

## **PROFILE**

**HATFIELD & DAWSON**  
Consulting Electrical Engineers

Specializing in Telecommunications  
And Electromagnetic Engineering

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James B. Hatfield, PE  
Benjamin F. Dawson, PE  
Thomas M. Eckels, PE  
Stephen S. Lockwood, PE  
David J. Pinion, PE

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Paul W. Leonard, PE  
Erik C. Swanson, EIT  
Thomas S. Gorton, PE

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Hatfield & Dawson  
9500 Greenwood Avenue North  
Seattle, WA 98103

Telephone: (206) 783-9151  
Facsimile: (206) 789-9834

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## INTRODUCTION

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Hatfield & Dawson is a Washington State consulting engineering firm with a practice limited to telecommunications and electromagnetic engineering. The firm has been in operation in its present form since 1973 and is the successor to the practice of J.B. Hatfield (Sr.) dating from 1945.

The principals and associates of the firm have extensive experience in all aspects of this specialized field. The firm performs design work, government agency and license application engineering, preparation of specifications, construction supervision, propagation analysis, measurements, testing, and operational review of:

- Compliance with RF exposure standards
- Wireless communications and two way communications systems
- Communications and radio systems for FM and AM broadcast – In-building wireless distributive antenna systems
- Closed circuit video and data
- Microwave
- UHF and VHF television systems
- Electromagnetic engineering and analysis

Hatfield & Dawson has a long history of innovative use of computational electromagnetic techniques for the design, analysis, testing and implementation of antenna systems and for non-ionizing radiation exposure prediction. Our experience in medium wave antennas is unequalled. The same analysis methods are applicable to long wave and HF antennas. We have a record of successful work with both conventional and unusual antennas at frequencies to the 1 GHz region. The firm makes extensive use of computer technology to access allocation databases and digitized terrain data, for CAD-system design and automated propagation studies.

Our clients include private broadcasting companies, wireless telecommunications carriers, telecommunications common carriers, industrial communications users, educational institutions, cable television systems, airports, cities, counties, states and agencies of the United States and foreign governments.

The firm maintains a fully equipped laboratory, and its library, containing over 1500 volumes, is one of the most complete private collections of telecommunications related material in the United States.

## **SERVICES – AN OVERVIEW**

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### **Broadcast Related Services**

- AM, FM, TV Facilities Engineering
- Propagation & Signal Strength Analysis Allocation Studies
- Antenna System Design
- Phasor Design Using Numerical Methods Techniques
- System Planning
- Implementation (*Tune-up, Measurements*)
- Verification Reports
- Complex AM, FM & TV Allocation Cases

### **Specialized Radio Systems for Industrial Use**

#### **Private and Common Carrier Microwave**

#### **Land Mobile Radio Systems**

- 800 MHz Trunked
- Paging
- Conventional Two-Way Radio
- Distributive Antenna Systems

#### **Radio Common Carrier**

- Cellular Applications and Problem Solving
- Paging
- Microwave
- DPLMRS Analysis & Design
- Propagation Analysis
- System Design

#### **Expert Appraisal and Valuation**

- Appraisal Work for Public Agencies
- Appraisal Work for Valuation in Transfer Cases
- Appraisal Work for Charitable Donation Valuation

#### **Due Diligence Inspection and Verification Work**

#### **Cable Television Inspection and Franchise Compliance Verification**

## **SERVICES – AN OVERVIEW (Continued)**

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### **Electromagnetic Compatibility**

- Multiple Site Analysis and Management
- Industrial Use Compatibility
- Compatibility of High Power Communication with Other Uses
- Computer System Susceptibility
- Intermodulation Analysis for Multi User Sites
- Cellular, Land Mobile Interference Issues
- ISM (900 MHz/2.4GHz) Compatibility Issues

### **Non-Ionizing Radiation Matters**

- Microwave
- Radio Frequency
- Power Line Frequencies
- Measurements and Analysis

### **Policy Matters**

- Telecommunications Regulatory Matters
- Land Use and Local Zoning Matters

### **System Planning**

- Private Broadcasting Services
- Public Systems

### **Propagation Analysis**

### **Expert Witness Analysis and Testimony**

## **BROADCAST SERVICES**

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The firm's practice began in broadcasting matters. We have provided engineering services of all types to broadcasting clients all over the United States and in several other countries.

### **Medium Wave (AM) Broadcasting**

Hatfield & Dawson are among the world's most experienced and knowledgeable engineers in medium wave allocation, propagation, and antenna design and implementation matters. The firm's principal engineers have pioneered the use of modern computational analysis methods to ensure that the design and implementation of medium wave antennas is as economical as possible. As a result, we have successfully designed antennas that met their design specifications without any incremental adjustment requirements. Our experience extends from low power AM systems in sports stadiums, at airports and on college campuses, to the million Watt transmitting systems of the VOA.

### **FM Broadcasting**

Our location in the western United States has given us a wide experience with VHF and UHF radio propagation under a huge variety of circumstances. As a consequence, we have expertise in the analysis and design of FM transmission facilities under almost every conceivable circumstance. We use automated propagation calculation techniques, measurement and theoretical analysis to evaluate proposed facilities as well as to optimize existing ones. Our experience in numerical analysis methods allows us to predict the performance of antenna systems with a high degree of reliability. Because we have been attentive to FM allocation matters over virtually the entire history of FM broadcasting, we have a record of solving unusual allocation situations. Our experience in the use of field measurement data and propagation calculations in FM licensing cases is equally extensive.

### **Television Broadcasting**

Many of the same factors that make up our expertise for FM broadcasting apply to television as well. In addition, our techniques for appropriate antenna design and specification for UHF television allow confident prediction of facility performance.

## **NON-IONIZING RADIATION & ELECTROMAGNETIC COMPATIBILITY**

Hatfield & Dawson performs analyses for electromagnetic compatibility and other more generalized areas involving fields and waves. These include measurements and calculations for electromagnetic fields (EMF's) at power line and radio frequencies.

Our firm provides environmental assessments of ELF, VLF, MF, VHF, UHF and microwave electromagnetic fields. We measure the electromagnetic field emissions from power line, video display terminals (CRT, VDT) in homes, offices and industrial environments. We also provide measurements of electromagnetic fields at AM, FM, Television and Microwave installations.

Our firm is represented on the IEEE SCC28 subcommittees SC-1 (Techniques, Procedures and Instrumentation for Measurement of Non-ionizing Radiation Hazards), SC-2, SC-3, SC-4, SC-5.

### **Representative Projects**

Performed calculations and measurements to determine compliance with FCC and local human exposure regulations of weather RADAR at SeaTac airport for KING-TV.

Made measurements for the Port of Seattle to determine the impact of airport RADAR upon electronics at parking tollbooths at SeaTac airport.

Measured exposure to RADAR emissions at Emery Air Freight offices at SeaTac airport as part of a cancer cluster investigation.

Surveyed microwave satellite up-link at KIRO-AM transmitter site, Maury Island, WA to determine compliance with local and FCC human exposure regulations.

Hawaii, City & County of Honolulu, Department of Land Utilization: Prepared a report on electromagnetic compatibility of a proposed transmitting facility and its relationship to local land use ordinances.

Hawaii Electric Company: Moment method analysis and measurements of RF shock and burn currents from power transmission lines adjacent to AM broadcast tower.

Non-ionizing electromagnetic radiation (NIER) measurements and studies at Cougar Mountain near Seattle, for FM and TV broadcast stations.

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## **NON-IONIZING RADIATION & ELECTROMAGNETIC COMPATIBILITY**

### **Representative Projects (continued)**

NIER EMF measurements and expert witness for US West (now Qwest), New Vector Group for various proposed cell sites.

NIER EMF measurements and expert witness for Cellular One regarding proposed cell sites.

NIER EMF measurements and meetings with citizens regarding proposed 800 MHz radio system for Arlington County, VA.

NIER EMF measurements of VHF transmission facility at proposed cell site for Santa Barbara County, CA.

NIER EMF measurements of radio and television VHF and UHF facilities for the City of Seattle, WA.

Consultant to City of Seattle on NIER aspects of EIS for proposals to increase heights of television towers in the city.

Consultant to King County on NIER aspects of proposed new land use policies for telecommunications facilities.

City of Seattle Office of Long Range Planning: Consultant on NIER policies for telecommunications.

Port of Seattle: Extensive measurements and analysis of human RF contact currents, electromagnetic compatibility and NIER matters vis a vis radio transmitting facilities within the Port of Seattle.

NIER magnetic (ELF & LF) and electric field measurements (LF), contact and induced current measurements, X-ray and ionizing radiation measurements on transmitter and tower lighting circuit insulation resistance measurements at United States Coast Guard LORAN transmission facilities.

Stimson Company: NIER and electromagnetic compatibility studies of high power industrial equipment.

Fisher Broadcasting – KOMO: Consultant to KOMO for measurements on NIER levels on Queen Anne Hill.

## **NON-IONIZING RADIATION & ELECTROMAGNETIC COMPATIBILITY**

### **Representative Projects (continued)**

Cellular Telephone and Telecommunications Facilities: Non-ionizing radiation predictions, calculations, measurements and expert testimony for over 100 telecommunications facilities (broadcast, land mobile, cellular & microwave).

Multiple Use Transmitter Sites: Measurements and analysis for planning, site management and remedial measures at multiple-use electronics sites.

RF field survey for IBB (formerly VOA) HF short wave transmission facility at Delano, CA. This work included electric and magnetic field surveys with NARDA, ANSI conformal probes and measurements of human RF contact currents.

Measurement of microwave and RADAR fields for ANSI standard compliance at SeaTac airport, various mountain top microwave transmission facilities, and most recently, Pima County, AZ.

Presented paper on human RF induced and contact currents at workshop on the ***Protection of Personnel Against Radiofrequency Electromagnetic Radiation***, U.S. Air Force School of Aerospace Medicine, Brooks Air Force Base, TX.

## **POLICY ANALYSIS**

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Hatfield & Dawson are very experienced in policy analysis matters that relate to telecommunications and electromagnetic compatibility.

The firm has advised government agencies and private clients on telecommunications regulatory matters and on land use and zoning matters. Because of the firm's experience in preparing comprehensive technical reports in language that can be understood by laymen, we have been called upon to act as expert advisors to a variety of government agencies.

### **Representative Projects**

#### **Government of Canada, Department of Communications**

We prepared a comprehensive analysis and report on the technical and non-technical implications of proposed new DOC regulations for licensing of low-power FM broadcast stations. This project required extensive discussion with various Canadian officials in Ottawa at both DOC and CRTC during the analysis phase.

#### **Government of Seychelles, Ministry of Information and Culture**

We supervised a team of experts and prepared a report on facilities planning and expansion, as well as an analysis of existing facilities, for Radio-Television Seychelles, the government owned broadcasting system. This report was prepared at the behest of the International Telecommunications Union, a United Nations agency.

#### **City of Seattle, Office of Long Range Planning**

We acted as technical experts in a consultant team, which provided a study of telecommunications land use matters and made recommendations for revised city land use ordinances. We acted as a consultant to OLRP for preparation of the Environmental Impact Statement for the proposed ordinance.

#### **Radio Exitos Mil Noventa, Caracas, Venezuela**

We provided expert consulting services on FM engineering and regulatory matters to this eminent Venezuelan broadcast company. During the period of time when the Venezuelan Ministry of Communications was formulating new technical regulations for FM broadcasting, we provided expert advice and consulted with the Ministry on behalf of Mil Noventa to ensure that licensing policies and technical regulations were reasonable and appropriate. We provided a technical seminar on FM propagation and facilities matters for the engineers of the Ministry at the request of the Director General.

## **OTHER TELECOMMUNICATIONS & RELATED PROJECTS**

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Many telecommunications engineering firms specialize in one or two narrow areas of work. Hatfield & Dawson has always resisted this type of specialization, which would limit our exposure to new techniques and ideas. For example, we have found that the most useful and innovative radio propagation work in the last two decades has been by scientists and engineers working with new, high technology land mobile systems. These techniques are often directly applicable to broadcast work, especially for VHF FM broadcasting, where over 50% of the audience is now listening on mobile or portable receivers.

A few unusual projects we have performed are:

For a confidential client, we were asked to provide conceptual design for VHF transmitters for paging in Singapore. Because there was no digitized topographic data available for the country, we created such a database from detailed topographical maps. The resulting propagation calculations were compared with measured data from the existing transmitting facilities, and were found to be extremely accurate.

For the states of Nevada and California, we served as expert appraisers for the proposed relocation of radio facilities due to planned freeway construction. In both cases we were called upon to prepare alternative facility designs, and to evaluate the comparative costs of our alternatives to those proposed by the licensees.

For King County, Washington, we designed and installed a repeater transmitter inside a sports stadium. The field strength from local AM stations carrying sports events was inadequate to provide coverage inside the stadium. We designed and installed an "upside down monopole" antenna which hung from the center of the building roof, and provided remarkable uniform signal strength inside the building. The system was fed as an on-frequency repeater without interference inside or outside the building. (The stadium has since been demolished.)

For City News Service of Los Angeles, we designed and specified equipment and installation procedures for a point to multi-point microwave system to distribute the newswire services to approximately 100 locations in the LA basin. This system eliminated telephone leased line charges of several thousand dollars a month, and paid its cost of installation in less than a year.

For SKY100.4 Athens, Greece, we specified a system of FM transmission facilities that provides coverage to the entire metropolitan area from three transmitter sites on three adjacent frequencies, 100.1, 100.4 and 100.7 MHz. This allows extremely high signal strengths to overcome high noise levels (and pirate low power FM stations) and propagation losses in the central city.

## **OTHER TELECOMMUNICATIONS & RELATED PROJECTS (continued)**

For Denver International Airport, we provided a technical feasibility study , cell site design recommendations, and extensive cell site acceptance tests to allow the compatible operation of a centrally located cell site for AT&T, Verizon Wireless, NEXTEL and the airport's safety and tenant two-way radio systems, which operate from a site outside the central airport core. We are also involved in a long-term Radio Frequency Improvements project at Denver International Airport to provide improvements in above-ground and underground wireless coverage, and to coordinate all radio frequency facilities at Denver International Airport to maximize coverage and performance and to prevent interference.

## DUE DILIGENCE SERVICES

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Brokers and financial institutions are experts at financial analysis. Brokers know that financial details supplied by sellers need to be verifiable and believable. If they aren't, the broker's reputation and relationship with the buyer can be destroyed. Financial institutions know that if they finance a transaction whose basic value assumptions are invalid, they can lose the basis for their security instruments.

It is much harder for brokers and buyers and their representatives to analyze the technical and administrative details of a broadcast or communications property. Frequently, buyers use their own personnel to make these evaluations. This doesn't always give the broker or financial institution enough information to be completely informed, or to be protected against possible future problems.

An even worse problem is evaluation of potential facility improvements. Blue sky representations by sellers may turn out to be very dark and stormy realities for a purchaser.

There are very substantial benefits to be gained from a thorough technical review of a proposed transaction. Some are obvious. Equipment condition and suitability can often be evaluated easily. What's more difficult to determine are subtle problems that can be disclosed only by a careful inspection of facilities and of licensing documents. Here are a few kinds of problems that we have uncovered:

- Stations with transmitter sites built at locations different than the authorized locations – sometimes by several miles.
- Stations operating with more than the licensed power – sometimes by as much as four or five times the allowable power.
- Stations operating with Special Temporary Authority whose basis is very different than disclosed by the seller.
- Cable TV systems which have serious deficiencies on meeting local franchise technical standards.
- Stations relying on coverage from unlicensed or illegally operating translators or boosters.
- Stations operating with unauthorized antenna systems.
- Stations whose sale price has been substantially discounted for alleged technical deficiencies that are simply not true.
- Stations with non-ionizing radiation emissions of PCB leaks, which violate applicable federal law.

## **DUE DILIGENCE SERVICES (continued)**

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Due diligence technical inspections cost very little, You wouldn't broker of finance a real estate transaction without a title search. You shouldn't broker or finance a communications property transaction without a thorough review of the licensing details and technical facilities by a qualified expert.

## **TERRESTRIAL AND SATELLITE COMMUNICATIONS SYSTEMS SERVICES**

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Hatfield & Dawson have provided propagation analysis and system design services for a large number of microwave frequency communications systems, including terrestrial transmission and satellite communications systems. The firm maintains in-house computer software for system design, topographic analysis, interference analysis with terrestrial systems for satellite transmission and reception, and for noise and signal level calculations.

### **Satellite Communications Systems**

Because the initial satellite communications systems shared frequency spectrum with terrestrial systems, Hatfield & Dawson developed interference analysis algorithms and a library of satellite signal and antenna data in order to perform licensing for terrestrial microwave systems. These capabilities have been expanded with time, so that we now perform both office analysis and field problem solving and interference resolution. We have prepared the basic engineering specifications, detailed design data and licensing documents for numerous satellite receiving and transmitting installations at all of the normally used frequency bands. We have extensive experience in the precise location of satellite facilities to avoid terrestrial interference, including the construction of berms and shields, and the specifications installation and testing of appropriate filters. M.L. Hatfield, P.E., consultant and formerly a partner in the firm, has over 25 years of experience in military and commercial satellite system engineering, including unusual modulations schemes. His expertise is available to the firm at all times.

### **Terrestrial Microwave Systems**

Because of our long experience in broadcasting, where extensive use of terrestrial microwave systems developed first, Hatfield & Dawson have designed dozens of microwave systems, from single hop short distance systems for video and 3 or 4 voice grade telephone circuits to extensive multiple hop wide-band multi-channel systems. We have a complete library of antenna data from all of the world manufacturers of antennas. We maintain computer databases of topography for all areas where it is available, as well as map resources for much of the world. Our capabilities include specification, design, path analysis, interference protection and coordination. We have designed microwave systems for broadcasting stations, communications common carriers, transportation companies and government agencies.

We prepare testing programs to insure that vendors meet all required performance specifications, as well as providing project management and quality control services. Our experience includes the design of over 100 microwave communications systems, including systems which operated under marginal conditions, such as lack of appropriate path clearance and over very long hops under a large variety of climatic conditions. The western U.S. contains a large number of climate zones, including rainforest, desert, mountains and areas with very anomalous and unusual ducting and propagation effects. Our experience allows us to confidently design systems under any conditions which are likely to be encountered worldwide.

## **MEDIUM WAVE (AM) ANTENNA ANALYSIS FOR POTENTIAL RE-RADIATION EFFECTS**

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Hatfield & Dawson are among the world's most experienced and knowledgeable engineers in the design and analysis of medium wave antenna systems. The firm's principal engineers have pioneered the use of modern computational analysis methods for the design and implementation of medium wave antenna systems. Among the many features of this type of analysis is its applicability to situations where there is potential re-radiation from nearby structures, including other communications towers.

The FCC has issued Public Notices, which outline the requirements for construction of new towers within ½ mile of non-directional AM antennas and within 2 miles of directional antennas.

Many land mobile and common carrier technical personnel are unfamiliar with the requirements for field intensity measurements and antenna impedance measurements outlined in this Public Notice. As a result they may deliberately avoid choosing sites that are close to AM antennas. This unnecessary restriction on site location is an impediment to good land mobile and cellular system design. Hatfield and Dawson maintains a complete current database of all AM antenna facilities, so that quick calculations of the distance from a proposed new land mobile or cellular antenna structure can be made, to determine if the FCC restrictions apply.

The techniques employed by Hatfield & Dawson for medium wave antenna analysis allow us to quickly and easily determine if a proposed new antenna structure will adversely affect an AM antenna. If any adjustment of the AM antenna is necessary, these techniques show us just what adjustments are appropriate. Our experienced engineers can quickly and efficiently make the necessary "before and after" field measurements and antenna impedance measurements, so that license application filing for the cellular system is not delayed.

For information regarding these services, please contact:

Benjamin F. Dawson III, P.E. or James B. Hatfield, P.E.  
Telephone (206) 783-9151  
Facsimile (206) 789-9834

We will be delighted to give you more information about any specific situation you may have.

## PUBLICATIONS

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Members of the firm have written several papers on antenna engineering and analysis. They include:

“A Comparison of the Fields of a Medium Wave Directional Antenna as Calculated by the FCC Method and the Numerical Electromagnetic Code” by James B. Hatfield and Paul W. Leonard, presented at the March, 1987 Conference of the Applied Computational Electromagnetics Society, at the Naval Postgraduate School, Monterey, CA.

“Sharing AM Transmitter Sites by Diplexing Antenna Systems” by Benj. F. Dawson III, presented at the 1987 Engineering Conference of the National Association of Broadcasters, Dallas, TX.

“Numerical Electromagnetic Code Analysis of AM Directional Antenna Nulls and the Proximity Effect” by James B. Hatfield, presented at the September, 1987 Broadcast Symposium of the Broadcast Technology Society of the IEEE, Washington, DC.

“Relationships between Base Drivers and Fields in Broadcast Medium Wave Directional Antennas” by James B. Hatfield, presented at the March, 1988 Conference of Applied Computational Electromagnetics Society, at the Naval Postgraduate School, Monterey, CA.

“Analysis of AM Direction Arrays Using Method of Moments” by James B. Hatfield, presented at the April, 1988 Engineering Conference of the National Association of Broadcasters, Las Vegas, NV.

“Verifying the Relationship between AM Broadcast Fields and Tower Currents” by James B. Hatfield, presented at the March, 1989 Conference of the Applied Computational Electromagnetics Society, at the Naval Postgraduate School, Monterey, CA.

“Relative Tower Currents and Fields in an AM Directional Array” by James B. Hatfield. IEEE Transactions on Broadcasting, vol. 35, No. 2, June 1989.

“Analysis of a Sectionalized Tower as an Element in a Medium Wave Phased Array Using the Method of Moments” by Benj. F. Dawson III. IEEE Transactions on Broadcasting, vol. 35, No. 2, June 1989.

“Using MININEC to Relate Tower Currents to Fields in an AM Directional Array” by James B. Hatfield, presented at the September, 1989 Broadcast Symposium of the Broadcast Technology Society of the IEEE, Washington, DC.

“Improved Night Interference Protection” by James B. Hatfield, presented at the Sixth Annual Conference of Applied Computational Electromagnetics Society, at the Naval Postgraduate School, Monterey, CA.

## **PUBLICATIONS (continued)**

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“A Modern Method of Predicting AM Tower Vertical Radiation” by James B. Hatfield, presented at the September, 1990 Broadcast Symposium of the Broadcast Technology Society of the IEEE, Washington, DC.

“Modern Analysis Methods for Medium Wave Antenna Design” by Benj. F. Dawson III, presented at the International Broadcasting Convention of the IEE (U.K.), Brighton, U.K., September 1990.

“Reciprocity and Moment Methods Applied to Predicting Radiated Emissions” by James B. Hatfield, presented at the March 1991 9<sup>th</sup> International Zurich Symposium on Electromagnetic Compatibility, Zurich, Switzerland.

“Effective Methods of Supplementing Coverage Deficiencies for VHF FM Broadcast Stations” by Thomas M. Eckels and Benj. F. Dawson III, presented at the April 1991 Engineering Conference of the National Association of Broadcasters, Las Vegas, NV.

## **LIBRARY & LABORATORY RESOURCES**

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### **Library & Resource Information**

Hatfield & Dawson maintains an extensive private library devoted to the communication and broadcast industries. Organized early in the company's history because of the need for up-to-date references and information, the library now contains over 1500 books in addition to hundreds of journals, technical reports and national and international maps. Our computerized terrain database and on-line capabilities provide accurate topographical information for the continental United States, and much of the rest of the world.

The following is an example of the broad range of subject material contained in our library:

- Communications Law and Rulemaking
- Electronic & Telecommunication Engineering, Circuit and Antenna Design
- Physics, Calculus, Analytic Geometry, Trigonometry, Vector Analysis, Geodesy
- Electromagnetic Waves including Biological Effects
- Propagation, Interference, Thermodynamics
- Chemistry, Fluid Mechanics, Vacuum Tube Technology
- Computer Science, Programming
- Communications: Microwave, Mobile Phone, Networking, Radio, TV  
Radio Telephone, Radar, Loran, Satellite, Radioteletype  
Fiber Optics
- Sound Engineering, Recording, Reproduction
- Radio Astronomy
- Cartography

### **Laboratory & Test Equipment**

Hatfield & Dawson owns a large variety of telecommunications test and measurement equipment including complete instrumentation for non-ionizing radiation and electromagnetic compatibility measurements. Our antenna test equipment allows complete antenna measurements to 1 GHz. We own complete field intensity measurement equipment from 200 kHz to 1 GHz, as well as spectrum analyzers covering the range from 100 Hz to 1 GHz. Our shop facilities allow us to fabricate and test specialized antennas and antenna feed systems.