BRAZIL

MINISTRY OF INFRA-STRUCTURE

COMPANY FOR RESEARCH ON MINERAL RESOURCES

DIRECTORY OF GEOLOGY AND WATER RESOURCES

STUDY TOUR REPORT

Author: FLAVIO ADAMI DE AVILA

SPONSOR - UNITED NATIONS DEVELOPMENT PROGRAMME

WORLD METEOROLOGICAL ORGANIZATION

UNDP/WMO PROJECT BRA/87/008

NOVEMBER 1991

CONTENTS

FOREWORD

The sped-up populational and technological growth in Brazil and the consequent necessity of applying water resources for irrigation, eletrical energy, urban supply, navigation, sanitation, among other purposes,have already been a reason for serious conflicts involving the various users of the water.

Also, in many urban and regional areas, floods and droughts menace populations and agricultural crops.

The anticipated knowledge of the meteorological phenomena as faster as possible, allows metereologists and governments to act in order to reduce those conflicts and damages.

Country's present financial difficuties and the high cost of equipment have hindered the establishment of an adequate nethwork of automatic weather stations network in Brazil.

UNDP's and WMO's representatives, conscious and worried about that situation, and perceiving CPRM as an important entity operating the DNAEE's hydrologic network and DNMET's principal climatologic stations, suggested to its Chief Water Resources Departament, a visit to countries which have been operating modern or intending to update their hydrometeorological networks.

The absorption and change of technical and managerial knowledge by CPRM should be pretty valuable for the operation of the Brazilian hydrometeorological network, nowadays made up of a few automatic stations among the 8,000 measuring sites.

For this purpose, in the course of a meeting in CPRM's office, being present Dr. Virgílio Torres Molinero - WMO's Chief Division for Latin America and Caribbean-,Dr.Lucien Munõz - UNDP's Assistant Resident Representative-,Dr. Manuel Dengo- UNDP's BRA/87/008 Chief,Technical Adviser-,Dr. Ari Cavedon - National Director of BRA/87/008 UNDP/SENIR-, Dr. Helion Moreira- Adviser,CPRM Director Board-, and the writer,Dr. Virgilio, supported by Dr. Lucien and Dr. Dengo,invited CPRM, represented by Flávio Adami de Ávila, its Chief,for Water Resources Department, for a Study Tour in the United States of America,Mexico and Colombia.

Sponsored by the UNDP/WMO project BRA/87/008,the Study Tour took place during the period 31 October-16 November/1991.

Attempting to make the most of this excellent opportunity granted by the UNDP/WMO Project BRA/87/008,the writer, besides the concern with the updating of the hydrometeorological network, looked for other details like

operational management of networks and training programs on weather forecast and also Geographic Information Systems.

This report aims to explain observed aspects encountered in those countries,and to present some suggestions in order to apply them in Brazil.

ACKNOWLEDGMENTS

CPRM and the writer wish to thank for the sponsorship, organization and support:

UNDP/WMO

* Prof. G.O.P. Obasi
WMO's Secretary General

* Dr. Virgilio Torres Molinero
WMO's Chief,Division for the
Latin America and the Caribbean

* Dr. Eduardo Gutierrez
UNDP's Representative in Brazil

* Dr. Lucien Muñoz
UNDP's Assistant Resident

* Dr. Manuel Dengo
UNDP's Project BRA/87/008
Chief Technical Adviser

SENIR

* Dr. Ari Delcio Cavedon
National Director of UNDP/SENIR

For the incentive and support,the writer thanks:

CPRM

* Dr. Hermes Augusto Verner Inda
Director, Geology and
Water Resources

* Dr. Helion França Moreira
Adviser,Geology and Water Resources

Due to careful consideration not only for the talks about their work activities but also for the individual support, the writer is also indebted to the following people contacted:

NOAA/Department of Commerce

* Dr.Richard Crouthamel
International Affairs Officer

* Dr. Alin Casabianca
Adviser,International Affairs Office

* Mrs. Maria das Graças Ramos
Assistant,International Affairs Office

NOAA/NWS

* Dr. Gene Starling
Chief,Office of Hydrology

* Dr.Larry Wenzel
Adviser,Office of Hydrology

* Dr.Thomas Baumgardner
Adviser,River Forecast Center
Cincinnati - Ohio

* Dr.Warren Bruns
Meteorologist

NOAA/NESDIS

* Dr. Michael Nestlebush
Data Collection Systems Coordinator

* Dr. Mary Hughes
Satellite Technical Information
Specialist

USGS

* Dr. Kimberly Barrett
International Water Resources
Program Specialist

* Dr. Anna Lenox
Chief,International Water
Resources Program

* Dr. Charles Boning
Chief, Office of Surface Water

* Dr. William Shope
Office of the Assistant Chief
Hydrologist for Operation

* Dr. Kenneth Lanfear
Assistant Branch Chief, Branch of
National Water Summary

* Dr. Ernest Cobb
Office of Surface Water

* Dr. Edward Gilroy
Branch of Systems Analysis

* Dr. Tim Miller
Office of Water Quality

* Dr. Kathy Fitzgerald
Office of Water Quality

BUREAU OF RECLAMATION

* Dr. Harry Taylor
Office of Data Collection Center

* Dr. Jerry Weeks
Office of Data Collection Center

* Dr. Ted Day
Office of Data Collection Center

SCS

* Dr. Peter Palmer
Survey Supervisor, Data Collection Office

* Dr. Phillip Morrisey
Office of Hydrology

VITEL

* Dr. Duane Preble
President

* Dr. John Weeks
Division Manager - Boise,Idaho.

CNA

* Dr. Enrique Ortega Gil
Manager, National Meteorologic Service

* Dr. Alfonso Medina
Office of Meteorology

* Dr. Othon Cervantes
Chief, Project of Climatology

* Dr. David Esparsa Villasana
Chief,Project of Meteorologic Data Collection Network.

INTA

* Dr. Jaime Collado
Chief

HIMAT

* Dr. Jorge Ivan Valencia Franco
Director, Hydrology and Meteorology

* Dr. Oscar Nelson Arango Botero
Chief, Office of Meteorology

* Dr. Emigdio Collante Barraza
Chief, Division of Hydrometeorologic Networks.

REMARKS

NOAA

31 October, 1th. 5,6, november

The writer's first contact in NOAA was maintained with Dr. Richard Crouthamel, who explained its activities and relationship with other nation and worldwide entities, in particular in meteorologic and hydrologic fields.

The National Weather Service is the organization in charge of issuing warnings of hurricanes, severe thunderstorms and flash floods. For this purpose, NWS makes use of images as well as hydrometeorologic data. The images are provided daily by NESDIS.

As an example of data application, was showed by Dr. Gene Starling and his technical staff, the Automated Local Flood Warning System and was detailed the Flash Flood Alarm System Mathematical Model.

In the NWS's office in Cincinnati, Ohio, Dr. Thomas Baumgardner expounded the River Forecast Center's activities. He showed the meteorologic network, and how they collect, work, store, and divulgate the informations.

Close to the office, was visited the automatic station on Ohio River. The station is composed of a gauge height sensor (STEVENS) and of a data Collection platform (SUTRON).

Data are straightly collected by NWS's office in Cincinnati, where are applied in mathematical models for floods prediction.

In NESDIS's office the writer was introduced by Dr. Crouthamel to Dr. Michael Nestlebush and Dr. Mary Hughes. Dr. Mike talked about NESDIS's activities remarking its importance both nation and worldwide.

In the world, survey organizations under agreement with NESDIS's make channel allocations in order to use the Sattelite Data Collection System.

Related to this matter, Dr. Nestlebush, Dr. Mary and the writer settled to maintain contacts in order to use this utility for the claimed modernization of the Brazilian hydrometeorologic network.

Relating to trainings on weather forecast matters, they are avaiable both in NWS and in NESDIS's. In order to carry them out should be contacted Dr. Betty Howard (fone (301)7634586).

USGS

In 4 november an also intense program was carried out in USGS's office, Reston, Virginia.

The writer met with a good reception by Dr. Kimberly Barrett who introduced him to Dr. Anna Lenox.

Afterwards, he attended to the following meetings.

10:00 am – 11:00 pm – Dr. William Shope
topic: Data Collection Plattforms and Instrumentations.

11:00 am – 12:00 – Dr. Charles Boning
topic: General Surface Water Data Collection.

12:30 pm – 01:00 pm – Dr. Kenneth Lanfear
topic: Geographic Information System.

01:00 pm – 01:45 pm – Dr. Ernest Cobb
topic: Urban Hydrology

01:45 pm – 02:15 pm – Dr.Edward Gilroy
topic: Statistical Analysis

02:15 pm – 03:00 pm – Dr. Tim Miller and Dr. Kathy Fitzgerald.
topic: Water Quality Parameter Measurements.

Based on the talks and the previous knowledge of the Survey's activities, was confirmed its important performace in the hydrologic field, not only in U.S.A. but also worldwide, where its specialists rend their experience.

USGS operates about 9000 hydrological stations, which about 3000,among them,are automatic.

Hydrological and water quality data are collected by sensors and transmited through NESDIS's satellites toward the Survey's headquarters and field offices.

Close to Cincinnatti, was visited the automatic station operated by USGS, on Ohio River.

Relating to training, was settled that at the moment should be better for the senior professionals,follow the "On the Job Trainings". The Juniors should participate both in "On the Job" and in Formal Courses.

VITEL

Saturday, 2 november 1991

As though as it was not included on the study tour program, the writer availed himself of the opportunity to visit VITEL, whose president Dr. Duane Preble had invited him.

VITEL is a medium factory of hydrometeorological equipments, including DCP's. Also, under agreement they carry out the maintenance of approximately 220 automatic stations of the Bureau of Reclamation.

During the explanation of the VITEL's activities, was noted that the price of the telemetric equipament in the U.S.A is many times lower than in Brazil. Certainly this is the principal reason why the automatized stations network is rather small in Brazil

BUREAU OF RECLAMATION

7,8 November

In the Federal Building in Boise the writer met Drs Harry Taylor, Jerry Weeks and Ted Day.

They explained the Reclamation's projects and specified the Hydromet, which is a remote data collection system for hydrologic and meteorologic data.

They also detailed the CROHMS - Columbia River Operational Hydromet Management System - a group formed to provide a form for coordination of the operation of the facilities and to adress water management issues.

The data are needed for real time operation, as well as runoff forecasts, and include reservoir levels, streamflow, canal flow, precipitation, temperature, snowpack, and water quality data.

Proceeding, was presented the BOISE-MINIDOKA SYSTEM. This system uses one-way communication from the remote site DCP through the GOES satellite to the receive site. The system currently includes approximately 200 remote sites through the region.

S.C.S

8 November

In the Soil Conservation Service office were contacted Drs. Peter Palmer and Phillip Morrisey. They exposed how the forecasts are made:

Most of the annual streamflow on the Western United States originates as snowfall that has accumulated high in the mountains during winter and early spring. As the snowpack accumulates, hydrologists estimate the runoff that will occour when it melts. Predictions are based on careful measurements of snow equivalent at selected index points.

Preciptation, temperature, soil moisture and streanflow data are combined with snowpack data to prepare runoff forecasts.

Streamflow forecasts are coordinated by Soil Conservation Service and National Weather Service hidrologists.

Snowpacks data are obtained by using a combination of manual and automated SNOTEL measument methods. SNOTEL site is composed of pressure pillows for measuring snowfall, a storage precipitation gauge provides current information about conditions of the site and temperature sensor measures the existing temperature.

In addition, snow water equivalent, precipitation and temperature are monitored on a daily basis and transmitted via METEORBURST telemetry to central data collection facilities. The data are used to project snowmelt runoff.

Accompanied by the VITEL's representative in Boise, Or. John Weeks, the writer visited the following sites:

- PNRI - station
  type : meteorological
  local: close fo Federal Building
  purpose: to test DCP's and sensors

- Diversion Dam station
  type: fluviometric
  local: Boise River, 7 km from Boise
  purpose: Irrigation and Flood Control

- Lake Lowell
  type: fluviometric
  local: 40 km from Boise
  purpose: Irrigation and recreative

- Parma Weather
  type: meteorological
  local: 45 km from Boise
  purpose: Irrigation studies

- Parma
  type: fluviometric
  local: Boise River - 42 km from Boise
  purpose: Irrigation

The Comision Nacional del Agua (CNA) was created in January 1989. It is the only authority regarding water issues; its purpose is to integrate functions related to water management on the federal level and to guarantee the efficient and fair distribuition, use and preservation of water resources, into adequate quantity and quality.

In order to carry out the tasks assigned to it, the CNA stablished four general departments:

Planning and finance
Water administration
Hydro agricultural infra-structure
Urban and industrial hydraulic infra-structure

Among other activities, the Water administration department is in charge of measuring hydrometeorological phenomena and of providing timely information in order to protect the population from possible floods. It also supervises security in flood control constructions.

In 11 and 12 november, the writer visited the Gerencia de Servicio Meteorologico Nacional, a direction subordinated to the Water Administration Departament. He was introduced by the office's chief Dr. Ortega Gil to his staff.

For 1 hour Dr.Ortega explained about "Modernization of the National Meteorologic Service". Also for 1 hour, Dr. David Esparsa Villasana presented the "Data Collection Automatic System".

This system expects in short data the operation of 65 synoptic, about 400 meteorologic and 200 gauge height automatic stations. For this purpose they have been contacting to NESDIS in order to get the licence to use other channels of NOAA's satellites.

Just after, Dr.Jaime Collado the representative of the -Instituto Mexicano de Tecnologia del Agua, -IMTA-, an important entity directly subordinated to The General Direction of CNA, gave an explanation of the "Estimation of the mean precipitation by the Kriging method". This method also can be used in order to maximinize the benefit-cost ratio of the hidrometorologic station networks.

After the expositions we paid a visit to the facilities of CNA's office, and also to the automatic meteorologic station.

During the explanations of the activities,it was also exposed the software CLICOM, which is used to deal with the meteorologic data. This software was created by NESDIS to attend WMO's order.

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HIMAT

13, 14 November

Himat is the Colombian Federal Institution in charge of the meteorologic and hydrologic development studies, the fluvial water use regulation, and the development of works for the agricultural and cattle breeding and also lands adequacy.

Relating to meteorology and hydrology, HIMAT operates about 500 climatologic and 1,000 hydrologic sites.

HIMAT also takes part in programs like BAPMON (dealing with atmospheric pollution), TOGA (Tropical Ocean Global,Atmospheric), WWW (World Weather Watch), CPPS (South Pacific Permanent Commision), El Niño Phenomena studies, and others.

In the case of automatic stations HIMAT has been operating 17 data collection platforms (rain and staff gage) and in 1992 will increase the DCP's network with the instalation of 75 new equipments.

For the purpose of operation and maintenance training, HIMAT has been controlling one NOAA's automatic station in Colombia that includes atmospheric pressure and air temperature measurements.

In 14 November the writer going along with Ors. Oscar Arango Botero and Emigdio Collante Barraza visited the fluviometric and pluviometric automatic station at Nariño,on Magdalena River 150 km far from Bogotá.

In 15 November was visited the meteorologic station of Airport, close to Bogotá. These stations use DCP SUTRON.

Specially due to the geographical vicinity between Colombia and Brazil, the writer suggested to Dr. Jorge Ivan Valencia Franco, Director of HIMAT, the signature of an accord HIMAT/CPRM with the UNDP/WMO sign in order to deal with common

activities like trainings and field operations in the Amazon river basin.

Dr. Jorge Ivan promptly agreed to the proposal and so everything was settled to take it under UNDP/WMO's consideration.

CONCLUSIONS/RECOMMENDATIONS

How can a manager, both public and private, make a good use of the water resources for its various applications if he does not know how much they are available ?

How properly can he predict a flood in order to control a threatening situation downstream to protect population if he does not know in time the ocurrence of a thunderstorm ?

The answers to these questions are well known but UNDP/WMO together with CPRM concerned with the situation of the hydrometeorological networks in Brazil, has been thinking about the effective solution for them, which is not easy at all.

Although, sure that the way crosses also the managerial and technical growth of the people involved in the problems, UNDP/WMO and CPRM anticipated to get the solution by arranging a study tour through countries which have for longer been facing those problems through more advanced technologies.

Obviously the whole course needs much more than one study tour but certainly an important step was taken on the purpose to get that solution.

Based on the formers and on the study tour contacts carried out by Flávio Adami de Ávila, is recommended to study the possibility of sign an agreement CPRM/UNDP-WMO which can be included in the following projects that have been accomplished by CPRM, in order to rehabilitate and up-grade the Brazilian hydrometeorological network:

A - G.A.T.E (own budget projects) - Territorial Administration - These projects are developed in urban or regional areas and are concerned with integrated meteorological, hydrological, hydrogeological, geological and environmental studies aiming to contribute to federal, state and municipal district governments.

B - PLHB - (own budget projects) - Basic Hydrometeorological Survey Programme - Based on PLGB (geological) projects, they also contemplate hydrometeorological informations presented on maps such area coincides with the former DNPM/CPRM's geological programmes. Those projects cover regional areas in the whole Brazilian territory.

C - NATIONAL AND INTERNATIONAL ACCORDS - (composed budget projects) - CPRM generally together with Government institutions develops hydrometeorological studies both in urban or regional territories.

D - CONTRACTS (contractor entity budget) - Under contract, CPRM operates public or private hydrometeorological networks. Nowadays CPRM has been operating DNAEE's hydrological network, where are also included under cooperation accord, the DNMET's stations.

As a consequence,should be necessary,among other items:

Equipment

- Acquire a large number of automatic weather stations and Data Collection Platforms (DCP's) (before the acquisition it must be necessary to evaluate the performance of the equipments by installing a pilot network).

- Acquire the correspondent Hardware

- Progressively, to replace the hydrometeorologic equipment that has been used up to now

- Provide instalations of repair shops aiming the maintenance of the equipment

Training

An intense program of training should be created. Initially can be pointed some matters:

- Data annalyses

- Planning of networks

- Weather forecast

- Database Management Systems

- Geographic Information System

- Techniques of hydrometeorology

Rio de Janeiro,January 23,1992

Flávio Adami de Ávila

adress:
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Av.Pasteur 404 Urca
22292 Rio de Janeiro Brazil

AGENCY ACRONYMS

CNA — National Comision of Water (Colombia)
— Comision Nacional del Agua

CPRM — Company for Research on Mineral Resources (Brazil)
— Companhia de Pesquisa de Recursos Minerais

DNAEE — National Department of Water and Electric Energy(Brazil
— Departamento Nacional de Aguas e Energia Eletrica

DNMET — National Department of Meteorology (Brazil)
— Departamento Nacional de Meteorologia

HIMAT — Colombian Institute for Hydrometeorology and Land Adequacy (Colombia)
— Instituto Colombiano de Hidrologia,Meteorologia y Adequacion de Tierras

IMTA — Mexican Institute of Water Technology (Mexico)
— Instituto Mexicano de Tecnologia del Agua

NESDIS — National Environment Satellite Data Information Service (U.S.A.)

NOAA — National Oceanic and Atmospheric Administration (U.S.A.)

NWS — National Weather Service (U.S.A.)

SCS — Soil Conservation Service (U.S.A.)

SENIR — National Secretariat for Irrigation (Brazil)
— Secretaria Nacional de Irrigacão

UNDP — United Nations Development Progamme (United Nations Organization)

USGS — United States Geological Survey (U.S.A.)

WMO — World Meteorological Organization (United Nations Organization)

ADRESSES

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Av. Pasteur, 404 - Urca
22290 RIO DE JANEIRO - BRAZIL

U.S.A

NOAA/DEPARTMENT OF COMMERCE
1325 - East West Highway - 13th Floor
SILVER SPRING, MARYLAND - U.S.A;

NOAA/NATIONAL WEATHER SERVICE - NWS
1325 - East West Highway - 8th Floor
SILVER SPRING, MARYLAND - U.S.A.

NOAA/NATIONAL ENVIRONMENTAL SATELLITE DATA SERVICE - NESDIS
WORLD WEATHER BUILDING, Room 806
WASHINGTON, D.C - 20233

NOAA/NWS - RIVER FORECAST CENTER
FEDERAL BUILDING
Main Street
CINCINNATI - OHIO - U.S.A

USGS - UNITED STATES GEOLOGICAL SURVEY
436 - National Center
RESTON, VIRGINIA - 22092 - U.S.A

BUREAU OF RECLAMATION
550 West Fort Street
FEDERAL BUILDING
BOISE - IDAHO - U.S.A

SCS - SOIL CONSERVATION SERVICE
3244 - Elder Street
BOISE - IDAHO - U.S.A

VITEL
14100 - Park Long Court
CHANTILLY - VIRGINIA - 22021 - U.S.A

MEXICO

CNA - COMISION NACIONAL DEL AGUA
Av. Observatorio, 192
Del.Miguel Hidalgo
Col Observatorio
CP 11860
CIUDAD DE MEXICO - MEXICO

IMTA
APARTADO POSTAL - 122-5
62051 - CUERNAVACA, MOR. - MEXICO

COLOMBIA

HIMAT - INSTITUTO COLOMBIANO DE HIDROLOGIA,METEOROLOGIA Y ADECUACION DE TIERRAS
Carrera 5a. - no. 15 - 80 Piso 18
BOGOTA - D.E. - COLOMBIA

NOAA´s BUILDINGS
SILVER SPRING - MARYLAND

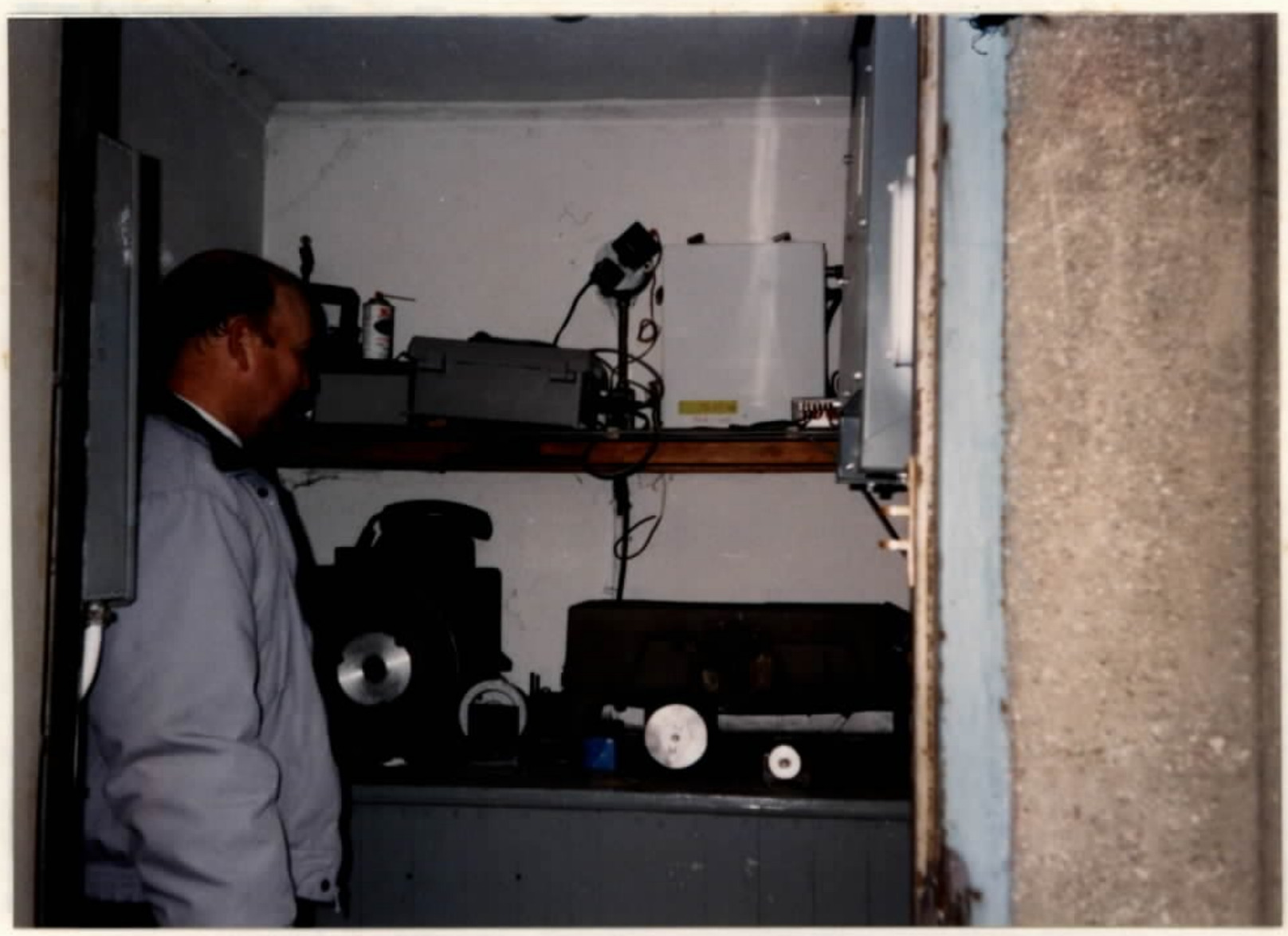
NOAA´s DEPARTMENT OF COMMERCE AND NWS ENTRANCE
SILVER SPRING - MARYLAND

NWS'e OFFICE IN CINCINNATI

NWS'e OFFICE IN CINCINNATI
THOMAS BAUMGARDNER (L) and FLAVIO ADAMI DE AVILA

AUTOMATIC STATION ON OHIO RIVER
- CINCINATTI -

WARREN BRUNS GETTING TO THE STATION
- CINCINATTI -



WARREN BRUNS SHOWING THE EQUIPMENT
- AUTOMATIC STATION IN CINCINATTI -

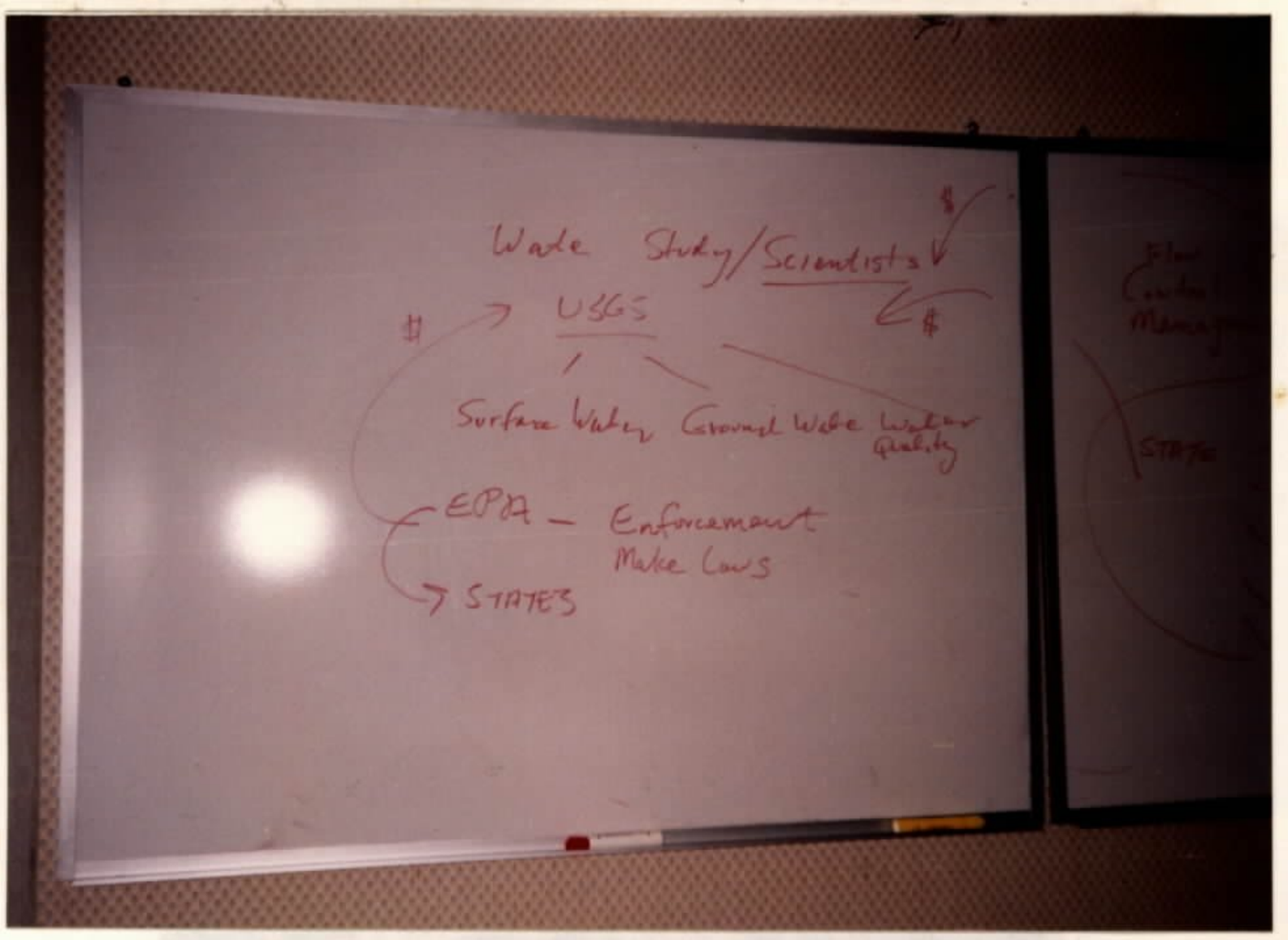
NESDIS's BUILDING

From left to right:
MIKE NESTLEBUSH, FLAVIO AVILA and
RICHARD CROUTHAMEL
- NESDIS's OFFICE -

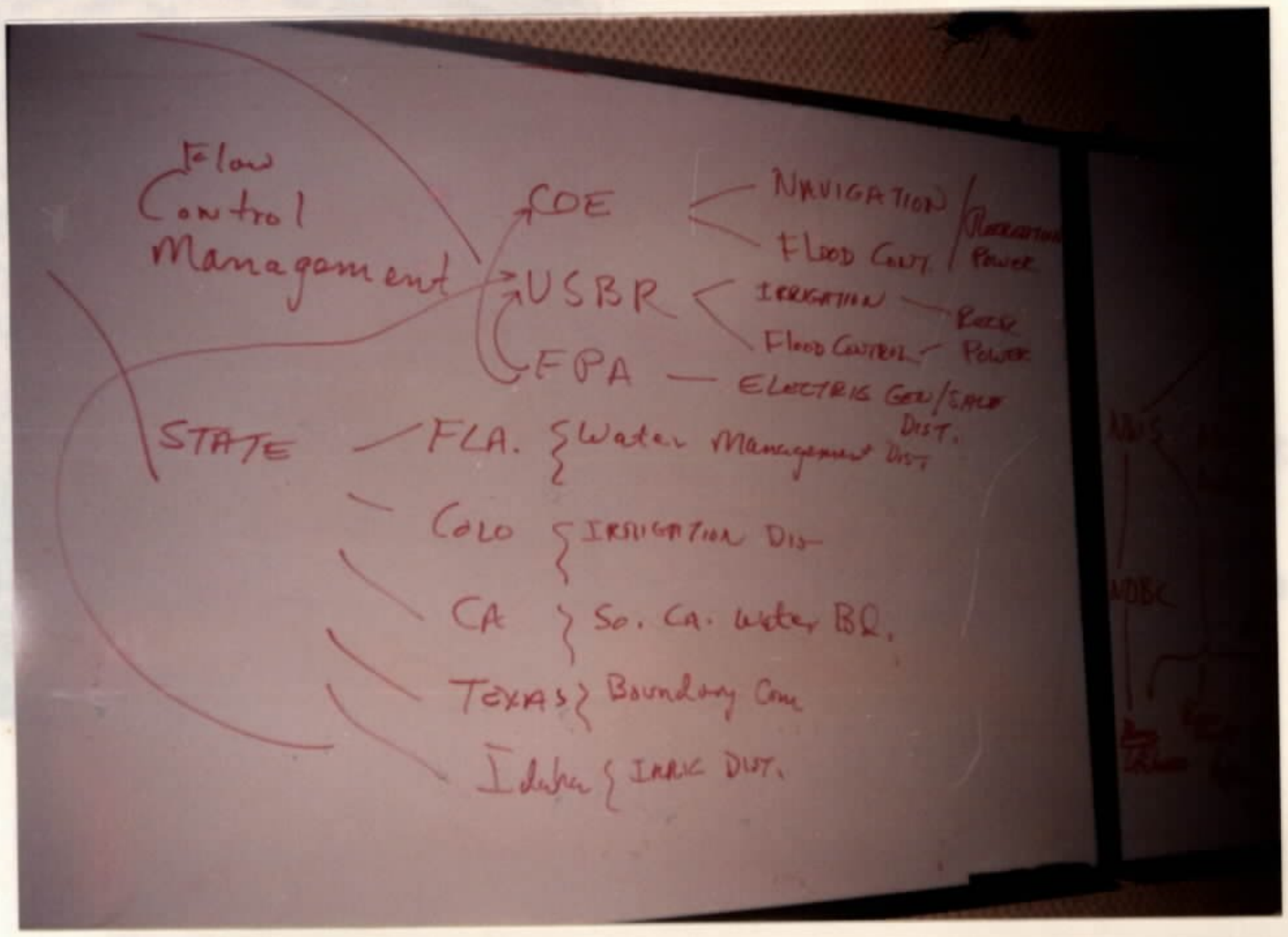
From left to right:
MIKE NESTLEBUSH, MARY HUGHES and
RICHARD CROUTHAMEL

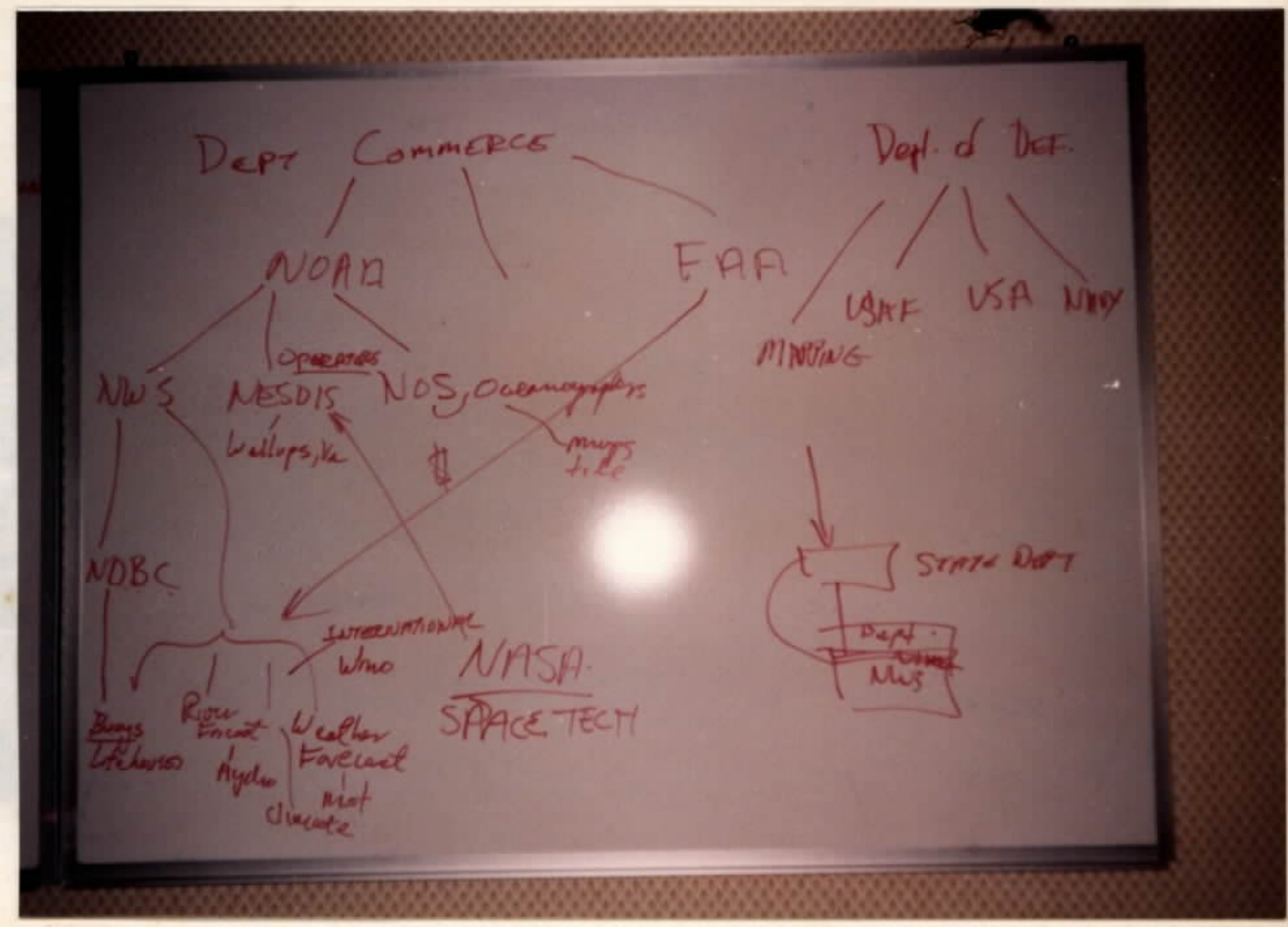
DEPARTMENT OF INTERIOR BUILDING
WASHINGTON D.C.

- USGS's BUILDING ENTRANCE
RESTON, VIRGINIA



Talking about the entities´s relationship -VITEL´s Office





6 November

A SNOWY DAY IN THE MIDWEST

-Illinois, Indiana

-Ohio, Kentucky

ENTRANCE OF THE FEDERAL BUILDING
- BOISE, IDAHO -

TED DAY and JERRY WEEKS
- RECLAMATION's OFFICE -
BOISE - IDAHO

PRESENTATION OF THE CROHMS SYSTEM
RECLAMATION's OFFICE - BOISE

JOHN WEEKS AT THE HARDWARE's ROOM
- BUREAU OF RECLAMATION OFFICE -
BOISE - IDAHO

PNRI STATION
BOISE - IDAHO

BOISE RIVER DOWNSTREAM DIVERSION
DAM STATION (CLOSE TO BOISE)

LAKE LOWELL STATION

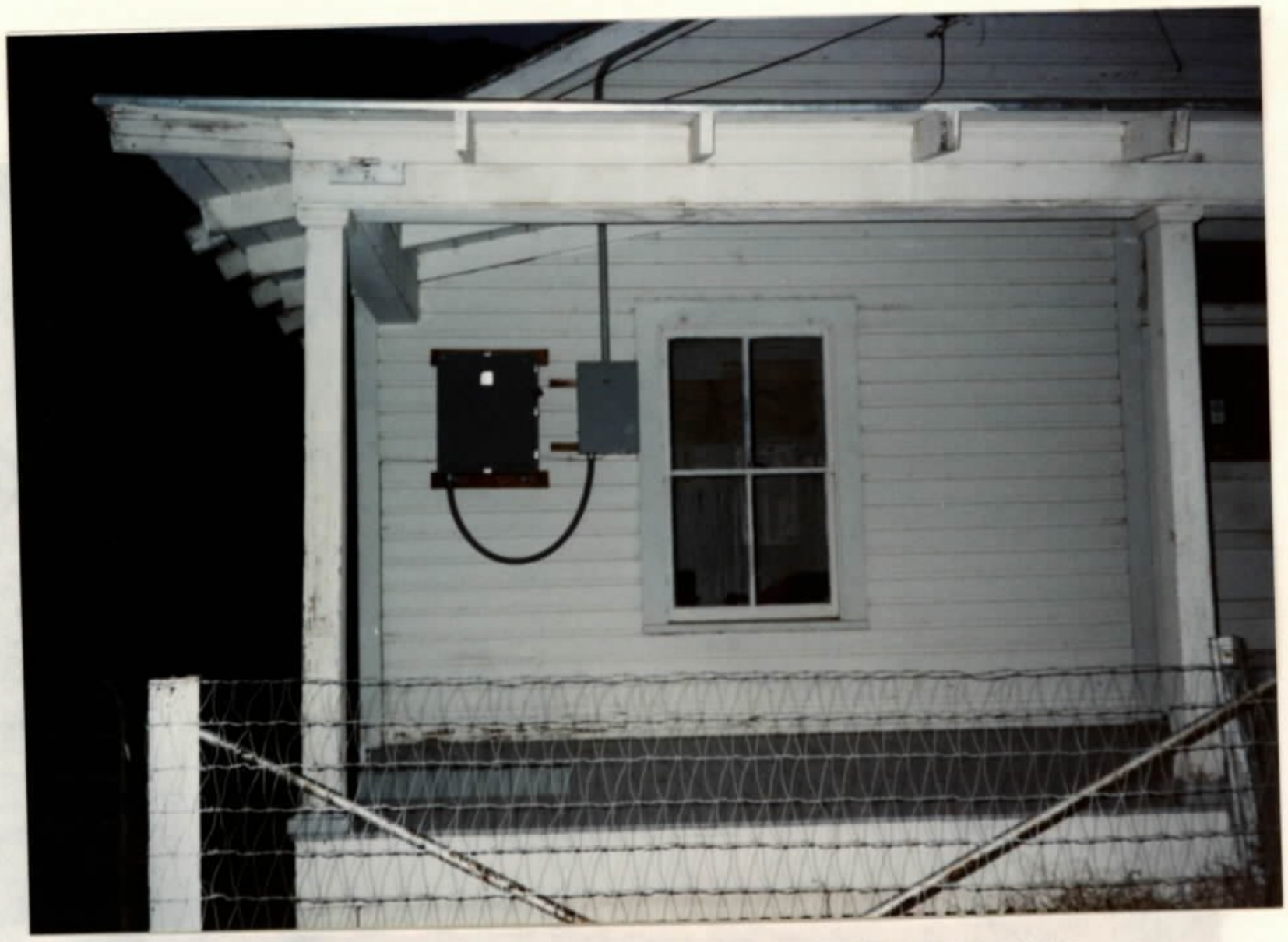
ALTERNATIVE INSTALLATION USED TO PROTECT
THE ANTENNA AND THE SOLAR PANEL
- LAKE LOWELL STATION -

PARMA WEATHER STATION

JOHN WEEKS TESTING THE DCP
PARMA WEATHER STATION

BOISE AUTOMATIC STATION

BOISE RIVER AT BOISE AUTOMATIC STATION



LAKE OYEHEE - PART OF THE DCP SYSTEM
(PICTURE TAKEN AT NIGHT)

SOIL CONSERVATION SERVICE
- BOISE - IDAHO -

JAIME COLLADO(IMTA) and OTHON CERVANTES SHOWING THE METEOROLOGIC STATION AT THE PENTHOUSE OF CNA IN MEXICO CITY

ANTENNA AT THE PENTHOUSE
CNA - MEXICO

OSCAR ARANGO BOTERO (L), EMIGDIO BARRAZA
and FLÁVIO ADAMI DE ÁVILA, IN FRONT OF
THE HIMAT´s METEOROLOGIC STATION CLOSE
TO THE AIRPORT OF BOGOTÁ

EMIGDIO BARRAZA SHOWING THE HIMAT´s
HYDROMETEOROLOGICAL STATIONS NETWORK

AIRPORT STATION
HIMAT
COLOMBIA

ENTRY OF THE NARINO STATION
- COLOMBIA -

MAGDALENA
RIVER VALLEY

MAGDALENA RIVER AT
NARIÑO STATION

NARIÑO STATION
BATTERY, SENSORS AND DCP