loggers and includes an integrated PC version of the DECODES program and a plotting routine that operates on standard-formatted files. Work proceeded on the next version of the laptop PFC program and on the development of a version for use in the hand-held computer.

PLANS FOR FY93.—Support will be provided for the administration of the hand-held contract and for the modification of the contract to include provisions for new PCMCIA industry-standard memory cards.

A revision of the laptop PFC program and the first version of the hand-held PFC program will be released. These two developments will be coordinated so that the laptop and hand-held programs will provide equivalent levels of support and will have essentially the same look and feel. Support will be added to the programs for servicing data-collection platforms (DCP's) and for transferring files to and from office computers.

Basic Data Recorder (BDR) Systems

PROJECT NUMBER.—ADS87-042

OBJECTIVE.—To acquire a suitable data-recorder system to replace the ADR in applications other than simple stage data-collection systems.

RESULTS OF FY92.—Modification programs were completed for the ESC 80 (corrected firmware problems and added provisions to support operation with an external modem) and the BDR 301 (corrected firmware problems). Development of the memory-module enhancement for the ESC 80 continued, although somewhat slower than anticipated due to technical problems. Technical information sheets for

the two BDR's were completed and placed in the warehouse for supply to the field.

PLANS FOR FY93.—Prototype units of the ESC 80 memory-module enhancement will be delivered, tested in the HIF laboratory, and placed in the field for operational evaluation.

PS-2 Pressure Sensor (PS-2)

PROJECT NUMBER.—ADS88-005

OBJECTIVE.—To acquire pressure sensor systems with SDI-12 outputs that can be used with basic data recorders and other SDI-12 data recorders and transmission products to replace manometer systems.

RESULTS OF FY92.—Support was provided for the administration of the final year of the procurement contract for nonsubmersible pressure sensors. A total of 145 PS-2 units are currently owned, and an additional 175 more are on order. The contract expired and the vendor was unable to place his product on the GSA schedule.

PLANS FOR FY93.—The technical objective was achieved, and this project was complete as of the end of FY92.

Pesticide Sampler

PROJECT NUMBER.—ADS89-005

OBJECTIVE.—To assist the National Water Quality Laboratory (NWQL) in the development of a field method for measuring volatile organic compounds in small-volume samples using a liquid-solid extraction technique and to develop equipment, as needed, to support the operational implementation of the method.

RESULTS OF FY92.—Field evaluations of the prototype sampler were performed by NWQL during the first quarter. No additional effort was requested of the HIF.

PLANS FOR FY93.—This project was complete as of January 1992.

Minimonitor Interface

PROJECT NUMBER.—ADS89-006

OBJECTIVE.—To redesign the QW minimonitor to support the acquisition of its data by recorders and transmission systems with SDI-12 or analog sensor interfaces.

RESULTS OF FY92.—Due to other priorities, no significant work was performed on this project.

PLANS FOR FY93.—Considering the low relative priority of this work, the project was proposed to the Instrumentation Committee for cancellation. ICOM approved cancellation of the project. The project was canceled as of the end of FY92.

Plastic Float Wheel

PROJECT NUMBER.—ADS90-001

OBJECTIVE.—To develop and test a one-piece plastic design that can be used as a future replacement for metal float wheels.

RESULTS OF FY92.—A design problem detected in the prototype plastic float wheel was corrected and a contract was issued to fabricate 100 prototype units. The prototype float wheels were delivered at the end of the fiscal year.

PLANS FOR FY93.—The prototypes will be acceptance tested and, if they pass, a program for evaluating them in field use will be planned and initiated. If they are suitable for field use, they will be considered for future procurements.

P-61 Sampler

PROJECT NUMBER.—ADS90-003

OBJECTIVE.—To redesign the P-61 sampler to provide improved sampling-valve operation, reduce the metallic oxide contamination of the water sample, and permit interchangeability of parts between sampler units.

RESULTS OF FY92.—Negotiations between the USGS and the U.S. Army Corps of Engineers resulted in a decision to move the sediment program to the Waterways Experiment Station (WES) in Vicksburg, Mississippi. All P-61 experimental models and design documentation were transferred to WES.

PLANS FOR FY93.—This project was canceled as of January 1992.

Hydrologic Benchmark Program

PROJECT NUMBER.—ADS90-004

OBJECTIVE.—To provide support in the acquisition, testing, and calibration of instrumentation to be used in upgrading hydrologic benchmark sites.

RESULTS OF FY92.—All equipment is ready and available; however, headquarters did not schedule any installations during the FY92 period.

PLANS FOR FY93.—Plans are to install the remaining 16 rain gages and 5 precipitation water-quality collectors during FY93.

Gas-Purge Regulator Improvement

PROJECT NUMBER.—ADS91-001

OBJECTIVE.—To examine and, if practical, redesign the gas-purge regulator to reduce leaks and guard against improper purging.

RESULTS OF FY92.—A commercial battery-powered pressure source/regulator system was ordered by the Test and Evaluation Section (TES), which plans to evaluate it for use as an alternative to the current high-pressure gas-bottle-driven system.

PLANS FOR FY93.—This project was canceled as of January 1992.

Acoustic Doppler Instrumentation

PROJECT NUMBER.—ADS91-002

OBJECTIVE.—To provide technical support to the WRD in establishing an operational capability for collecting current profiles and making real-time measurements of discharge in small-to-large streams and rivers using acoustic Doppler technology.

RESULTS OF FY92.—Development of a prototype broadband acoustic Doppler current profiler system was completed, and the unit was delivered. Field tests were conducted by the California District. Some problems were found and corrected, and the system was transferred to the Florida District for further tests and operational use.

A workshop was held to provide training on the system, to examine its potential uses, and to explore possible future developments. Based on the results of the workshop, a requisition was submitted for the procurement of engineering to optimize the system for use in shallow water.

PLANS FOR FY93.—Modifications will be performed to the system to reflect the current results of field evaluations and the engineering being conducted by the vendor to optimize shallow-water performance. Field evaluations of the system will continue by the Florida District and other districts (to be selected by the Office of Surface Water).

Bank-Operated Cableway

PROJECT NUMBER.—ADS91-003

OBJECTIVE.—To develop a portable cableway reel and current-meter transport mechanism that can be operated remotely from the streambank and to deliver one prototype system to the North Carolina District.

RESULTS OF FY92.—A design for the reel/transport mechanism was completed and reviewed with the district. Per requirements, the unit is manually operated and does not include meter proximity, depth, or angle sensors. A prototype of the mechanism was fabricated and is being tested at the HIF cableway installation.

PLANS FOR FY93.—HIF testing will be completed, and the prototype will be turned over to the North Carolina District for operational evaluation. Assistance will be provided to the district in the initial installation and use of the prototype and, if necessary, modifications will be performed to the unit. Drawings will be made to support the manufacture of additional units in accordance with the final approved design; however, it is not anticipated that they will be finalized next year.

ADR Replacement Systems

PROJECT NUMBER.—ADS91-004

OBJECTIVE.—To identify commercial products that could serve as replacements for ADR-based stage-measurement systems in warm- and cold-weather environments and to test those products that are considered suitable, cost-effective alternatives.

RESULTS OF FY92.—A market search revealed five products with combinations of features that appeared to meet the need. All were dedicated stage sensor/recorders that use removable data modules and are capable of low-temperature operation. Three are float driven and two are pressure driven. Four of the candidate products were purchased (one pressure-driven product was considered too expensive) and studied to determine their features and characteristics and tested to determine their operational and environmental performance.

PLANS FOR FY93.—The results of the HIF studies and tests will be reported to the field. Additional field evaluations will be conducted to determine the operational suitability of the products. When completed, the results of field evaluations will be reported to the field. The market search for additional products will continue.

Static Tube for Pressure Sensors

PROJECT NUMBER.—ADS91-005

OBJECTIVE.— To develop an installation device that will accommodate a variety of submersible pressure transducer types and will eliminate velocity-induced errors. (Submersible pressure transducers are being increasingly used to measure stage in surface-water applications. Tests, however, indicate that significant errors can be present in such measurements due to flow velocities.)

RESULTS OF FY92.—A concept for a device that utilizes a galvanized pipe and the standard crest-stage gage cap was developed. A prototype of the device was fabricated, and a plan was developed and approved by the OSW for testing it. Tests were conducted in the hydraulics laboratory on the DAA H-300 and Druck submersible pressure sensors installed in the static tube. Results, which indicate that the static tube acts as a satisfactory housing in flow conditions up to about 8 feet per second, were reported at the workshop on surface-water applications of pressure sensors.

PLANS FOR FY93.—Tests will be performed with additional submersible pressure sensors, to be identified.

Cable-Car Improvements

PROJECT NUMBER.—ADS92-001

OBJECTIVE.—To improve the performance and safety of cable cars, specifically with respect to braking, load capacity (up to 2,500 pounds), and accidents caused by snagged cables.

RESULTS OF FY92.—Work began on the development of a mechanism that can be added to standard reels to let streamgagers quickly and safely cut snagged cables. A prototype of the mechanism is being installed on the portable reel being developed for the North Carolina District (ADS91-003). Production engineering was started on a cable-car braking mechanism developed by the Sandpoint office of the Idaho District. No work was conducted with respect to the load-capacity issue.

PLANS FOR FY93.—The prototype cable-cutting mechanism will be delivered to the North Carolina District for operational evaluation. Production engineering of the Sandpoint braking mechanism will be completed and several prototypes of the unit will be fabricated and distributed to the field for operational evaluation. Analyses will be conducted of the cable-car load-carrying capacity and, if necessary, design modifications will be performed. Manufacturing drawings will be completed for all work.

Manometer Replacement Systems

PROJECT NUMBER.—ADS92-002

OBJECTIVE.—To identify commercial products that could serve as replacements for bubble-gage manometers and to test those products that are considered viable, cost-effective alternatives.

RESULTS OF FY92.—Discussions were held with several pressure transducer vendors to acquaint them with WRD's needs and learn of their plans for future products. Three vendors claim to be developing products that are potentially applicable and others expressed interest. One vendor offered a prototype nonsubmersible pressure sensor, with SDI-12 and incremental encoder outputs and options for a mechanical output and a built-in data logging capability, for evaluation.

Support was provided to the field in the procurement of certain pressure sensor products that are not on GSA schedule. Technical presentations were made at the workshop on surface-water applications of pressure sensors.

PLANS FOR FY93.—The market search will continue and technical support will be provided in the testing and evaluation of new pressure sensor products.

Commercial Product Utilization and Support

PROJECT NUMBER.—ADS92-003

OBJECTIVE.—To provide marketing and procurement services aimed at informing districts of the variety of available commercial products and assisting in the selection, purchase, and application of those that best meet their needs.

RESULTS OF FY92.—Information libraries on instrumentation products that are of potential interest to the WRD and on the availability of products from GSA contract are being collected. Waivers were prepared to support the procurement of DAA H-300 and H-350 submersible pressure sensors off the GSA contract. A wide variety of marketing and procurement assistance was provided in response to requests from the field.

PLANS FOR FY93.—Information libraries will be distributed to field offices and efforts will be conducted to keep the libraries up to date. A list of WRD

field contacts that can be made available to instrumentation vendors for marketing purposes will be assembled and maintained. Marketing and procurement assistance will continue to be provided and additional services will be performed as needed.

Conductivity-Temperature System

PROJECT NUMBER.—ADS93-001

OBJECTIVE.—To provide a two-parameter water-quality sensor system that utilizes the minimonitor conductivity and temperature probes and can operate directly with data loggers and data-collection platforms equipped with general-purpose analog sensor inputs. The system will be packaged in a small rectangular case and will allow the probes to be connected individually using cable lengths up to several hundred feet.

RESULTS OF FY92.—This is a new project. No work was completed.

PLANS FOR FY93.—Engineering development will be performed and several prototype systems will be fabricated and tested. Field evaluations of the system will be initiated and will probably extend well into FY94. Drawings will be prepared to facilitate the manufacture of the system by contract.

TEST AND EVALUATION SECTION

The Test and Evaluation Section (TES) provides instrument test and evaluation services to HIF and WRD. With a staff of three engineers, three technicians, and a part-time secretary and quality improvement coordinator, the section has experience and knowledge in the areas of hydrologic data collection, organic chemistry, water-quality laboratory services, electrical engineering, instrumentation tests and calibration, and quality improvement concepts. The section's capabilities are augmented with contractor support for tests and by direct access to the National Aeronautics and Space Administration's Standards and Calibration Laboratory located near the HIF.

The section recommends minimum performance standards for instrumentation to ensure that WRD data-collection requirements are met and that legal and scientific credibility continues. TES recommends acceptance standards, develops quality-control and test procedures for procurement actions, and works closely with USGS offices and other Federal agencies to ensure that the evaluation criteria and calibration procedures used are in compliance with all applicable legal and operational requirements. TES provides quality control acceptance test services for all items stocked by the HIF warehouse and items repaired or modified by HIF shops.

TES designs and conducts engineering tests and analyses of commercial hydrologic instrumentation. Tests have been conducted on a variety of products this past year, and the results are summarized below. All WRD offices are encouraged to check with the HIF if procurement of unfamiliar instrumentation is being considered. In addition to the products tested at the HIF, TES may be able to pass on experience from other Federal agencies. WRD offices are encouraged to pass on information to TES regarding experience with new commercial instrumentation.

Fiscal Year 1992 Project Highlights

- Reorganized in July, after losing two engineers and reassignment of the TES senior technician to HIF's new Systems Application Team (SAT). Three TES persons were assigned, on a part-time basis, to the newly formed Quality Control Unit (QCU) to shorten the time required and to handle the increasing number of warehouse products acceptance tests, which had been conducted by one TES person.
- Conducted acceptance tests on 208 new item shipments received by the warehouse. This is about 80 more tests than in an average year and 55 more than last year. Approximately 97 percent of all 1992 shipments passed all HIF requirements.
- Tested a number of commercial products to determine that WRD and HIF operational requirements were met. Extensive acceptance tests were conducted on new SDI-12 products: three data-collection platforms, two data loggers, and one encoder. Laboratory tests were conducted on four different water-level sensors, one water-quality monitor, four pH meters, five conductivity meters, and new dissolved oxygen and pH electrodes for the minimonitor.
- Recalled 17 used Price Type AA and Pygmy meters from district offices for inspection and calibration as part of the Office of Surface Water and HIF QA program. This meter recall program helps establish the reliability of meters used by WRD.

- Calibrated more than 74 instruments and sensors for the Yucca Mountain Project (YMP), which is 44 more sensors calibrated than last year.
- Continued the operation of the Mississippi District acid precipitation stations at Stennis Space Center and Stennis Airport.

Project Status

There were 12 active projects in the Test and Evaluation Section in FY92. Brief descriptions of these projects are presented in table 2, and accomplishments during the year and plans for FY93 are described in the project summaries that follow.

Table 2. Test and Evaluation Section projects active in FY92

Number	Name	Chief	Period
79-5410A	Quality Control of HIF Warehouse Procurements	Potter Olive Treadway	July 1979 and continuing
79-5410B	Test and Evaluation of Hydrologic Instrumentation	Potter Olive Treadway	July 1979 and continuing
86-5410C	Test and Evaluation of Power Systems	Olive	Dec. 1985 and continuing
87-5406A	Lightning and Transient Protection for Station Instrumentation	Olive	Jan. 1987 and continuing
87-5413D	Ground-Water Sampler Testing	Tai	Mar. 1987 and continuing
88-5413A	Hazardous-Waste Instrumentation Support	Tai	Oct. 1987 and continuing
89-5410A	Yucca Mountain Project	Treadway	Mar. 1989 and continuing
89-5410B	Basic Data Recorder System Tests	Potter Olive	May 1989 and continuing
89-5413B	Submersible Water-Quality Monitor Tests	Tai	June 1989 and continuing
90-5413A	Acid-Rain Data Collection	Tai Garcia	Sept. 1989 to Oct. 1992
91-5413A	Conductivity Meter, pH Meter, and pH Electrode Tests	Tai Garcia	Jan. 1991 and continuing
92-5413A	Alkalinity Test-Kit Tests	Tai	Mar. 1992 to June 1992

Quality Control of Warehouse Procurements

PROJECT NUMBER.—TES79-5410A

OBJECTIVE.—To ensure that WRD-purchased instruments meet all contract specifications and that in-house assembled, fabricated, and repaired equipment meets WRD specifications before being stocked in the warehouse.

RESULTS OF FY92.—Of the 208 shipments received and tested last year, 202 were accepted. Over the previous 10 years, 84 percent of the 1,282 new product shipments received were accepted (figure 6). In conjunction with the Office of Surface Water district reviews, 17 used Price type AA and Pygmy meters were returned to the HIF. These meters were calibrated in the condition received, inspected, and then rebuilt. This meter recall program helps establish the reliability of current-meters used by WRD.

PLANS FOR FY93.—TES will test all shipments of new and repaired items received in the warehouse, support the meter recall program, and assist in the teaching of various HIF training courses.

Test and Evaluation of Hydrologic Instrumentation

PROJECT NUMBER.—TES79-5410B

OBJECTIVE.—To test new commercial products to determine if WRD and HIF operational requirements are met.

RESULTS OF FY92.—Laboratory tests of five Fluid Data Systems Water Gage II balance-beam manometers were completed and the results were reported in the *WRD Instrument News*. Environmental tests of the Environmental Systems Corporation Basic Data Recorder model ETM 80 were completed and were found to meet USGS requirements for operation over -40 to +60 degrees Celsius.

PLANS FOR FY93.—TES will conduct tests and evaluation of new commercial products that appear to be direct replacements for manometers. This will include tests of new submersible and nonsubmersible pressure transducers and acoustic transducers.

Test and Evaluation of Power Systems

PROJECT NUMBER.—TES86-5410C

OBJECTIVE.—To investigate power-supply systems for field use.

RESULTS OF FY92.—Phone inquiries concerning batteries, solar panels, and controllers were answered. The course "Power Supply Protection and Grounding of Electronic Data Acquisition Equipment" was presented in Calgary, Alberta, and Guelph, Ontario, Canada, for Water Survey of Canada personnel.

Battery solicitation and battery test procedures were reviewed prior to submission to the contracts office. Battery bid samples received in response to the

battery solicitation were evaluated prior to battery contract award.

PLANS FOR FY93.—TES will continue to support requests for information on power systems.

Lightning and Transient Protection

PROJECT NUMBER.—TES87-5406A

OBJECTIVE.—To minimize damage from lightning and transient power surges at gaging stations.

RESULTS OF FY92.—Phone inquiries on grounding and lightning protection were answered. *WRD Instrument News* articles on establishing proper grounding and lightning protection systems were written.

PLANS FOR FY93.—TES will continue to support requests for information on proper protection devices. The section will gather information on power line, phone, and antenna surge suppressors so that they may be considered for warehouse stock items. TES will find an electromagnetic interference (EMI) detector in support of ultrasonic velocity meter installation and troubleshooting. This is in response to an ICOM request.

Ground-Water Sampler Testing

PROJECT NUMBER.—TES87-5413D

OBJECTIVE.—To perform comparative tests of various sampling techniques to determine the effectiveness of water-sample collections of volatile organic compounds (VOC).

RESULTS OF FY92.—The Project Chief visited EPA to confer on EPA's VOC autosampler. EPA furnished one sampler for HIF use. The Project Chief assisted the Indiana District and the EPA in testing more than 10 ground-water samplers and pumps in May and September 1992. The results of the Grundfos pump and the Solinst VOC trap sampler tests will be presented at the National Groundwater Symposium in November 1992. HIF's hazardous-waste equipment was exhibited at the USGS/Defense Environmental Contamination meeting in Las Vegas, Nevada, in May 1992. The Project Chief was an instructor for the two Denver courses for Sampling and Analysis of Organic Contaminants in Surface and Ground Water. The Project Chief represented the HIF on the Environmental Chemistry Task Group and Southeastern Region Ground Water Specialists' meeting.

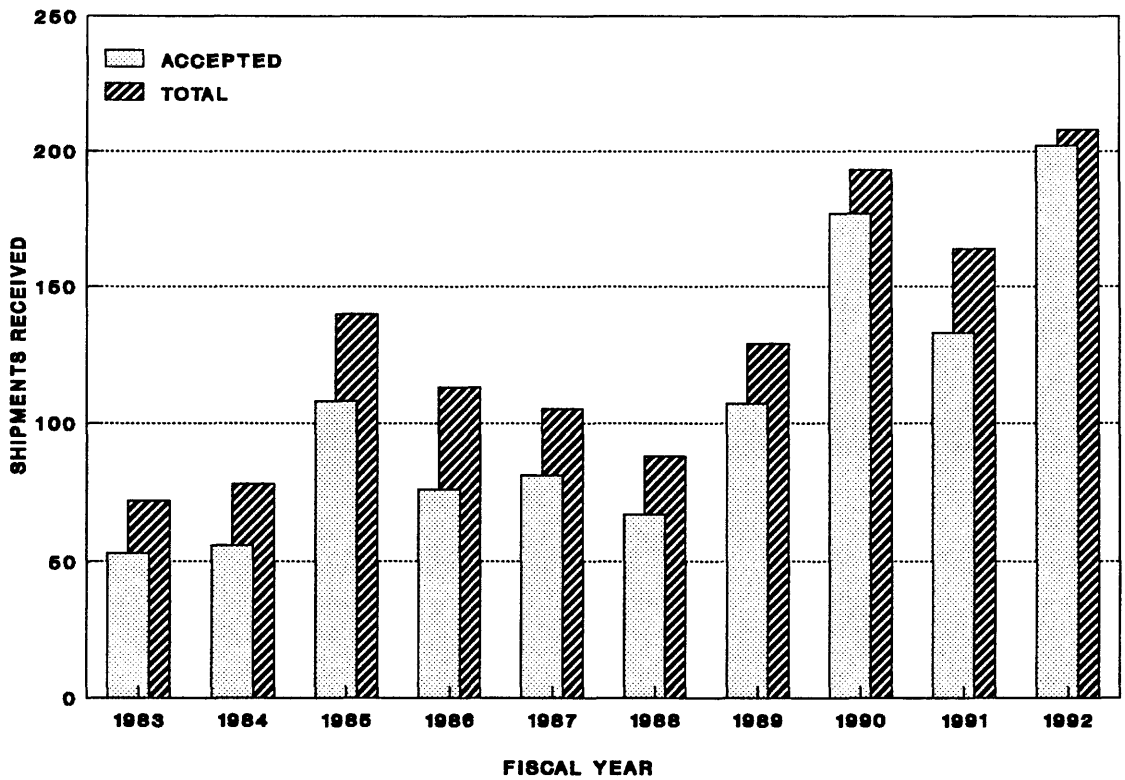

Figure 6. Results of 1983 to 1992 acceptance tests of shipments received by the HIF warehouse.

PLANS FOR FY93.—TES will continue testing commercially available samplers and prepare a report on those tests.

Hazardous-Waste Instrumentation Support

PROJECT NUMBER.—TES88-5413A

OBJECTIVE.—To support HIF's hazardous-waste instrumentation rental program.

RESULTS OF FY92.—At the end of the year, the HIF warehouse had eight HNU photoionization analyzers, seven Foxboro OVA-128 meters, and one Photovac GC with capillary column and oven. These instruments were serviced routinely and rented to WRD district offices. Enmet meter service was discontinued in July 1992.

PLANS FOR FY93.—TES will continue instrumentation support for the hazardous-waste program.

Yucca Mountain Project

PROJECT NUMBER.—TES89-5410A

OBJECTIVE.—To provide the Nevada Nuclear Waste Storage Yucca Mountain Project (YMP) the required National Institute of Standards and Technology (NIST) traceable calibration and test support.

RESULTS OF FY92.—Seventy-four instruments and sensors were calibrated and returned to YMP, which is 44 more sensors calibrated than last year.

PLANS FOR FY93.—Calibration and test support will be provided for YMP, the Nevada District, and all districts that request NIST traceable calibrations and products.

Basic Data Recorder Systems Tests

PROJECT NUMBER.—TES89-5410B

OBJECTIVE.—To determine that each model BDR, encoder, Pressure Sensor-2 (PS-2), and other BDR sensors meets all contract requirements and WRD expectations.

RESULTS OF FY92.—After 1 year, the four WRD offices participating in the PS-2 field tests report successful data collection. The results were summarized in the September issue of the *WRD Instrument News.*

PLANS FOR FY93.—TES will continue the PS-2 field tests in Iowa and Maine only. Comparison tests of the PS-2, Water Gage I and II, STACOM manometer, DAA H-350 and H-310 will be continued at two sites in Iowa and the H-350 and PS-2 at eight other sites throughout the United States.

Submersible Water-Quality Monitor Tests

PROJECT NUMBER.—TES89-5413B

OBJECTIVE.—To test Hydrolab model H20 four-parameter water-quality monitor with the SDI-12 interface to verify that the manufacturer's specifications are met.

RESULTS OF FY92.—The field test of H20 with flowthrough cell has been completed by the Ohio District. The results of the field test of the H20 will be reported in the December issue of the *WRD Instrument News.*

PLANS FOR FY93.—The YSI-3800 submersible water-quality meter will be tested.

Acid-Rain Data Collection

PROJECT NUMBER.—TES90-5413A

OBJECTIVE.—To collect weekly rainfall records and water samples and to measure the pH and conductivity for the Mississippi District rainfall station at Stennis Space Center.

RESULTS OF FY92.—The weekly rainwater samples and data were sent to the Mississippi District office.

PLANS FOR FY93.—This project was discontinued at the end of FY92.

Conductivity Meter, pH Meter, and pH Electrode Tests

PROJECT NUMBER.—TES91-5413A

OBJECTIVE.—To test and evaluate commercial conductivity meters, pH meters, and pH electrodes for general field use, especially for the NAWQA Program.

RESULTS OF FY92.—Tests of 4 pH meter models and 10 pH electrode models (2 of each) have been completed. The results were reported in QW-Talk (June 1992) and the September issue of the *WRD Instrument News.* Five conductivity meter models have been tested.

PLANS FOR FY93.—The results of the tests of five conductivity meter models will be reported in QW-Talk and the December issue of the *WRD Instrument News.* Solid state pH meters and electrodes will be tested. Five Royce dissolved oxygen monitors with a chlorine cleaning cycle will also be tested.

Alkalinity Test-Kit Tests

PROJECT NUMBER.—TES92-5413A

OBJECTIVE.—To investigate the available alkalinity test kits for accuracy for field use.

RESULTS OF FY92.—Alkalinity test kits were selected for the test. The tests have been completed by the HIF and the Ocala Laboratory. The results were reported in the September issue of the *WRD Instrument News.*

PLANS FOR FY93.—This project was completed last year.

FIELD SERVICE AND SUPPLY SECTION

The Field Service and Supply Section (FSS) operates the warehouse, provides repair and calibration services, initiates procurement actions to purchase equipment, monitors contracts, fills orders, and serves as technical liaison with the districts.

The FSS staff consists of four engineering technicians, seven electronics technicians, three supply technicians, and a computer assistant. Section activities are supported by technical and administrative personnel in other HIF sections.

Procurement

Procurement actions, comprising 18 contracts and 23 purchase orders, were issued totaling $2,234,608.00.

Property Management

The FSS computer assistant tracks and accounts for rental property held in the district offices and the field with HIF-CSS and tracks and accounts for property held by HIF employees with a personal computer INFO data base. Hydrologic Instrumentation Facility employee-held controlled property is valued at more than $1 million and the controlled rental-program property, frequently cycled through the HIF, is valued at more than $2 million.

Equipment Rental

The equipment rental program, a major effort of the HIF, is operated by FSS. In most cases, equipment is sold to field offices; however, in the case of widely used recording and monitoring equipment, the HIF maintains a rental program for the field and is responsible for procurement and maintenance of the equipment. The rental program is divided into four major categories: recorders and timers, water-quality monitors, telemetry equipment, and special equipment.

Electronic/Mechanical Repair Services

Services provided include maintenance, repair, and calibration of district-owned and rental-program equipment. In the HIF Mechanical and Electronics Units, capabilities exist, either in-house or by contract, to repair, adjust, or calibrate virtually any type of USGS-owned equipment. Charges to field offices are assessed on a straight time-and-materials basis. Table 3 summarizes activity in FSS units and special programs.

Borehole Equipment Support Project

The Borehole Equipment Support Project (BESP) leasing program was terminated effective September 30, 1992, with the exception of system probes/tools which will be repaired, upon request, through FY94. The probe repair function at the HIF will be conducted by the Field Service and Supply Section Electronic Repair Unit.

BESP loggers and some peripheral components were sold to districts and/or granted-in-aid depending on the age and operational status of the equipment.

BESP personnel at the HIF formulated a Request for Proposal package which will be used by WRD districts to procure borehole logger systems in the future.

Eight radioactive sources were received at the HIF in FY92. Continuing escalation of the costs and expansion of regulations associated with the storage, handling, disposal and licensing of the materials will likely prompt users to seek all available options for disposing sources. Alternative prospects continue to be investigated by facility and contractor personnel. A refresher training course focusing upon these alternatives was attended by the project technician and Radiation Safety Officer this year.

The HIF's principal BESP technician is transferring to the Borehole Support and Services Group of the Southeastern Region where he will assist them in providing field operational assistance to districts. The HIF wishes Mike Williams the best of success in his upcoming transfer.

Table 3. Activity totals for Field Service and Supply units and programs in FY92

Electronics Unit	
2,163	Work orders received
2,128	Work orders completed
150	Handar equipment serviced
385	Synergetics DCP's serviced
38	Sutron 8200 DCP's serviced (factory)
6	7300 Ultrasonic Velocity Meters
139	R200 downhole recorders serviced
447	Timers (model III) (June-August)
436	Minimonitors serviced
401	Minimonitor printed cards serviced
15	Minimonitor printed circuit cards fabricated
322	Minimonitor pH probes serviced
269	Minimonitor conductivity probes serviced
154	Minimonitor temperature probes serviced
310	Minimonitor dissolved oxygen probes serviced
284	Minimonitor extension cables serviced
3	Flowthrough monitors serviced
75	Flowthrough signal conditioners serviced
62	Flowthrough probes serviced
3	Flowthrough power supplies serviced
3	Flowthrough panel meters serviced
445	Equipment exchange work orders
Mechanical Unit	
435	Work orders received
36	Work orders in mechanical shop
399	Work orders in meter shop
194	Work orders from field
241	Work orders from HIF
424	Work orders completed
11	Work orders in progress
Analog-to Digital Recorders Rental Program	
639	ADR's to contractor for repair
626	ADR's repaired by contractor
1,519	ADR's in storage for repair/teardown
197	ADR's ready to be shipped (warehouse inventory)
Borehole Equipment Support Program	
46	Work orders received
42	Work orders completed
6	New rentals
21	Sales
21	Loans/exchanges
15	Repairs/calibrations
410	Incoming communications
190	Outgoing communications
7	Rental terminations

Warehouse Activity

In addition to 4,508 orders shipped to district offices totaling $2,199,501.09, the HIF warehouse also sells a significant volume of hydrologic instrumentation to other Federal agencies. This section responds to frequent calls from other Federal agencies regarding the whole range of instrumentation problems and possible solutions. Sales to other Federal agencies during the year totaled $214,666.66. One hundred ninety-nine orders were filled. Monthly warehouse sales for FY92 along with the maximum and mean monthly sales are shown in figure 7. A full disclosure of all USGS activity is listed in table 4.

Hydrologic Instrumentation Facility Computerized Support System

The processing of field orders is supported by HIF-CSS, an interactive computerized support system. Sixty-seven cost centers are registered to use HIF-CSS, with a total of 277 users allowed access to the field office functions. These functions include the ability to scan the computerized price list and place orders directly from interactive terminals, determine the status of previously placed orders, and retrieve numerous accounting reports by cost center. HIF-CSS also generates accounting documents, tracks inventory and procurement actions, and generates management reports used to improve future stocking and procurement decisions based on sales patterns. HIF-CSS automates the tracking of controlled property, eliminating the need for processing hardcopy property transfer forms for each transaction. Activities of the Hydrologic Instrumentation Facility Computerized Support System for fiscal year 1992 are presented in table 4.

FSS maintains close liaison with field offices, is cognizant of equipment needs, and adds or deletes items to the inventory in response to field needs. About 1,250 catalog items are in the inventory. With the exception of some convenience items such as boots and waders, all items are built to USGS plans and specifications or require tight quality-control procedures to ensure that USGS data-collection standards are met.

Water-Quality Monitor Equipment

Flowthrough monitor rental remained largely unchanged in FY92, while minimonitor demand

declined slightly. Major expenses incurred in support of the water-quality monitor program included the fabrication of specific conductance, pH, temperature, and DO sensors and the purchase of extension cables.

Special Equipment Rental Program

The Special Equipment Rental Program (SERP) received $30,318 from the rental of 83 pieces of equipment. No new equipment was purchased, but several pieces of equipment were returned to the manufacturer for repair. Equipment covered by the program included flowmeters, sediment samplers, pipe thickness gages, precipitation gages, oscilloscopes, and hazardous-waste detection equipment. During the year, approximately 19 inquiries concerning SERP were handled.

Analog-to-Digital Recorders, Timers, and Basic Data Recorders

A total of 958 analog-to-digital recorders (ADR's) were repaired during FY92. At the end of FY92, 11,116 recorders, of which 579 were CR10's and 485 were BDR's, were in field service. The demand for ADR's has continued to decrease. Figures 8 through 15 present results of the recorder and timer repair program.

The following repair and maintenance support for these programs was provided.

Description	Units repaired, modified, or refurbished	Units shipped to field
Solid-state timer	1,498	1,300
Fischer and Porter (F&P) ADR	541	610
F&P ADR with telekit	26	19
Leupold and Stevens (L&S) ADR	46	152
L&S ADR with module A	103	107
L&S ADR with input/output	142	98
CSI BDR 301	1	142
ESC 80 BDR	13	89
CR10	16	241
TOTAL	2,486	2,758

The ADR activity is supported by FSS, the onsite contractor, and the Pearl River Work Activity Center. The Pearl River Work Activity Center is a nonprofit organization supported by the State of Mississippi to provide training and employment for physically and mentally handicapped citizens of Pearl River County, Mississippi.

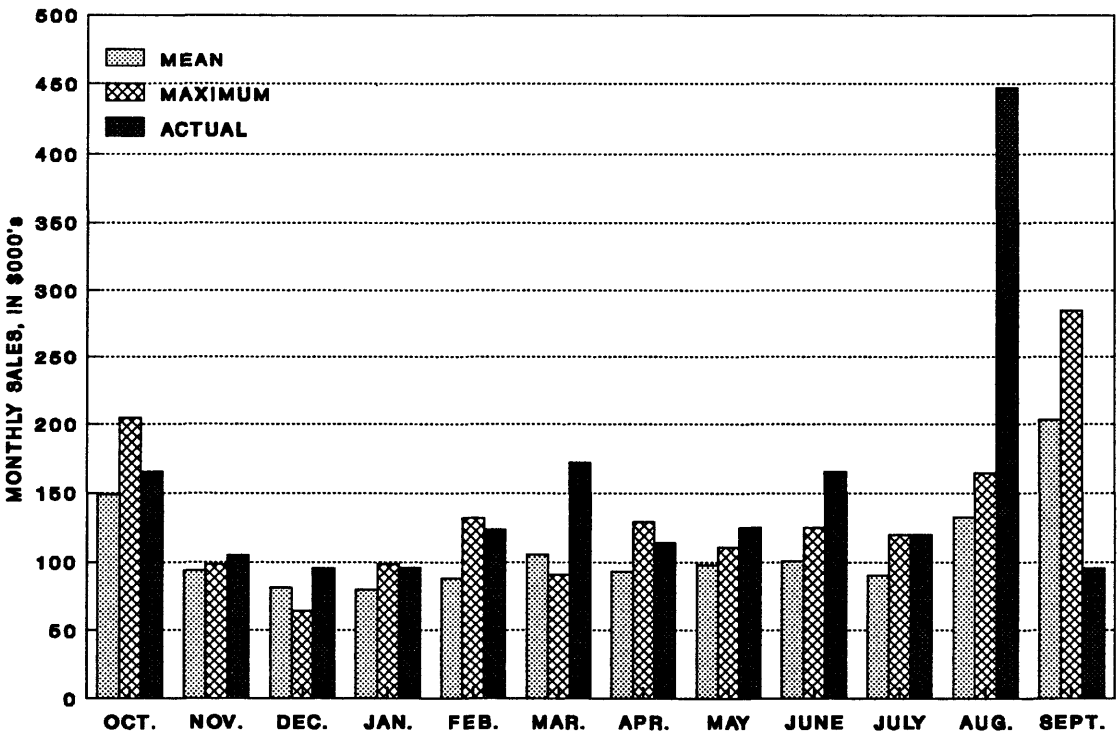

Figure 7. Monthly warehouse sales for fiscal year 1992 and the maximum and mean monthly sales.

Table 4. Hydrologic Instrumentation Facility Computerized Support System activity in fiscal year 1992

Activity	Quantity	Dollar Value
TOTAL ORDERS		
Orders placed FY92	4,508	$2,199,501.09
Orders cancelled	(225)	(318,099.80)
Total orders not cancelled FY92	4,283	$1,881,401.29
Refunds FY92	(77)	(58,001.74)
NET SALES FY92	4,206	$1,823,399.55
ORDERS, ITEMS IN STOCK		
Orders placed, items in stock	3,210	1,302,831.34
Orders cancelled	(51)	(13,637.85)
Orders filled and shipped	3,159	$1,289,193.49
Mean value per filled and shipped order: $408.10		
BACKORDERS		
Backorders placed FY92	1,298	896,669.75
Unfilled backorders placed in FY91	320	159,691.00
Unfilled backorders placed in FY90	14	8,690.00
Backorders cancelled	(174)	(304,461.95)
Total backorders not cancelled FY92	1,458	$ 760,588.80
FY92 backorders filled and shipped	919	223,542.30
Mean value per filled and shipped backorder: $243.24		
FY91 backorders filled and shipped in FY92	320	159,691.40
FY90 backorders filled and shipped in FY92	14	8,690.00
FY92 backorders remaining	205	368,665.00
FY91 backorders remaining	0	0.00
FY90 backorders remaining	0	0.00
Total backorders remaining in system	205	$ 368,665.00
WAREHOUSE INVENTORY		
Warehouse inventory, September 30, 1992		$3,592,457.56

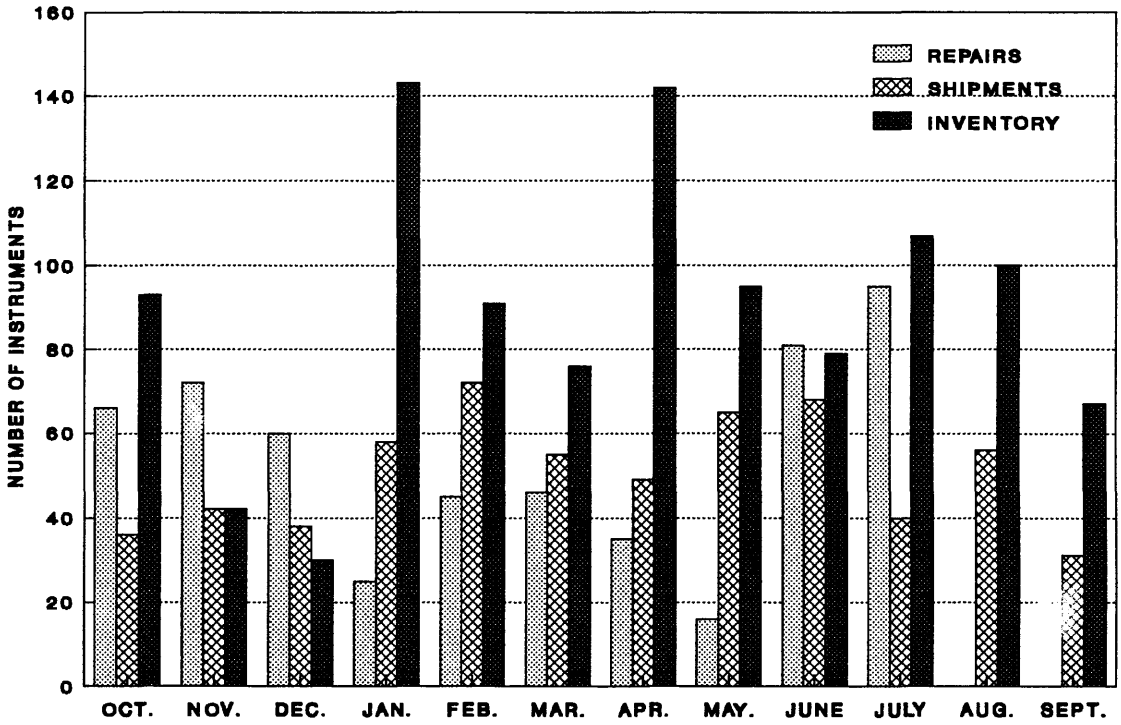

Figure 8. Repairs, shipments, and inventory of Fisher and Porter model 1542 analog-to-digital recorder by month.

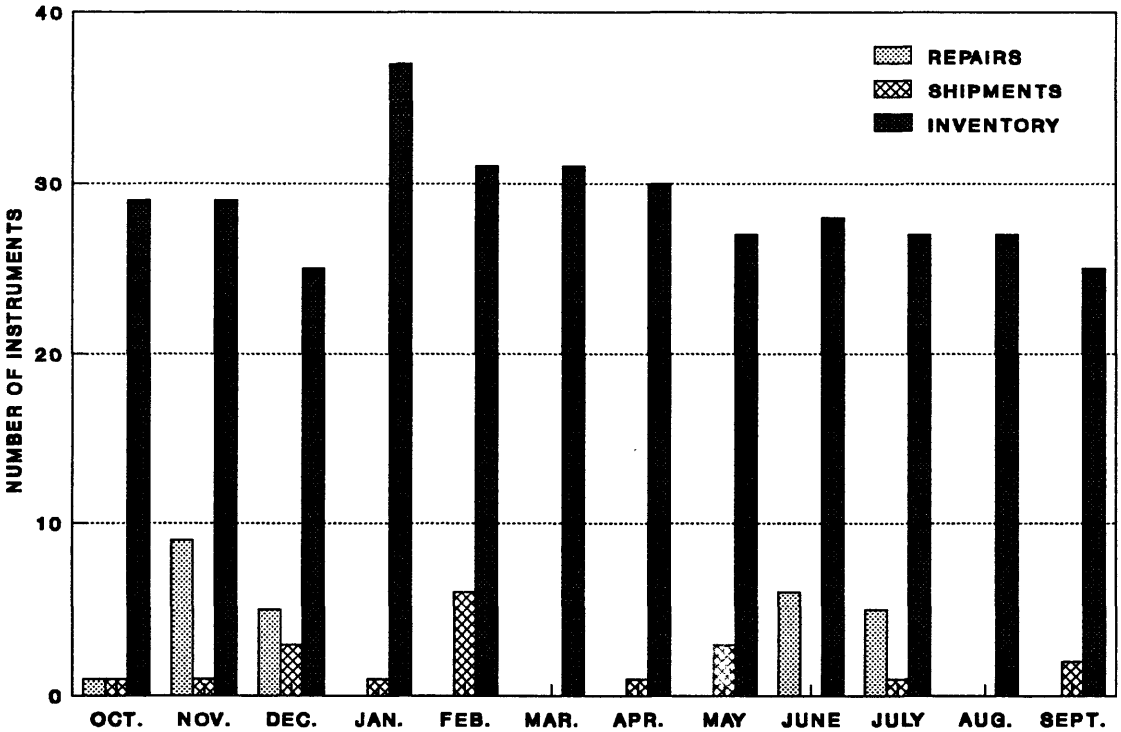

Figure 9. Repairs, shipments, and inventory of Fisher and Porter model 1542 analog-to-digital recorder with telekit by month.

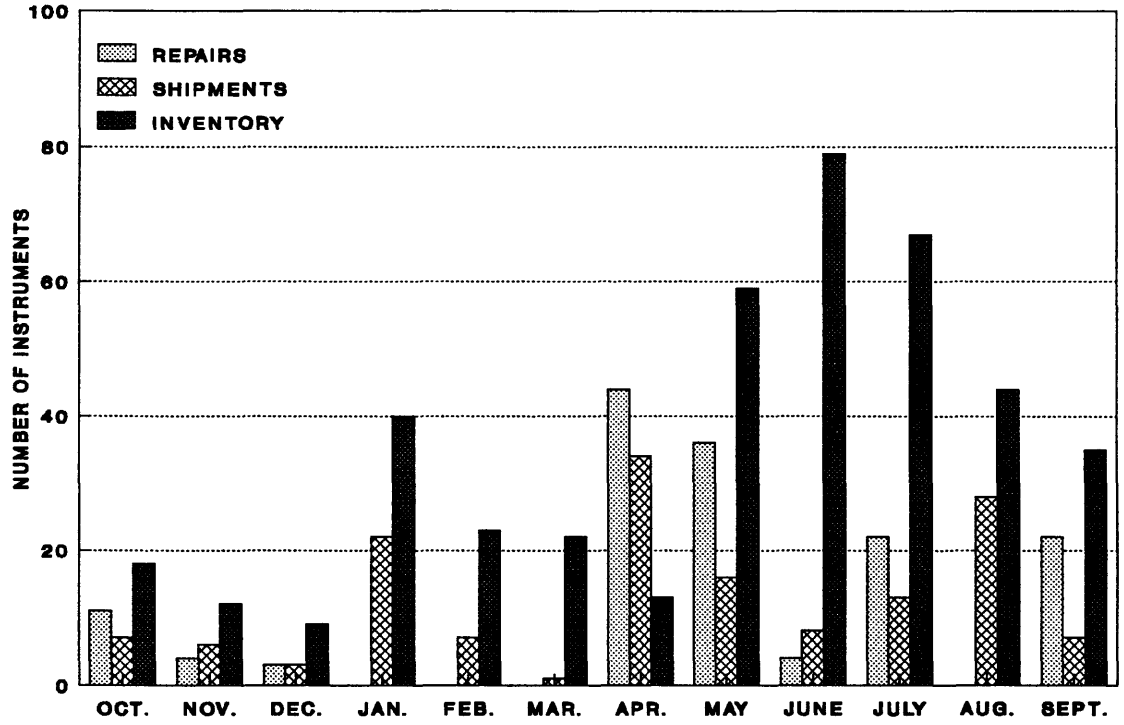

Figure 10. Repairs, shipments, and inventory of Leupold and Stevens model 7000 analog-to-digital recorder by month.

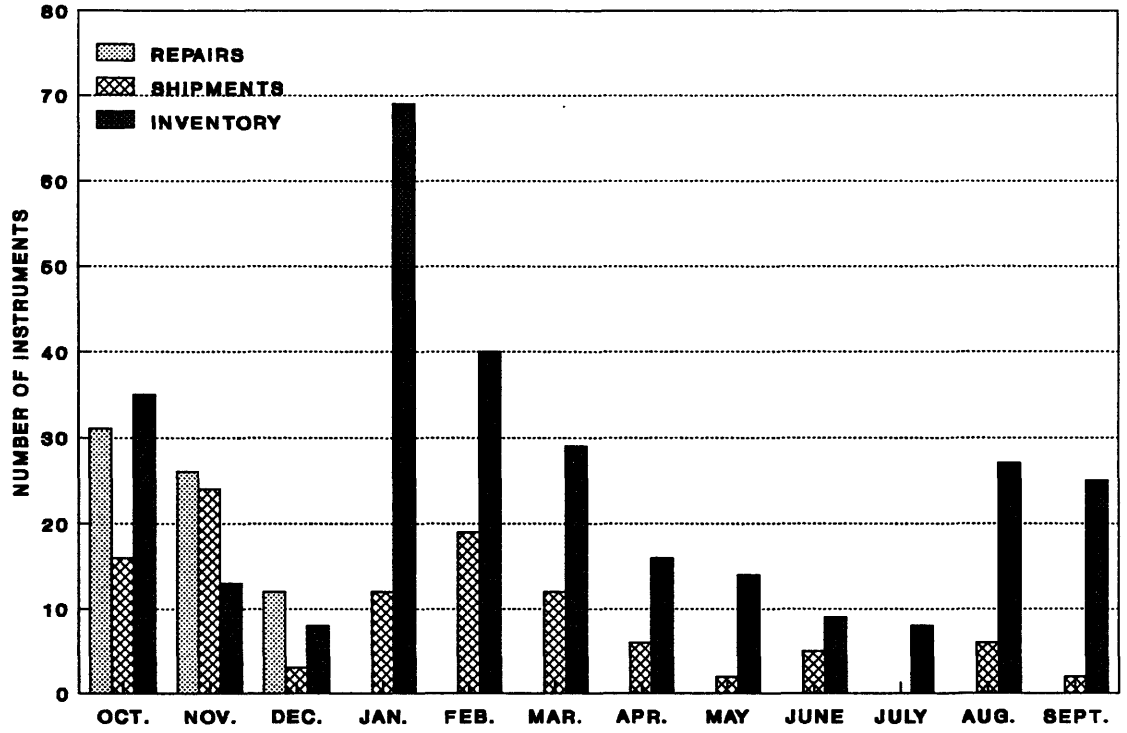

Figure 11. Repairs, shipments, and inventory of Leupold and Stevens model 7000 analog-to-digital recorder with module A by month.

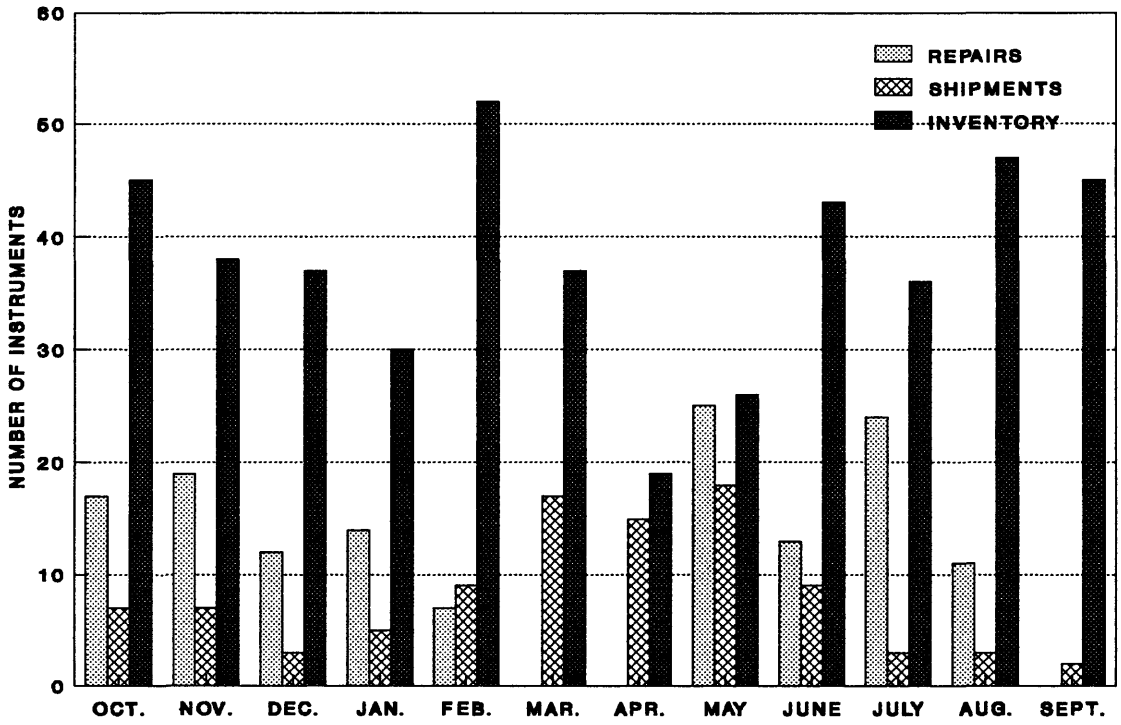

Figure 12. Repairs, shipments, and inventory of Leupold and Stevens model 7000 analog-to-digital recorder with input-output by month.

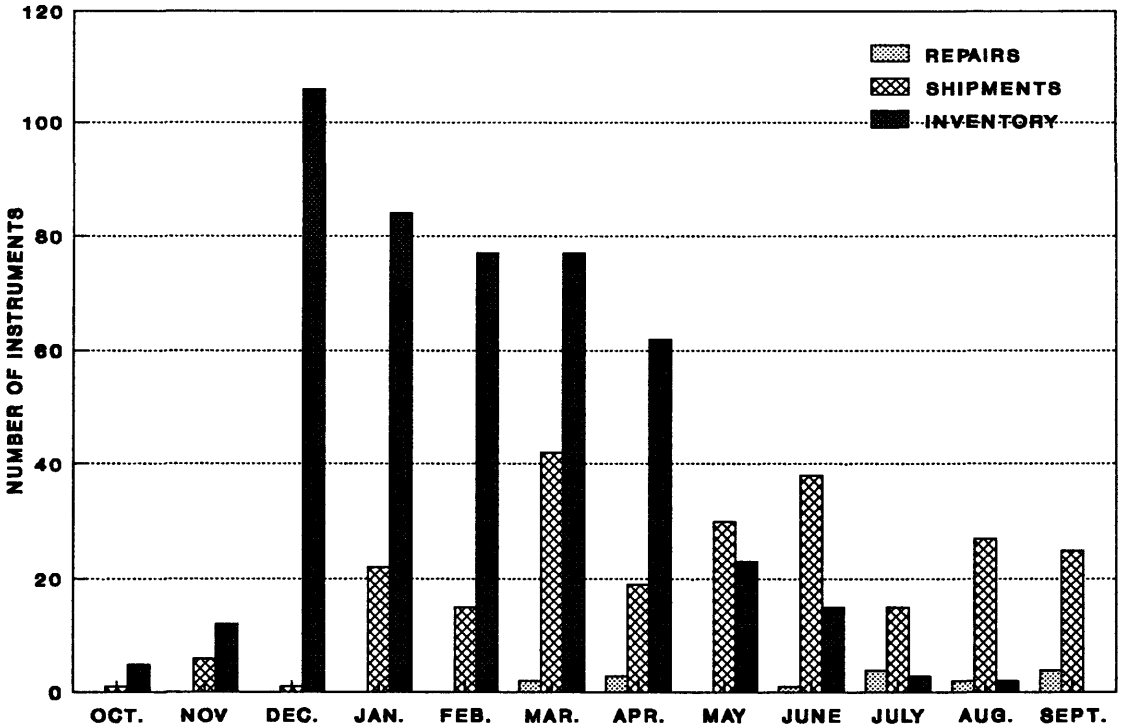

Figure 13. Repairs, shipments, and inventory of Campbell Scientific model CR10 basic data recorder by month.

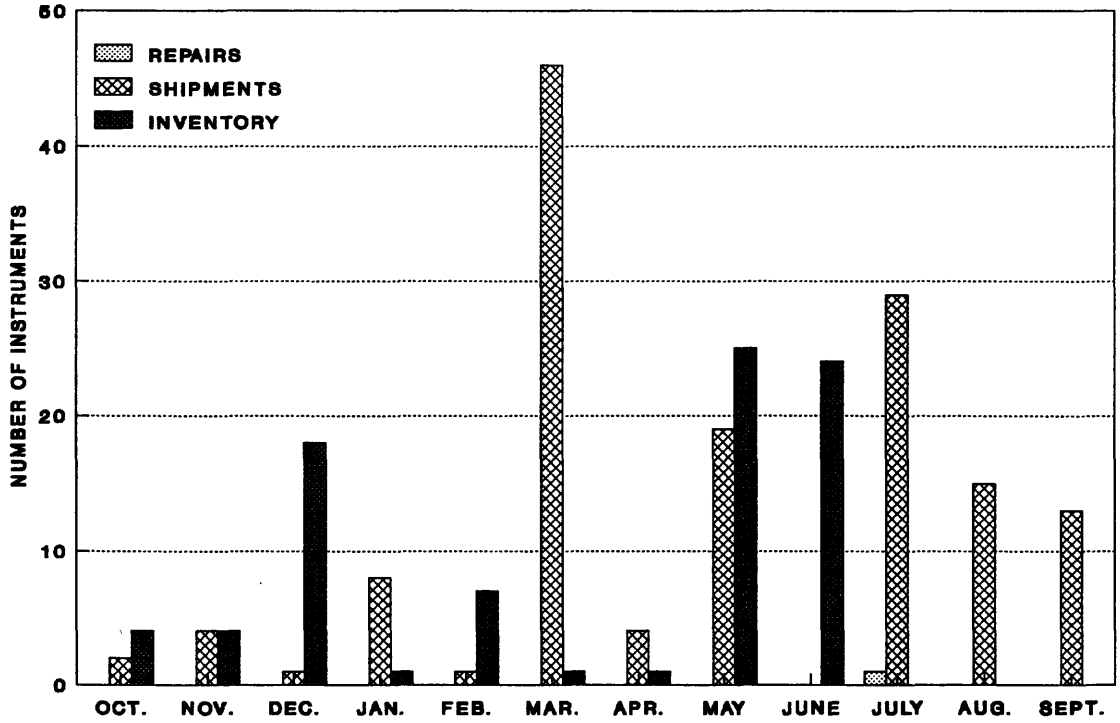

Figure 14. Repairs, shipments, and inventory of Campbell Scientific model 301 basic data recorder with junction box by month.

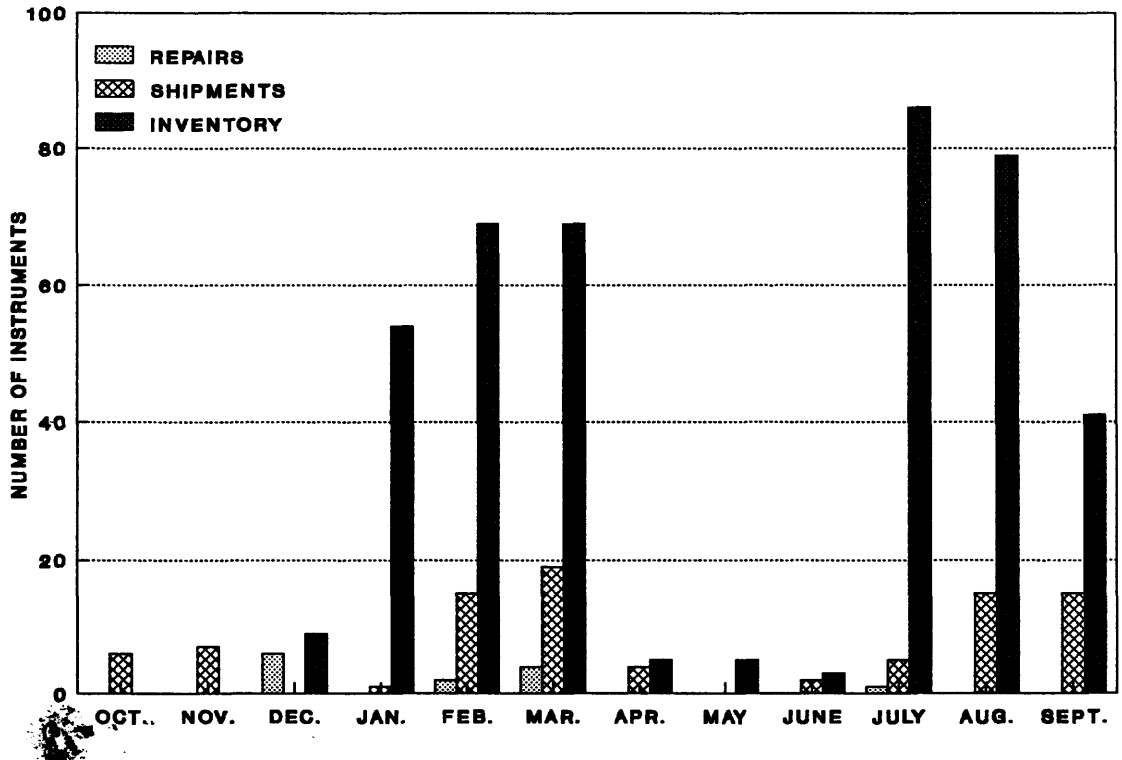

Figure 15. Repairs, shipments, and inventory of Environmental Systems Corporation model 80 basic data recorder with junction box by month.

APPENDIXES

APPENDIX 1. INSTRUMENTATION COMMITTEE AND INSTRUMENTATION TECHNICAL ADVISORY SUBCOMMITTEE MEMBERSHIP

INSTRUMENTATION COMMITTEE

Member	Title/Office represented
William G. Shope, Jr.	Chief, Branch of Instrumentation
Vito J. Latkovich	Chief, Hydrologic Instrumentation Facility
John V. Skinner	St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota
John M. Klein	Area Assistant Regional Hydrologist, California Pacific Area Program
Nick B. Melcher	District Chief, Iowa
Derrill J. Cowing	District Chief, Maine
Timothy W. Hale	District Chief, Georgia
Ernest D. Cobb	Office of Surface Water
Kenneth J. Hollett	Office of Ground Water
Harold C. Mattraw	Office of Water Quality
John C. Briggs	Office of Assistant Chief Hydrologist for Scientific Information Management
William N. Herkelrath	Regional Research, Western Region

INSTRUMENTATION TECHNICAL ADVISORY SUBCOMMITTEE

Member	Title/Office represented
Phillip W. Potter	Hydrologic Instrumentation Facility, Stennis Space Center, Mississippi
Wayne Rodman	Yucca Mountain Project, Lakewood, Colorado
Larry R. Shelton	National Water Quality Assessment, Sacramento, California
Robert L. Goemaat	Central Region, Oklahoma City, Oklahoma
Terrance E. Lamb	Southeastern Region, Little Rock, Arkansas
Hubert L. Reed	Southeastern Region, Rolla, Missouri
Richard L. Kraus	Western Region, Medford, Oregon
Richard D. Hayes	Western Region, Carson City, Nevada
Max S. Katzenbach	Northeastern Region, Columbus, Ohio
George M. Farlekas	Northeastern Region, Trenton, New Jersey
Kathleen R. Wilke	Central Region, Lakewood, Colorado

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APPENDIX 2. DISTRICT, SUBDISTRICT, AND FIELD OFFICE VISITS

Date	Office/Location	Personnel
Oct. 1991*	Central Region Lakewood, Colorado	V. J. Latkovich
Oct. 1991	Central Region Arvada, Colorado	V. J. Latkovich E. L. Ford
Oct. 1991	Southeastern Region Atlanta, Georgia	P. W. Potter
Oct. 1991	District Office Indianapolis, Indiana	P. W. Potter
Oct. 1991	Central Region Lakewood, Colorado	D. H. Rapp
Oct. 1991	Southeastern Region Atlanta, Georgia	J. C. Jones
Oct. 1991*	Project Office Minneapolis, Minnesota	V. J. Latkovich
Nov. 1991	Central Region Lakewood, Colorado	D. H. Rapp
Nov. 1991	Subdistrict Office Fort Worth, Texas	L. C. Colangione
Nov. 1991	Central Region Lakewood, Colorado	D. Y. Tai
Dec. 1991	Central Region Lakewood, Colorado	A. M. Sturrock
Dec. 1991	Central Region Lakewood, Colorado	J. C. Futrell
Dec. 1991	Field Office Tempe, Arizona	P. W. Potter
Dec. 1991*	District Office Columbia, South Carolina	V. J. Latkovich
Dec. 1991*	District Office, Raleigh North Carolina	V. J. Latkovich J. C. Jelinski
Dec. 1991	Southeastern Region Norcross, Georgia	D. Y. Tai
Dec. 1991	Central Region Lakewood, Colorado	B. J. Ourso
Jan. 1992*	District Office Jackson, Mississippi	S. L. Wilbourn P. W. Potter
Jan. 1992	Headquarters, Reston, Virginia	E. L. Ford F. S. Henry V. J. Latkovich
Jan. 1992*	Central Region Lakewood, Colorado	V. J. Latkovich R. H. Billings B. D. Brewer P. W. Potter F. S. Henry
Feb. 1992	Headquarters, Reston, Virginia	E. L. Ford
Feb. 1992	Central Region Lakewood, Colorado	R. H. Billings
Feb. 1992	National Training Center Lakewood, Colorado	R. A. Johnson P. W. Potter M. D. Szkolnik
Feb. 1992	Central Region Lakewood, Colorado	V. J. Latkovich R. H. Billings B. J. Ourso
Mar. 1992	Southeastern Region Atlanta, Georgia	E. L. Ford
Mar. 1992	District Office Oklahoma City, Oklahoma	E. L. Ford
Mar. 1992	Southeastern Region Atlanta, Georgia	P. D. Farrell
Apr. 1992†	Central Region Lakewood, Colorado	B. J. Ourso

DISTRICT, SUBDISTRICT, AND FIELD OFFICE VISITS—Continued

Date	Office/Location	Personnel
Apr. 1992	Headquarters, Reston, Virginia	E. L. Ford
Apr. 1992*	District Office Sacramento, California	R. H. Billings
Apr. 1992*	District Offices Maine, New York, and Pennsylvania	E. J. Parrozzo
Apr. 1992*	Field Site, Omaha, Nebraska	A. M. Sturrock
Apr. 1992*	Field Site, Omaha, Nebraska	P. H. Potter
Apr. 1992*	District Office Columbus, Ohio	D. Y. Tai
Apr. 1992	Headquarters, Reston, Virginia	G. E. Loman P. S. Tippett
Apr. 1992*	Subdistrict Office Miami, Florida	J. C. Futrell
Apr. 1992*	Subdistrict Office Memphis, Tennessee	D. H. Rapp
Apr. 1992	National Training Center Lakewood, Colorado	J. C. Jones D. C. Tracey
May 1992*	Subdistrict Office Las Vegas, Nevada	D. H. Rapp
May 1992	National Training Center Lakewood, Colorado	R. A. Johnson C. T. Scott
May 1992	Central Region Lakewood, Colorado	E. L. Ford
May 1992*	District/Field Offices Memphis, Tennessee Nashville, Tennessee Washington, North Carolina	E. J. Parrozzo
May 1992†	District Offices North and South Dakota and Minnesota	B. J. Ourso
May 1992*	Central Region Lakewood, Colorado	P.W. Potter
June 1992*	Project Office Idaho Falls, Idaho	A. M. Sturrock
June 1992*	Project Office Ocala, Florida	D. Y. Tai
June 1992	National Training Center Lakewood, Colorado	D. H. Rapp
June 1992*	National Training Center Lakewood, Colorado	D. Y. Tai
June 1992†	Central Region Lakewood, Colorado	B. J. Ourso
June 1992*	District Offices Indianapolis, Indiana Lansing, Michigan	E. J. Parrozzo
June 1992	Subdistrict Office Miami, Florid	R. H. Billings
June 1992	Headquarters, Reston, Virginia	E. L. Ford
July 1992	Headquarters, Reston, Virginia	E. L. Ford
July 1992	Field Site, Gary, Indiana	J. C. Futrell
July 1992	Central Region Lakewood, Colorado	J. C. Jelinski
July 1992	Field Sites North and South Dakota	E. J. Parrozzo
July 1992*	National Training Center Lakewood, Colorado	V. J. Latkovich R. H. Billings F. S. Henry R. A. Johnson D. H. Rapp S. L. Wilbourn F. S. Henry

DISTRICT, SUBDISTRICT, AND FIELD OFFICE VISITS—**Continued**

Date	Office/Location	Personnel
July 1992	Field Site Charleston, West Virginia	J. C. Futrell
July 1992	Central Region Lakewood, Colorado	E. L. Ford
July 1992	Headquarters, Reston, Virginia	F. S. Henry
Aug. 1992*	Subdistrict Office Tampa, Florida	S. L. Wilbourn M. D. Szkolnik J. C. Futrell R. H. Billings
Aug. 1992*	Central Region Lakewood, Colorado	V. J. Latkovich R. H. Billings P. H. Potter
Aug. 1992*	Northeastern Region Herndon, Virginia	V. J. Latkovich B. J. Ourso
Aug. 1992	Field Sites Youngstown, Ohio Columbus, Ohio New Philadelphia, Ohio	M. D. Szkolnik
Aug. 1992	Central Region Lakewood, Colorado	E. L. Ford
Aug. 1992	Field Site Elizabeth City, North Carolina	J. C. Futrell
Aug. 1992*	National Training Center Lakewood, Colorado	R. A. Johnson C. T. Scott
Sept. 1992	Central Region, Lakewood, Colorado	E. L. Ford
Sept. 1992	Field Site Corpus Christi, Texas	J. C. Futrell
Sept. 1992	Central Region Lakewood, Colorado	J. C. Jelinski
Sept. 1992	District Office Bismarck, North Dakota	R. A. Johnson C. T. Scott P. W. Potter
Sept. 1992	District Office St. Paul, Minnesota	P. S. Tippett

*HIF presentation
†QIC presentation

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APPENDIX 3. PROFESSIONAL AND TECHNICAL MEETINGS ATTENDED BY HYDROLOGIC INSTRUMENTATION FACILITY PERSONNEL

Date	Meeting	Attendee(s)
Oct. 1991*	Oceans-91 Conference Honolulu, Hawaii	J. C. Futrell
Nov. 1991	SCAN-Tech 91 Seminar Dallas, Texas	E. L. Ford
Nov. 1991*	Annual USGS-TVA Program Conference Memphis, Tennessee	V. J. Latkovich
Dec. 1991	SR System Administrator Meeting Orlando, Florida	E. L. Ford C. P. Nelson
Jan. 1992	Joint meeting of USGS/ National Ocean Service Rockville, Maryland	V. J. Latkovich R. H. Billings
Jan. 1992	ASCE Hydraulics Division Technical Committee Meeting Denver, Colorado	V. J. Latkovich
Mar. 1992	Pittsburgh Conference (PITCON) New Orleans, Louisiana	D. Y. Tai L. A. Garcia
Mar. 1992	Power Supply, Protection, and Grounding of Electronic Data- Acquisition Equipment Workshops Calgary, Alberta, and Guelph, Ontario, Canada	T. E. Olive
Apr. 1992	38th International Instrumentation Symposium, Instrument Society of America Las Vegas, Nevada	D. H. Rapp
May 1992†	National Computer Technology Meeting (NCTM) and Adminis- trative Information System (AIS) Review Board Meeting Norfolk, Virginia	E. L. Ford C. P. Nelson
Apr. 1992*	Office of Surface Water 1992 Meeting Memphis, Tennessee	D. H. Rapp
Apr. 1992	Bar Code Committee Meeting and Software Issues Team Meetings Reston, Virginia	E. L. Ford
May 1992	OPM Human Resources Management Conference Atlanta, Georgia	V. J. Latkovich
May 1992*	Urban Stormwater Workshop San Antonio, Texas	P. W. Potter
May 1992*	Mid-Atlantic District Conference Canaan Valley, West Virginia	S. L. Wilbourn
May 1992*	USGS/Department of Defense Environmental Contamination Program Exhibit Las Vegas, Nevada	D. Y. Tai L. A. Garcia
May 1992	NASA-Local Business Ceremony Stennis Space Center, Mississippi	V. J. Latkovich
May 1992*	Central Region District Chiefs' Meeting Lakewood, Colorado	E. L. Ford
May 1992	DOI Safety Seminar San Francisco, California	B. D. Brewer
May 1992	American Management Association Right Sizing Seminar Chicago, Illinois	V. J. Latkovich
June 1992	National Prime User Group 16th Annual Conference San Francisco, California	E. J. Nilsson

PROFESSIONAL AND TECHNICAL MEETINGS ATTENDED BY HYDROLOGIC INSTRUMENTATION FACILITY PERSONNEL—**Continued**

Date	Meeting	Attendee(s)
June 1992	OSHA Conference Gulfport, Mississippi	V. J. Latkovich B. D. Brewer
July 1992	1992 Southeastern Region Total Quality Management Conference Atlanta, Georgia	V. J. Latkovich B. J. Ourso
Sept. 1992	Instrumentation Management Advisory Committee Meeting Williamsburg, Virginia	V. J. Latkovich
Sept. 1992*	Water Resources Branch Environment Canada Calgary, Alberta, Canada	V. J. Latkovich R. H. Billings

*HIF presentation/technical paper
†Exhibit

APPENDIX 4. VENDOR VISITS BY HIF PERSONNEL

Date	Vendor/Location	Personnel
Dec. 1991	RDI San Diego, California	R. H. Billings F. S. Henry
Dec. 1991	Handar, Inc. Sunnyvale, California	R. H. Billings F. S. Henry
Dec. 1991	ACRO Silver Springs, Nevada	R. H. Billings F. S. Henry
Dec. 1991	Design Analysis Logan, Utah	R. H. Billings F. S. Henry
Dec. 1991	Omni Data Logan, Utah	R. H. Billings F. S. Henry
Dec. 1991	Handar, Inc. Sunnyvale, California	C. W. Willett M. Carpenter
Feb. 1992	Omnidata International Logan, Utah	R. H. Billings
Feb. 1992	Design Analysis Associates Logan, Utah	R. H. Billings
Apr. 1992	O.R.E. International Falmouth, Massachusetts	E. J. Parrozzo
May 1992	O.R.E. International Falmouth, Massachusetts	J. C. Futrell
May 1992	Handar, Inc. Sunnyvale, California	B. D. Brewer
May 1992	Paravant Computers West Melbourne, Florida	R. H. Billings F. S. Henry
June 1992	Environmental Systems Corp. Knoxville, Tennessee	R. H. Billings
June 1992	Paravant Computers West Melbourne, Florida	R. H. Billings F. S. Henry M. D. Szkolnik
July 1992	Design Analysis Systems Logan, Utah	R. H. Billings

(p. 45 follows)

APPENDIX 5. REPORTS BY HYDROLOGIC INSTRUMENTATION FACILITY PERSONNEL

Anderson, C.E., 1992, Hydrologic Instrumentation Facility Technical Information Sheet for care and handling of minimonitor pH combination electrode (ISI model 11), 2 p.

Billings, R.H., 1985, An adaptable hydrologic data acquisition system: American Geophysical Union 1985 Fall Meeting, December 9-13, 1985, San Francisco, California, Proceedings.

Billings, R.H., and Latkovich, V.J., 1982, An adaptable hydrologic data acquisition system: International Symposium on Hydrometeorology, Denver, Colorado, June 13-17, Proceedings.

———1984, Modular hydrologic data acquisition and real-time communications instrumentation: American Water Resources Association Symposium, Seattle, Washington, June 11-13, Proceedings.

Brewer, B.D., ed., 1990 and 1991, WRD Instrument News: Hydrologic Instrumentation Facility, Nos. 49, 50, 51, 52, and 53.

Ciegler, J.C., 1984, Operating manual for the HIF-CSS, vol. I: users guide: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 9-84-01, 104 p.

———1985, Data element dictionary for the HIF-CSS: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 9-85-03, 162 p.

———1985, Operating manual for the HIF-CSS, vol. II: warehouse guide: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 9-85-01, 60 p.

———1985, Operating manual for the HIF-CSS, vol. III: administrators guide: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 9-85-04, 74 p.

———1985, Program descriptions for the HIF-CSS: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 9-85-02, 774 p.

———1985, Flowcharts for the HIF-CSS: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 9-85-05, 116 p.

Coon, W.F., and Futrell, J.C. II, 1986, Evaluation of wet-line depth-correction methods for cable-suspended current meters: U.S. Geological Survey Water-Resources Investigations Report 85-4329, 31 p.

Cordes, E.H., 1984, Ground-water instrumentation program: Second National Symposium and Exhibition on Ground-Water Instrumentation, Las Vegas, Nevada, April 2-4, Proceedings.

———1988, Operating manual for the R100 digital vibration-time totalizer: U.S. Geological Survey Open-File Report 88-454, 8 p.

Ficken, J.H., 1980, Troubleshooting probe problems on the USGS servo programmer with a conductivity meter: Reston, Va., U.S. Geological Survey WRD Bulletin, April-June 1980, p. 4.

———1985, Instrumentation for automatically monitoring sediment concentration and particle size - a progress report, *in* Glysson, G. Douglas, ed., Proceedings of the Advanced Seminar on Sedimentation, August 15-19, 1983, Denver, Colorado: U.S. Geological Survey Open-File Report 85-98, p. 14.

———1986, Instruments for measuring suspended sediment: Fourth Interagency Sedimentation Conference, Las Vegas, Nevada, 1986, Proceedings.

———1988, Recent development of downhole samplers for trace organics *in* Special Technical Publication 96 31988: American Society for Testing and Materials, Philadelphia, Pennsylvania, p. 253-257.

Ficken, J.H., and Rorabaugh, J.I., 1980, USGS Minimonitor: Reston, Va., U.S. Geological Survey WRD Bulletin, April-June 1980, p. 1.

Ficken, J.H., and Scott, C.T., 1980, Improved dissolved oxygen record on automatic water-quality monitors by installation of velocity tube in sample chamber: Reston, Va., U.S. Geological Survey WRD Bulletin, April-June 1980, p. 4.

———1984, Operating manual for the USGS Minimonitor: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 6-83-02, 71 p.

———1984, Feasibility of monitoring toxicity in streams: HIF technical report on file at Quality of Water Branch, Reston, Virginia, 21 p.

———1984, Operating manual for the ultrasonic ranger: U.S. Geological Hydrologic Instrumentation Facility operating manual 1-84-01, 15 p.

———1988, Operating manual for the U.S. Geological Survey Minimonitor, 1988 revised edition, punched-paper-tape model: U.S. Geological Survey Open-File Report 88-491, 76 p.

———1989, Operating manual for the U.S. Geological Survey minimonitor, 1988 revised edition, analog-voltage model: U.S. Geological Survey Open-File Report 89-403, 188 p.

Ficken, J.H., Sonntag, W.H., and Boettcher, A.J., 1985, Recent developments of downhole samplers for trace organics: Southeastern Region Water Quality Symposium, Jacksonville Beach, Florida, January 29 - February 1, Proceedings.

———1988, Recent developments in downhole samplers for organic and volatile compounds in ground water *in* U.S. Geological Survey program on toxic waste-ground-water contamination: Proceedings of the second technical meeting, Cape Cod, Massachusetts, October 21-25, 1985, Ragone, S.E., ed.: U.S. Geological Survey Open-File Report 86-481, p. F-5 - F-8.

Ficken, J.H., and Tai, D.Y., 1989, Activities of the U.S. Geological Survey's Hydrologic Instrumentation Facility in support of hazardous- and toxic-substances programs *in* U.S. Geological Survey Toxic Substances Hydrology Program—Proceedings of the Technical Meeting, Phoenix, Arizona, September 26-30, 1988, G.E. Mallard and S.E. Ragone, ed.: U.S. Geological Survey Water-Resources Investigations Report 88-4220, p. 625-631.

Ford, E.L., ed., 1989 through 1990, WRD Instrument News: Hydrologic Instrumentation Facility, Nos. 47 and 48.

Futrell, J.C. II, 1983, Operating manual for the modified P-61 sampler and the BP-76 control unit: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 4-83-01, 9 p.

———1985, Current meter digitizer: What's new about version 1.4: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 6-84-03, addendum, 5 p.

———1985, Operating the Kevlar line marking machine: Hydrologic Instrumentation Facility internal report, 31 p.

———1985, Prototype cable-car lock installation and removal: Hydrologic Instrumentation Facility instruction pamphlet, 4 p.

———1986, Ice metering system and ice chisels: Sixth International Northern Research Basins Symposium Proceedings, Houghton, Michigan.

———1987, Hydrologic Instrumentation Facility Technical Information Sheet for servicing of USGS sounding reel, 2 p.

———1987, Hydrologic Instrumentation Facility Technical Information Sheet for wading tag-line reel, 2 p.

———1987, Hydrologic Instrumentation Facility Technical Information Sheet for use of model II AA tail-fin assembly, 1 p.

———1987, Hydrologic Instrumentation Facility Technical Information Sheet for installation and use of the CMD adapter, 2 p.

———1987, Hydrologic Instrumentation Facility Technical Information Sheet for USGS ice chisel, 2 p.

———1988, Hydrologic Instrumentation Facility Technical Information Sheet for wire-weight gage reading instructions, 2 p.

———1989, Hydrologic Instrumentation Facility Technical Information Sheet for electric tape gage installation, 2 p.

———1989, Hydrologic Instrumentation Facility Technical Information Sheet for care and maintenance of optic-head meters, 16 p.

———1989, Hydrologic Instrumentation Facility Technical Information Sheet for P-Pygmy Current Meters, 2 p.

———1989, Hydrologic Instrumentation Facility Technical Information Sheet for wading tag-line reel, revision, 3 p.

———1991, Hydrologic Instrumentation Facility Technical Information Sheet for the use of model II AA tail-fin assembly, revision, 1 p.

Futrell, J.C., and Latorre, R., 1991, Preliminary design of low-velocity current-meter rating facility: Oceans 91 Conference of the Institute of Electrical and Electronics Engineers, Honolulu, Hawaii, October 1-3, Proceedings.

Hardee, J., 1983, Operating manual for the urban hydrology monitoring system: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 6-83-01, 41 p.

———1990, Hydrologic Instrumentation Facility Technical Information Sheet for standard orifice static tube, 4 p.

Healy, R.W., deVries, M.P., and Sturrock, A.M., Jr., 1987, Evapotranspiration and microclimate at a low-level radioactive-disposal site in northwestern Illinois: U.S. Geological Survey Open-File Report 86-301, Urbana, Illinois, 88 p.

———1989, Evapotranspiration and microclimate at a low-level radioactive-waste disposal site in northwestern Illinois: U.S. Geological Survey Water-Supply Paper 2327, 44 p.

Henry, F.S., Rickly, S.E., Vaughn, E.C., 1988, Hydrologic Instrumentation Facility Drafting Manual: Hydrologic Instrumentation Facility Internal Report, 182 p.

Holland, R.R., and Rapp, D.H., 1988, Results of qualification tests on water-level sensing instruments, 1986: U.S. Geological Survey Open-File Report 88-193, 34 p.

Hydrologic Instrumentation Facility, 1982, Environmental specifications for field monitoring equipment HIF-E-1: Hydrologic Instrumentation Facility specification, 36 p.

———1982, Power Study System: Hydrologic Instrumentation Facility internal report, 25 p.

———1983, Annual report 1981-82: Hydrologic Instrumentation Facility internal report, 104 p.

———1983, Specifications and guidelines for electrification of WRD gage houses: Hydrologic Instrumentation Facility unnumbered report, 20 p.

———1984, Annual report 1983: Hydrologic Instrumentation Facility internal report, 129 p.

———1984, Instrumentation for today and tomorrow: The U.S. Geological Survey's Hydrologic Instrumentation Facility: Hydrologic Instrumentation Facility circular, 6 p.
———1985, Annual report 1984: Hydrologic Instrumentation Facility internal report, 129 p.
———1985, Annual report 1985: Hydrologic Instrumentation Facility internal report, 131 p.
———1986, Annual report 1986: Hydrologic Instrumentation Facility internal report, 114 p.
———1987, Annual report 1987: Hydrologic Instrumentation Facility internal report, 71 p.
———1988, Annual report 1988: Hydrologic Instrumentation Facility internal report, 54 p.
———1989, Annual report 1989: Hydrologic Instrumentation Facility internal report, 62 p.
———1990, Annual report 1990: Hydrologic Instrumentation Facility internal report, 72 p.
———1988, WRD instrumentation catalog (revision): Hydrologic Instrumentation Facility internal report, 211 p.
———1990, The U.S. Geological Survey's Hydrologic Instrumentation Facility: Hydrologic Instrumentation Facility circular, 6 p.
Instrument Development Laboratory, 1973, General and accessory hydrologic instrumentation:Instrument Development Laboratory, unnumbered report, 16 p.
———1983, Instrumentation for measuring and recording streamflow data at river-control structures: U.S. Geological Survey Open-File Report 83-872, 29 p.
———1984, Operating manual for installation of electrical power service: implementation guide: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 7-84-02, 24 p.
Jeffers, S.R., and Wagner, C.R., 1984, The Water Resources Division water-level recorder program - history and operation: U.S. Geological Survey Open-File Report 84-735, 16 p.
Jelinski, J.C., 1988, Hydrologic Instrumentation Facility Technical Information Sheet for installing a mercury overflow kit on the USGS screw-type manometer, 8 p.
———1989, Hydrologic Instrumentation Facility Technical Information Sheet for B-Connector Brass Bushing Retrofit Kit, 1 p.
Johnson, R.A., 1987, "The Series 310 Recorder," Proceedings of the 1987 American Geophysical Union Spring Meeting, May 18-22, 1987, Baltimore, Maryland, 1 p.
———1988, Hydrologic Instrumentation Facility Technical Information Sheet for the R200 downhole recorder, 4 p.
Johnson, R.A, and Rorabaugh, J.I., 1988, Operating manual for the R200 downhole recorder with Husky Hunter retriever: U.S. Geological Survey Open-File Report 88-455, 11 p.
———1988, Operating manual for the R200 downhole recorder with Tandy 102 retriever: U.S. Geological Survey Open-File Report 88-488, 113 p.
Jones, J.C., Tracey, D.C., and Sorensen, F.W., eds., 1991, Operating manual for the U.S. Geological Survey's data-collection system with the geostationary operational environmental satellite: U.S. Geological Survey Open-File Report 91-99, 237 p.
Kilpatrick, F.A., Kaehrle, W.R., Hardee, J.H., Cordes, E.H., and Landers, M.N., 1985, Development and testing of highway storm-sewer flow measurement and recording system: U.S. Geological Survey Water Resources Investigations Report 85-4111, 98 p.
Knott, S.A., and Rapp, D. H., 1985, Specification for the procurement of in situ and field pH meters and pH electrodes: Hydrologic Instrumentation Facility specification HIF-P-08, 12 p.
Latkovich, V.J., 1985, Recent developments in hydrologic instrumentation: American Society of Civil Engineers Hydraulics Division Symposium, Orlando, Florida, August 13-16, Proceedings.
———1992, Hydrologic Instrumentation Facility of the U.S. Geological Survey annual report for fiscal year 1992: U.S. Geological Survey Open-File Report 92-132, 76 p.*
———1992, New pressure-based water-level sensor used by the U.S. Geological Survey: U.S. Geological Survey Open-File Report 92-134, 6 p.*
Latkovich, V.J., and Futrell, J.C. II, 1986, Recent developments in hydrologic instrumentation: American Water Resources Association Cold Regions Hydrology Symposium Proceedings, Fairbanks, Alaska.
Latkovich, V.J., Rorabaugh, J.I., Sharp, K.V., Cordes, E.H., and Jelinski, J.C., 1983, Ground-water monitoring system: International Symposium on Methods and Instrumentation for the Investigation of Ground-Water Systems, The Hague, Netherlands, Proceedings, 12 p.
Latkovich, V.J., and Shope, W.R., 1990, New hydrologic instrumentation in the U.S. Geological Survey: American Society of Civil Engineers, 6th International Cold Regions Engineering Specialty Conference, Hanover, New Hampshire, February 26-28, 1991, Proceedings.
Nichols, W.D., and Sturrock, A.M., 1988, Averaged hourly energy budget fluxes measured over cotton, alfalfa, and bare soil, at the Maricopa Agricultural Center, Maricopa, Arizona, June 11-12, 1988: paper, p. 31.
Olive, T.E., 1989, Results of qualification tests on water-level sensing instruments, 1987: U.S. Geological Survey Open-File Report 89-397, 37 p.
Parrozzo, E.J., 1990, Hydrologic Instrumentation Facility Technical Information Sheet for universal junction box, 4 p.
———1990, Hydrologic Instrumentation Facility Technical Information Sheet for Campbell Scientific, Inc. Model 301 cable kit, 4 p.

———1990, Hydrologic Instrumentation Facility Technical Information Sheet for Environmental Systems Corporation Model 80 cable kit, 4 p.

———1991, Hydrologic Instrumentation Facility Technical Information Sheet for installing electrical surge arrester, 5 p.

———1991 (rev. 92), Hydrologic Instrumentation Facility Technical Information Sheet for Campbell Scientific, Inc. Model 301 cables, 4 p.*

———1991 (rev. 92), Hydrologic Instrumentation Facility Technical Information Sheet for Environmental Systems Corporation Model 80 cables, 4 p.*

Rapp, D.H., 1982, Specification for procurement of water-level sensing instrumentation, specification number HIF-I-1: U.S. Geological Survey Open-File Report 82-89, 24 p.

———1983, HIF-I-1 Amendment-1, April 20, 1983, U.S. Geological Survey, Water Resources Division specification instrumentation, water-level sensing, 2 p.

———1985, Test facility for pressure transducer evaluation: Marine Technology Society Symposium Proceedings, New Orleans, Louisiana, May 1-3, 1985, p. 38-40.

———1986, U.S. Geological Survey's qualification program for water-level sensing instruments: Marine Data Systems International Symposium proceedings, New Orleans, Louisiana, p. 364-366.

———1991, New serial digital interface for pressure sensors acquired by the U.S. Geological Survey: American Water Resources Association 27th Annual Conference Water Management of River Systems and Symposium, New Orleans, Louisiana, September 8-13, Proceedings.

Rapp, D.H., McDonald, B.L., and Hughes, R.M., 1985, Results of qualification tests on water-level sensing instruments: U.S. Geological Survey Open-File Report 85-199, 47 p.

———1985, Results of qualification tests on water-level sensing instruments, 1984-85: U.S. Geological Survey Open-File Report 85-489, 18 p.

Rapp, W.L., 1986, Operating manual for the miniservo-control tester: U.S. Geological Survey Open-File Report 85-690, 7 p.

Rathbun, R.E., and Tai, D.Y., 1988, Volatilization of benzene and eight alkyl-substituted benzene compounds from water: U.S. Geological Survey Water Supply Paper 2342, 24 p.

Rathbun, R.E., Stephens, D.W., Shultz, D.J., and Tai, D.Y., 1988, Fate of acetone in an outdoor model stream in southern, Mississippi, U.S.A. *in* Journal of Hydrology, 104, Amsterdam, p. 181-209.

Reddy, M.M., Liebermann, T.D., Jelinski, J.C., and Caine, T.N., 1983, Precipitation pH during summer storms on the Continental Divide in Central Colorado: National Atmospheric Deposition Program meeting, Knoxville, Tenn., November 6-10, 1983.

———1985, Variation in the pH during summer storms near the continental divide in central Colorado: February 1985, Arctic and Alpine Research, v. 17, no. 1, p. 79-88.

Rickly, S.E., 1990, History of the applications and development section of the Hydrologic Instrumentation Facility, Stennis Space Center, Mississippi: U.S. Geological Survey Open-File Report 90-380, 66 p.

Rodman, W., 1985, Quality Assurance Manual: Hydrologic Instrumentation Facility, 129 p.

Rodman, W., ed., 1984 through 1988, WRD Instrument News: Hydrologic Instrumentation Facility, Nos. 24 through 29 and 32 through 46.

Rodman, W., and Wheat, J.T., 1985, Operating manual for the hydraulic power unit: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 2-85-02, 21 p.

Rorabaugh, J.I., 1979, Electromagnetic flowmeter interface: U.S. Geological Survey Hydrologic Instrumentation Facility unnumbered operating manual, 10 p.

———1980, Electronic times for analog-to-digital recorders: U.S. Geological Survey WRD Bulletin, April-June 1980, p. 2.

———1985, Operating manual for the USGS shaft encoder/interface: Hydrologic Instrumentation Facility operating manual 85-01, 7 p.

Rorabaugh, J.I., and Rapp, W.L., 1985, Operating manual for the USGS regulator: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 7-84-04, 17 p.

———1986, Operating manual for the digital data-collection system for flow-control structures: U.S. Geological Survey Open-File Report 85-691, 39 p.

Rosenberry, D.O., Sturrock, A.M., Scarborough, J.L., and Winter, T.C., 1988, Climatic data for Williams Lake, Hubbard County, Minnesota, 1982: U.S. Geological Survey Open-File Report 88-89, 43 p.

Rosenberry, D.O., Sturrock, A.M., and Winter, T.C., 1988, Climatic data for Williams Lake, Hubbard County, Minnesota, 1986: U.S. Geological Survey Open-File Report 88-304, 38 p.

Sasser, D.C., Sturrock, A.M., Jr., and Covay, K.J., Meteorological and microlysimeter data for a rice irrigation study in southwestern Louisiana, 1985 and 1986: state cooperator report, 37 p.

Schneider, V.R., and Futrell, J.C., II, 1984, Performance of ice meter and weight assemblies: U.S. Geological Survey Water-Resources Investigations Report 84-4035, 26 p.

Sharp, K.V., and Rapp, W.L., 1984, Operating manual for the current meter digitizer (software version 1.2): U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 6-84-03, 8 p.

Sharp, K.V., Higgins, W.B., and Bartlett, W.P., Jr., Operating manual for the rechargeable 12-volt power system: implementation guide: U.S. Geological Survey Hydrologic Instrumentation Facility operating manual 7-83-01, 47 p.

Snell, W.H., 1991, Hydrologic Instrumentation Facility Technical Information Sheet for the B-56 reel brake adjustment, 4 p.

———1992, Hydrologic Instrumentation Facility Technical Information Sheet for the Accusonic Ultrasonic Velocity Meter Model 7300, 8 p.*

———1992, Hydrologic Instrumentation Facility Technical Information Sheet for the Handar Shaft encoder models 436A, 436B, 4 p.*

———1992, Hydrologic Instrumentation Facility Technical Information Sheet for the Environmental Systems Corporation Model 80 (ESC 80) Basic Data Recorder, 4 p.*

———1992, Hydrologic Instrumentation Facility Technical Information Sheet for the Campbell Scientific, Inc. Model 301 Basic Data Recorder, 5 p.*

———1992, Hydrologic Instrumentation Facility Technical Information Sheet for the PS-2 Pressure Sensor, 4 p.*

Sturrock, A.M., Jr., 1984, Instrumentation for measuring lake and reservoir evaporation by the energy-budget and mass-transfer methods: U.S. Geological Survey Open-File Report 84-863, 21 p.

———1985, Measurement of the variation of atmospheric precipitation in Mississippi: Southeastern Region Water Quality Symposium, Jacksonville Beach, Florida, January 29 - February 1, Proceedings.

Sturrock, A.M., Jr., Buso, D.C., Diever, G.M., Engelbrecht, L.G., and Winter, T.C., 1984, Climatic data for Mirror Lake, West Thornton, New Hampshire, 1981-82: U.S. Geological Survey Open-File Report 84-816.

Sturrock, A.M., Jr., Buso, D.C., Scarborough, J.L., and Winter, T.C., 1986, Climatic data for Mirror Lake, West Thornton, New Hampshire, 1984: U.S. Geological Survey Open-File Report 86-134, 70 p.

———1988, Climatic data for Mirror Lake, West Thornton, New Hampshire, 1986: U.S. Geological Survey Open-File Report 88-494, 68 p.

———1988, Climatic data for Mirror Lake, West Thornton, New Hampshire, 1985: U.S. Geological Survey Open-File Report 87-682, 64 p.

Sturrock, A.M., Jr., and Jelinski, J.C., 1984, An instrument to automatically measure and record the magnitude, conductivity, pH, and temperature of precipitation during storms: Proceedings of 40th Eastern Snow Conference, Torrent, Canada, June 2-3, p. 102-105.

Sturrock, A.M., Hanson, B.A., Scarborough, J.L., and Winter, T.C., 1986, Climatic data for the Cottonwood Lake area, Stutsman County, North Dakota, 1982: U.S. Geological Survey Open-File Report 86-477, 24 p.

———1987, Climatic data for the Cottonwood Lake area, Stutsman County, North Dakota: U.S. Geological Survey Open-File Report 87-216, 28 p.

Sturrock, A.M., Jr., Rosenberry, D.O., Engelbrecht, L.G., Gothard, W.A., and Winter, T.C., 1984, Climatic data for Williams Lake, Hubbard County, Minnesota, 1983: U.S. Geological Survey Open-File Report 84-247.

Sturrock, A.M., Jr., Nichols, W.D., 1991, Measurements of vapor pressure over natural vegetation at a high desert site in southeastern Arizona: United States-People's Republic of China Bilateral Symposium on Droughts and Arid-Region Hydrology, Tucson, Arizona, September 16-20, Proceedings.

Tai, D.Y., and Rathbun, R.E., 1988, Photolysis of Rhodamine-WT dye *in* Chemosphere, v. 17, no. 3: Pergamon Journals Ltd., Great Britain, p. 559-573.

Tai, D.Y., Turner, K.S., and Garcia, L.A., 1990, The use of a standpipe to evaluate ground-water samplers in Ground Water Monitoring Review, vol. 11, no. 1, Water Well Publishing Co., Dublin, Ohio, p. 125-132.

Tai, D.Y., Jennings, M.E., White, K.D., and Garcia, L.A., 1991, Evaluation of a modified automatic sampler for the collection of water samples for analysis of trace organic compounds or suspended sediment: U.S. Geological Survey Open-File Report 91-469, 26 p.

Thibodeaux, K.G., and Futrell, J.C., II, 1987, The effects of vertical motion on the performance of current meters: U.S. Geological Survey Water-Resources Investigations Report 87-4147, 50 p.

Tracey, D.C., ed., 1991, WRD Instrument News: Hydrologic Instrumentation Facility, No. 54.

———1992, WRD Instrument News: Hydrologic Instrumentation Facility, Nos. 55, 56, 57, and 58.*

Turner, K.S., 1987, "The establishment of a qualified products list for water-quality instrumentation and sensors," Proceedings of the American Water Resources Association Symposium on Monitoring, Modeling and Mediating Water Quality, May 17-20, 1987, Syracuse, New York, p. 269-275.

Wagner, C.R., 1982, Organization of instrumentation within the U.S. Geological Survey, Water Resources Division: International Symposium on Hydrometeorology, American Water Resources Association, Denver, Colorado, June 13-17, 1982.

———1984, Instrumentation support of the U.S. Geological Survey Water Resources Division: Journal of Water Science and Technology, International Association of Water Pollution Research and Control Symposium, p. 117-128.

———1986, Annual Report 1986, Hydrologic Instrumentation Facility: Hydrologic Instrumentation Facility internal report, 114 p.
———1986, Organizational Aspects of Supporting Hydrometric Instrumentation, *in* Herschy, Reginal W., ed., New Technology in Hydrology: Boston, Adam Hilger Ltd., p. 67-81.
———1986, A systems approach to hydrologic data collection: Energy-Sources Technology Conference and Exhibition, February 23-27, 1986, American Society of Mechanical Engineers, New Orleans, Louisiana, 4 p.
———1986, Overview of the U.S. Geological Survey's Hydrologic Instrumentation Facility: Sixth International Northern Research Basins Symposium Proceedings, Houghton, Michigan, January 26-February 2, 1986.
———1987, "Instrumentation support of the U.S. Geological Survey Water Resources Division," Proceedings of the American Water Resources Association Symposium on Monitoring, Modeling and Mediating Water Quality, May 17-20, 1987, Syracuse, New York, 8 p.
Wagner, C.R., and Jeffers, S.R., 1984, The Hydrologic Instrumentation Facility of the U.S. Geological Survey: U.S. Geological Survey Open-File Report 84-227, 18 p.
———1984, The Water Resources Division water level recorder rental program - history and operation: U.S. Geological Survey Open-File Report 84-735, 16 p.
Wells, D.K., ed., 1985, Annual report 1985, Hydrologic Instrumentation Facility: Hydrologic Instrumentation Facility internal report, 60 p.
———ed., 1985, Gulf Coast Hydroscience Center Projects and Activities, Gulf Coast Hydroscience Center, 21 p.
———ed., 1985, WRD Instrument News: Hydrologic Instrumentation Facility, Nos. 30 and 31.
Wells, Frank, and Scott, Carl, 1985, Laboratory techniques, *in* McCutcheon, Steve C., and others, Water Quality and Streamflow Data for the West Fork Trinity River in Fort Worth, Texas: U.S. Geological Survey Water-Resources Investigations Report 84-4330, p. 19-20.

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GLOSSARY OF ACRONYMS

ADC	Analog-to-digital conversion
ADP	Automatic data processing
ADR	Analog-to-digital recorder
ADS	Applications and Development Section
APS	Automatic pesticide sampler
AS	Administrative Services Section
ASAE	American Society of Agricultural Engineers
AWRA	American Water Resources Association
BDR	Basic data recorder
BESP	Borehole Equipment Support Program
BQA	Branch of Quality Assurance
CMD	Current-meter digitizer
CR	Central Region
CSI	Campbell Scientific, Incorporated
DCP	Data-collection platform
DIS-II	Distributed Information System-II
DO	Dissolved oxygen
ECR	Engineering change requests
EDAT	Electronic Data Logger Applications Team
ESC	Environmental Systems Corporation
ETS	Equipment Tracking System
ET	Evapotranspiration
ETM80	Extended temperature model 80
F&P	Fisher and Porter
FSS	Field Service and Supply Section
FY90	Fiscal year 1990
FY91	Fiscal year 1991
FY92	Fiscal year 1992
FY93	Fiscal year 1993
FY94	Fiscal year 1994
GC	Gas chromatograph
GOES	Geostationary Operational Environmental Satellite
GSA	General Services Administration
HBN	Hydrologic Benchmark Network
HIF	Hydrologic Instrumentation Facility
HIF-CSS	HIF Computerized Support System
I/O	Input-Output
ICOM	Instrumentation Committee
ISD	Information Systems Division
ITAS	Instrumentation Technical Advisory Subcommittee
L&S	Leupold and Stevens
LAN	Local Area Network
NASA	National Aeronautics and Space Administration
NAWQA	National Water Quality Assessment
NIST	National Institute of Standards and Technology
NPUG	National PRIME Users' Group
NR	Northeastern Region
NRC	Nuclear Regulatory Commission
NRP	National Research Program
NTN	National Trends Network
NWQL	National Water Quality Laboratory
OSW	Office of Surface Water
OWQ	Office of Water Quality
PC	Personal computer
PFC	Personal field computer
PS	Pressure sensor
PS-2	Pressure sensor 2
PSS	Pressure sensor system
QA	Quality assurance
QAP	Quality assurance procedure
QAS	Quality assurance specialist
QIC	Quality Improvement Concepts
QPL	Qualified products list
SAFHL	St. Anthony Falls Hydraulic Laboratory
SDI	Serial digital interface
SE	Shaft encoders
SERP	Specialized Equipment Rental Program
SOP	Standard operating procedure
SPE	Solid-phase extraction
SPOTS	Single programming of telemetry systems
SR	Southeastern Region
SSC	John C. Stennis Space Center
STACOM	Stabilized and temperature-compensated manometer
TES	Test and Evaluation Section
THIIP	Techniques of Hydrologic Investigations for International Participants
TSS	Technical Services Section
UVM	Ultrasonic velocity meters
USGS	United States Geological Survey
VOC	Volatile organic compounds
WR	Western Region
WRD	Water Resources Division
WES	Waterways Experiment Station
WSC	Water Survey of Canada
YMP	Yucca Mountain Project