MASTER

DOE INTERLABORATORY WORKING GROUP FOR DATA EXCHANGE (IWGDE)

PROGRESS REPORT - OCTOBER 1978

ARGONNE NATIONAL LABORATORY
BROOKHAVEN NATIONAL LABORATORY
LAWRENCE BERKELEY LABORATORY
LAWRENCE LIVERMORE LABORATORY
LOS ALAMOS SCIENTIFIC LABORATORY
OAK RIDGE NATIONAL LABORATORY
PACIFIC NORTHWEST LABORATORY

Edited by
Carmen M. Benkovitz

ATMOSPHERIC SCIENCES DIVISION
DEPARTMENT OF ENERGY AND ENVIRONMENT

BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.

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ABSTRACT

This report describes the activities of the DOE Interlaboratory Working Group for Data Exchange (IWGDE) as of October 1978. The IWGDE was created in response to an evident need for increased sharing of resources among ERDA installations. During fiscal year 1976 it was supported through funds allocated to the Energy Analysis and Assessment Programs of seven multipurpose ERDA national laboratories. During fiscal years 1977 and 1978 it was supported by direct funding from the Division of Environmental Impacts, Office of Technology Impacts, Department of Energy. Principal accomplishments included the interlaboratory exchange of socioeconomic, environmental, demographic, and energy--related data bases; liaison development through interlaboratory meetings; definition and partial implementation of a computer-independent standard for exchange of data; initial definition of a Geographic Exchange Standard and Primer, and a first attempt at the definition of content and format for a set of DOE Reference Data Bases.

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I. INTRODUCTION

In 1975 the nonregulatory activities of the former U.S. Atomic Energy Commission (AEC) were transferred to the U.S. Energy Research and Development Administration (ERDA), whose broader goal was to coordinate U.S. energy research and development, both nuclear and non-nuclear. In 1977 ERDA became part of the Department of Energy (DOE).

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The DOE-supported national laboratories, long noted for their expertise in nuclear science, have expanded their horizons to consideration of energy resource shortages, socioeconomic impacts of energy alternatives, advanced energy supply technologies, energy conservation measures, power plant siting criteria, and other related questions.

DOE is studying these questions in close cooperation with legislators, other government agencies, private industry, and the public. DOE has the responsibility of using both its own resources and those outside to the best possible advantage, avoiding unnecessary duplication of expertise or research facilities.

A. Background

With the transfer of part of the activities of the AEC, ERDA acquired a new charter. Besides the pursuit of nuclear and basic physical and biomedical research, ERDA was charged with the mission of determining the socioeconomic and environmental impacts of energy policy for both nuclear and non-nuclear energy sources.

The ERDA national laboratories were suddenly faced with the need to use data bases generated by other agencies besides those carefully constructed by their own research. Many federal agencies collect and process data on our society, and their missions are usually legislated to be non-overlapping. This may appear to be a government frugality, but the result is a modern Tower of Babel. There are Bureau of Economic Analysis (BEA) areas, Environmental Protection Agency (EPA) Air Quality Control Regions (AQCRs), and Bureau of the Census Standard Metropolitan Statistical Areas (SMSAs); there are fiscal years and calendar years; there are people with Spanish surnames and people of Spanish descent; there are counties in California, townships in Massachusetts, and civil divisions in Alaska; there are state plane coordinates, Universal Transverse Mercator coordinates, and earth grid coordinates; there are census data for 1970, emissions data for 1972, and mortality data for 1975. It soon

becomes evident that one cannot buy a data tape, write a simple program to read it, and produce input to an economic model to project trends to the year 2020 with little extra effort.

The quality and quantity of these data bases varied by orders of magnitude from anything existing before. Also, these data bases had to be integrated into coherent and consistent data sets for the studies required by the new ERDA charter. In order to model impacts of energy policies, methodologies had to be devised for combining, in a reasonable manner, data gathered by different agencies for different purposes. ERDA had no authority to influence the content or even the format of these data.

The scope of the problem remained more or less obscure until the Division of Biomedical and Environmental Research (DBER) organized the Regional Studies Program (RSP). The idea behind RSP was to divide the country into regions and assign a lead laboratory for each region to coordinate studies of environmental and socioeconomic impacts of energy policies. Eventually, it was hoped, the regional models would be combined into a national (or multiregional) model for long-term projections. That was a worthwhile goal, and certainly more than a little ambitious. The need for data was immediate and overwhelming. There was no recognized procedure for exchanging data, and no formal mechanism for cataloging, evaluating, and distributing data that had already been processed by one or more of the laboratories.

Many of the difficulties faced by the individual researchers stem from the naive notion that a data base consists of a set of characters and numbers encoded on a magnetic tape. This leads to the impression that using a data base involves acquiring these magnetic tapes and installing them in the computer center tape library, since the tapes are usually either free or available for the cost of reproduction. It gradually became clear that the basic problem of integrating data from tape into a useful data base system had been somewhat underestimated. In fact, it has become evident that until the proper basic tools for this type of project have been established, there is usually little useful work for the various subject area specialists to perform--especially in cases where models are primarily data dependent (e.g., input/output econometric models). Techniques for handling very large data bases comprise a very active research area in computer science and are the subject of an annual international conference; several research journals are devoted solely to this topic. The problems have not yet been solved, but a great deal of progress has been made. It is not cost effective to overlook such research.

B. Energy and Environment Programs

Certain energy-related questions, such as decisions relating to power plant siting or large-scale mining operations, have profound socioeconomic and environmental impacts on particular regions of the U.S. Such questions are being studied in DOE Energy and Environment Programs, which include (among others) the programs formerly known as Regional Studies Programs.

Beginning in FY 1976, the parallel Analysis and Assessment (Regional Studies) Programs were initiated at each of seven multipurpose National Laboratories, namely: Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Los Alamos Scientific Laboratory (LASL), Lawrence Berkeley Laboratory (LBL), Lawrence Livermore Laboratory (LLL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest Laboratory (PNL). These laboratories, taken together, have an array of scientific expertise and computing capability unequaled in any other government agency.

The Analysis and Assessment Programs encompass a variety of studies too numerous to list here. Although each laboratory has responsibility for a particular region of the U.S., research efforts are coordinated to achieve comparability of results at the national level.

C. History of the IWGDE

The IWGDE evolved from a data management subcommittee of the RSP group, formed by Murrey Goldberg (BNL) in 1974. Proposals for the formation of a Data Clearinghouse were requested by Jeff Swinebroad of DBER, and so many responses were received that a workshop was called at ERDA headquarters in April 1975. This workshop, hosted by Jeff Swinebroad and John Wilson (DBER), emphasized the need for ERDA-wide collaboration among not only the subject-area specialists doing the studies but also the computer scientists interested in data base management. Murrey Goldberg called a meeting at Brookhaven in May 1975 (in conjunction with the Brookhaven Energy Modeling Conference), where the initial group met to create a Joint 189 (proposal) for seven laboratories (Savannah River Laboratory joined later).

The goals of the IWGDE, as stated in the Joint 189, are as follows:

1. To share expertise in computer based information and data.
2. To establish both short-term and long-term objectives for resource sharing in data management.
3. To establish, test, and implement practical data exchange formats.
4. To examine the laboratories' data base management systems and practices and develop appropriate mechanisms for interfacing among these systems.
5. To make long-term recommendations for a common data base management system.
6. To recommend administrative guidelines for exchange of data and programs.

Tasks for FY 1976

To implement these objectives, the following tasks were established for FY 1976:

Task I. Establish a steering committee to be known as The Interlaboratory Working Group for Data Exchange, composed of one representative and one alternate from each laboratory.

Task II. Request that each principal investigator prepare for his/her laboratory an up-to-date status report on past and present data management activities. This is to include, but not be limited to, a description of computer hardware, data bases, and data management systems. Upon completion of the individual laboratory reports, the IWGDE is to prepare a summary status report.

Task III. Propose a data exchange format consistent with the statement of short-term objectives. Each laboratory, after testing the format, is to report its recommendations to the IWGDE.

Task IV. Contribute to the joint development of a kernel system to interface to individual data base management systems by testing and implementing currently available, transportable, generalized systems.

Task V. Examine each laboratory's current capabilities and needs for computer network implementation of data exchange.

Task VI. Begin to examine prerequisites for a common data base management system.

In November 1975 the group met at LBL for the first time as a funded group. Don Austin (LBL) was elected chairman, and Carmen Benkovitz (BNL) secretary. A subcommittee on geocoding was established, with Paul Dionne (PNL) as chairman, to investigate special problems with the use of geographic data bases.

II. ACCOMPLISHMENTS

The primary purpose of the IWGDE is face-to-face exchange of information to ensure effective coordination of programs at DOE national laboratories. Representatives from each of each laboratory met approximately four times a year during fiscal years 1976, 1977, and 1978. At each meeting about fifteen IWGDE members from DOE laboratories plus advisors from ERDA/DOE headquarters were present as well as observers from several other Federal agencies including EPA, USGS, and FEA.

During the meetings IWGDE members acquired a clearer understanding of the nature of the Energy and Environment Programs and the resources available at the DOE laboratories. This knowledge quickly led to the exchange of energy--related and socioeconomic data bases required for ongoing programs. Even more important, the IWGDE functioned as an interlaboratory liaison group, facilitating the interlaboratory transfer of specific data bases requested by Energy and Environmental Program personnel and others.

A. Interlaboratory Data Exchanges

A considerable number of socioeconomic, environmental, and demographic data bases were copied on tape and exchanged between two or more DOE national laboratories. Most of these exchanges were bilateral, with no attempt to reformat the data for the convenience of the user (see Section II.E.). These exchanges illustrate the high degree to which data are already being shared by the DOE national laboratories, but they also point up some of the inefficiencies due to the absence of a data exchange standard.

B. IWGDE Exchange Standard

The most important substantive accomplishment of the IWGDE was the initial definition of an exchange standard for the interchange of data. The draft of the standard was presented to the American National Standards Institute (ANSI) X3L5 Committee on Labels and File Structure in May 1976. It was recast in ANSI format, revised, and extended to a media-independent standard.¹ It has also been presented to the International Standards Organization (ISO) as a working paper, the first step toward establishing an ISO project in this area.

An important feature of the proposed ANSI exchange standard is its generality and flexibility. An introductory record defines the format and content of all successive records, so that a general reading routine can accept any standard-format file with no need for auxiliary information.

The primary emphasis of the IWGDE so far has been on the transfer of socioeconomic, environmental, demographic, and energy-related data bases on magnetic tape. Nevertheless, the proposed exchange standard is sufficiently general to allow the transmission of arbitrary bibliographic, numerical, or geographic data.

C. Implementation of the Exchange Standard

Implementation of the proposed ANSI exchange standard, namely the creation at each DOE installation of the computer software necessary for reading and writing standard-format files on magnetic tape, was undertaken by IWGDE members. The Light Water Reactor Environmental Effects Program, headed by Savannah River Laboratory, provided additional funding, which allowed the coordination of a multi-installation implementation effort (see Section IV.). Implementation of level 1 of the standard was accomplished, and all laboratories completed installation of this software.^{2,3}

D. Geographic Interchange Standards Committee

The Geographic Interchange Standards Committee (GISC) had its formal beginning in a two-day workshop on Coordination of Exchange of Data Bases and Models at ERDA headquarters in Germantown in April 1975, where geocoding standards was one of the many subjects discussed. As a result of the discussions, Paul Dionne of PNL was nominated to chair the GISC.

The GISC was formed in order to develop guidelines for the transfer of data that includes geographic coordinates. The IWGDE identified appropriate staff members from the laboratories to serve on the GISC. Members of the GISC met several times and developed an initial definition of a proposed geographic exchange standard based on the use of the data interchange standard developed by the IWGDE. Activities of the GISC are further documented in PNL-2748.⁵

E. Reference Data Bases

The concept of Reference Data Bases arose from the need of the DOE National Laboratories and other groups to use the same geocoded, thematic files for regional and national studies. The IWGDE recognized this need and the savings that could be realized if a subgroup of the users could undertake responsibility to make such files available in a form that is transportable, usable and documented.

The IWGDE proposed to undertake this endeavor at its meeting in September 1977 in Germantown. A list of candidate data bases was compiled at the February 1978 meeting at Los Alamos and further discussed at the May 1978 meeting at Brookhaven. Further details of this project are given in Section III.

F. Computer Networks and Teleconferencing

From the very start, attempting to communicate more or less simultaneously with more than twenty people from eight laboratories presented problems that had to be solved before any useful collaboration could proceed. At LBL a simple centralized information system was set up which could be accessed over FTS lines or over ARPANET. An IWGDE News Service, maintained on-line, provided a simple mail system with which the group could communicate asynchronously.

The shortcomings of this one way communication system pointed to the need for a general computer teleconferencing system. Under a grant from the National Science Foundation, the Institute of the Future had implemented a computer teleconferencing system called PLANET-2 which was easy to use and simple to learn. In conjunction with the ERDA Network Experimentation Project, an account was established at Bolt, Beranek and Newman, Inc., (BBN) for the use of

PLANET, and an IWGDE conference was created. Since a BBN machine was available over both TELENET and ARPANET, all IWGDE members had fairly easy access to a network port and could maintain communication on an almost daily basis. Since that time, the IWGDE has depended heavily on the network teleconference for arranging meetings, distributing the minutes of meetings, providing instructions for accessing software and data bases, and keeping in touch with what the other laboratories are doing. A quick scan of the transcripts of several PLANET conferences reveals a vast amount of information being traded on the progress of projects, the availability of new data bases, and the exchange of software and data bases. More than two dozen DOE-based conferences using the PLANET system at BBNL have been held.

Interlaboratory exchange of data via computer networks has been actively discussed. ARPANET implementation including user and server TELNET and user and server File Transfer Protocol (FTP) is operational at ANL, BNL, and LBL. Tests were conducted on the use of ARPANET as a medium for data transfer between these laboratories.

Members of the IWGDE have made regular use of both ARPANET and dial-up facilities to exchange small data bases and software packages directly. This has proven very effective in debugging utility programs (such as coordinate transformation subroutines) and in familiarization with other data base management systems and data bases.

As mentioned earlier, the proposed ANSI exchange standard may be used for exchanges via computer networks. Since ARPANET operates at a maximum bandwidth of 50 kilobits/second (and an average of 10 to 20) exchange of data bases on the order of a few million characters may be practical. For larger data bases, however, this method will not replace exchange of magnetic tapes in the proposed ANSI standard exchange format. Further work is needed in this area.

The computer teleconferencing and network activities are supported by the Applied Mathematics Program, Division of Engineering, Mathematics and Geosciences, Office of Basic Energy Sciences, Office of Energy Research, Department of Energy.

III. REFERENCE DATA BASES

A. Introduction

Since the DOE national laboratories and other groups need to use the same geocoded, thematic files for regional and national studies, the IWGDE undertook the preparation of Reference Data Bases in a form that is transportable, usable, and documented (see Section II.E.). This section presents the conventions proposed by IWGDE for Reference Data Bases and lists suggested data bases. Since many of the thematic files contain county level data, a discussion of independent cities such as occur in Virginia is also included.

Reference Data Bases are thematic files that are useful for regional or national-scale assessment and for the planning studies with a level of resolution equivalent to "county units." Criteria for candidate data bases include national coverage, lack of rapid change, use by several groups, adequate documentation, and willingness of an individual to "standardize," distribute, and maintain the file. Conventions for the format of a file initially include exchange standard as defined in ANSI Specifications; if county data, 5-digit FIPS geocodes for a standard set of country units; if

points, latitude/longitude; metric units of measure; conventions for indicating missing values; and adequate documentation such as citations to the original source, reports utilizing the file, sample maps and tables, etc. These conventions are not intended to be rigid, comprehensive "standards" but, rather, to be guidelines that can be modified as users create, exchange, and apply the Reference Data Bases to their needs.

B. Candidate Data Bases

Data bases initially suggested as candidate reference data bases by a survey of IWGDE representatives are listed in Table 1. This survey, although not comprehensive, did include individuals connected with energy and environment programs at each of the members laboratories. Most of the files listed were available from at least one of the national laboratories, and at least several other installations had needs for these files in the immediate or near future. As part of the IWGDE future activities, individuals have agreed to work on creation of sample Reference Data Bases for several of these files having a high demand including county outlines, land use, and air quality.

C. Documentation

Documentation of a Reference Data Base is of two types. The primary form utilizes the bibliographic data elements established by the Information Coordination Focal Point (ICFP) representatives from each national Laboratory. The secondary form encouraged by IWGDE consists of supplemental hardcopy listings, reports, maps, etc., to accompany the magnetic tape containing the Reference Data Base. The tape would comprise two pairs of files created in the proposed ANSI exchange standard format. The first pair would contain the abstracted documentation information and the second pair would contain the data base. The DDF of the first file would be a standard description of the 27 data elements on the ICFP form. The accompanying DF would contain one (or more) bibliographic entry describing the contents and naming the contact person associated with the Reference Data Base. The DDF of the second file would be written to describe the format of the data elements and record structure of the Reference Data Base as it resides in the accompanying DDF.

An alternative arrangement would be to have a single pair of DDF and DF files with the documentation material either in a large DDF or as part of the DF with unique tags. The proposed arrangement allows a lengthy textual description to be written without expanding the DDF to an extreme length or mixing free field text with DF which often would consist of fixed length FORTRAN readable records. In addition the documentation material would be directly compatible for entry into the ICFP inventory and the data elements could be retrieved individually as needed.

D. Conventions

The DDF is used to define the format and structure of the data base including variable position and type within a record, geographic units, geocodes, units of measure, missing value conventions, file organization, and any other information useful in processing and using the Reference Data Base. IWGDE considers it more important to provide the flexibility to define the peculiarities of each Reference Data Base rather than to define a standard and expect all

Table 1

Informal IWGDE Survey of Data Base Availability and Needs, Spring 1978.

The survey was based on responses from a limited number of knowledgeable representatives but it is not exhaustive

	Year	Geo Unit	Original source	National Lab Availability								Data Base Needs							
				ANL	BNL	LASL	LBL	LLL	ORNL	PNL	SRL	ANL	BNL	LASL	LBL	LLL	ORNL	PNL	SRL
1. Population (by Age, Sex, Race)	1950	Counties	Census		X		X		X								X		
	1960	Counties	Census		X	X	X		X								X		
	1970	Counties	Census		X	X	X		X								X		
	1975	Counties	Census			X	X						X			X	X	X	X
2. County and City Data Book	1972	County, Cities	Census		X		X		X							X			
	1977	County, Cities	Census																
3. MED-X	1970	County, Cities	Census		X	X	X		X		X								
4. Mortality Rates (53 causes)	1968-1972	Counties	NCHS	X					X				X	X		X			
5. Air Quality Control Regions	1975	County	EPA		X		X		X					X					
6. Point Source Emissions	1974-1976	Aggr., Points	EPA		X				S					X	X	X			
7. Ambient Air Quality	1974-1976	Points, AQCR's	EPA		X		X		S					X		X			
8. PARAP (Population at Risk to Air Pollution)	-	Counties					X							X					
9. Weather Station Locations	-	Points	NOAA		X				X		X				X	X			
10. Weather Surface Observations	1800's-1978	Points	NOAA		X	X			X		X				X	X			
11. Monthly Temp and Precip. for State Climatic Divisions	1931-1975	County Aggregates	NOAA			X			X						X	X			
12. Wind Roses	-	Points	?	X											X				
13. Watershed Boundaries	-	Polygons	USGS				X				X		X	X		X		X	
14. Water Quantity		Points	USGS, EPA						X				X		X	X			X
15. Water Quality (NASQAN)		Basins	USGS, EPA						X				X		X	X			X
16. Land Use from Conservation Needs Inventory	1967	Counties	USDA						X				X	X	X				X
17. Agriculture Production	1974	Counties	USDA				X		X					X		X			X
18. Endangered Species	1978	Counties	USF&WS		X		X		X					X					
19. ENL Energetics Atlas	1972-1974	Counties	ENL		X	X			X							X			
20. Coal Reserves	-	Counties	DOE						X				X	X		X			
21. County Outlines	1970	Counties			X	X			X	X	X								
22. Census Tract Boundaries	1970	Tracts								X						X			X
23. World Data Bank II	1977					X	X		X	X			X						X

data bases to conform to it. The following tags within the DDF normally would contain the information defined below:

Tag 000 Data base name (same as NAME field in documentation file)
Tag 001 Record identification field name such as: 'RECORD SEQUENCE'
Tag 002 Descriptive information
Tag REC Record description including format

The 1970 FIPS* codes are recommended as geocodes for countries, states, and counties. State and county codes consist of a 5-digit number (see additional discussion below). For many regional studies, data for independent cities, such as those in Virginia, are aggregated with counties. These combinations should be defined in the DDF. In addition, a single character tag is used to indicate either that a county unit contains data for independent cities or that it contains data for only a portion of a county. The latter may occur if large counties are subdivided. Proposed tags are as follows:

'*' Contains independent city data

'A,B,C,...' Sub-county units

Points would be described by latitude/longitude coordinates given in degrees with minutes and seconds converted to a decimal fraction. User defined conventions such as expressing west longitude as negative degrees would be described in the DDF.

Appropriate metric units of measure are to be used and defined in the DDF. Missing and special values can be defined by the user with the restriction that numeric data fields should contain only digits, decimal point, + or - sign, and exponential notation. Other alphabetic characters, overpunches, and other devious space saving techniques are to be avoided. Alphanumeric tags to indicate missing, estimated, not available, etc., values should be placed in a separate field and defined in the DDF.

E. County and Equivalent Units

Many of the candidate data bases contain county level data which will be used in regional studies. Counties are well established geopolitical units, common units for state and federal data collection, relatively uniform in size in the eastern 37 states, and often used as management or administrative units. The usefulness of counties is limited by the occurrence of large heterogeneous counties, primarily in the west, and of small independent city units, primarily in Virginia. In addition, counties occasionally change names or boundaries, but IWGDE plans to use the most recent census list (1970) for defining them. Although most socioeconomic data are available for all the independent cities, environmental (agriculture, forestry, land use, etc.) data often are not collected for them, and the current geographic base file for county outlines does not include most independent cities. IWGDE initially proposed that county level Reference Data Bases can consist of either the 3141 units or a set of 3071 county units for the conterminous U.S. with the independent cities aggregated with appropriate counties. As described above, county units containing

* Counties and county equivalents of the States of the United States, Federal Information Processing Standard 6-2, Department of Commerce, National Bureau of Standards, FIPS PUB 6-2, 1973.

Table 2
Counties That Contain Aggregated Data From Associated Independent Cities

State	County	FIPS code		Associated independent city	FIPS code
		State	County		
MD	Baltimore	24	005	Baltimore City	510
MO	St. Louis	29	189	St. Louis City	510
MT	Park	30	067	Yellowstone National Park - Part	113
VA	Albermarle	51	003	Charlottesville	540
VA	Alleghany	51	005	Clifton Forge	560
VA	Alleghany	51	005	Covington	580
VA	Arlington	51	013	Alexandria	510
VA	Augusta	51	015	Staunton	790
VA	Augusta	51	015	Waynesboro	820
VA	Bedford	51	019	Bedford	515
VA	Campbell	51	031	Lynchburg	680
VA	Carroll	51	035	Galax	640
VA	Dinwiddie	51	053	Colonial Heights	570
VA	Dinwiddie	51	053	Petersburg	730
VA	Fairfax	51	059	Fairfax	600
VA	Fairfax	51	059	Falls Church	610
VA	Fredrick	51	069	Winchester	840
VA	Greensville	51	081	Emporia	595
VA	Halifax	51	083	South Boston	780
VA	Henrico	51	087	Richmond	760
VA	Henry	51	089	Martinsville	690
VA	James City	51	095	Williamsburg	830
VA	Montgomery	51	121	Radford	750
VA	Pittsylvania	51	143	Danville	590
VA	Prince George	51	149	Hopewell	670
VA	Roanoke	51	161	Roanoke	770
VA	Roanoke	51	161	Salem	775
VA	Rockbridge	51	163	Buena Vista	530
VA	Rockbridge	51	163	Lexington	678
VA	Rockingham	51	165	Harrisonburg	660
VA	Southampton	51	175	Franklin	620
VA	Spotsylvania	51	177	Fredericksburg	630
VA	Washington	51	191	Bristol	520
VA	Wise	51	195	Norton	720
VA	Chesapeake	51	550	Chesapeake	550
VA	Chesapeake	51	550	Norfolk	710
VA	Chesapeake	51	550	Portsmouth	740
VA	Hampton*	51	650	Hampton	650
VA	Newport News*	51	700	Newport News	700
VA	Suffolk	51	800	Suffolk	800
VA	Suffolk	51	800	Namesmond	695
VA	Virginia Beach*	51	810	Virginia Beach	810

* Independent cities that are treated as unique county units.

an independent city would have a geocode consisting of the 5-digit FIPS code and a single character tag consisting of an asterisk. Table 2 lists the independent cities and the appropriate county for aggregating data based on geographic location, origin of the independent city, and conventions used by groups currently using aggregated county data. Table 3 lists counties that often cause problems in creating or using county files because of historic changes. The number of county units in each of the 48 conterminous states is given in Table 4.

Table 3
County Units That Provide Confusion Due to Historic Changes

State	County	FIPS Code		Comments
		State	County	
GA	Columbus	13	510	Formerly Muscogee County (13215)
NV	Carson City	32	510	Formerly Ormsby County (32025)
WI	Menominee	55	078	Formerly Menominee Indian Reservation
WY	Park (6,959 sq mi)	56	029	Formerly Yellowstone Nat. Pk, now assigned to these two counties
	Teton (4,000 sq mi)	56	039	
ID	Fremont	16	043	Contains part of Yellowstone National Park

Large heterogeneous counties may need to be subdivided into smaller sub-county units for certain studies. Alaska is a prime example of an area having county units inadequate for most regional studies. Although IWGDE is not in a position to suggest a set of subcounty units, a Reference Data Base could accommodate such units by utilizing the geocode tag described above, each sub-county unit being assigned a letter (A to Z).

IV. STATE OF THE EXCHANGE STANDARD

The interchange standard developed by the IWGDE was presented to the ANSI/X3L5 Committee on Labels and File Structure in May 1976 and it was adopted by X3L5 to fulfill an existing development project for information interchange files. The standard has been recast in ANSI format, revised, and extended to its present state. The principal revisions were made to change it from a magnetic tape standard to a media-independent standard and to provide for the use

Table 4
Number of County and County Equivalents in the Conterminous United States
as Aggregated for Reference Data Bases by IWGDE (Total = 3071)

State	FIPS	Abbrev.	Area, km ²	No. of Counties
Alabama	01	AL	132960	67
Arizona	04	AZ	294210	14
Arkansas	05	AR	138130	75
California	06	CA	405050	58
Colorado	08	CO	270370	63
Connecticut	09	CT	13010	8
Delaware	10	DE	5220	3
District of Columbia	11	DC	160	1
Florida	12	FL	145020	67
Georgia	13	GA	151490	159
Idaho	16	ID	215350	44
Illinois	17	IL	145760	102
Indiana	18	IN	93800	92
Iowa	19	IA	145140	99
Kansas	20	KS	213020	105
Kentucky	21	KY	105150	120
Louisiana	22	LA	119580	64
Maine	23	ME	83700	16
Maryland	24	MD	25940	23
Massachusetts	25	MA	20770	14
Michigan	26	MI	148160	83
Minnesota	27	MN	218490	87
Mississippi	28	MS	123220	82
Missouri	29	MO	178880	114
Montana	30	MT	380020	56
Nebraska	31	NE	200380	93
Nevada	32	NV	287580	17
New Hampshire	33	NH	24080	10
New Jersey	34	NJ	19750	21
New Mexico	35	NM	301580	32
New York	36	NY	125790	62
North Carolina	37	NC	127140	100
North Dakota	38	ND	183510	53
Ohio	39	OH	106730	88
Oklahoma	40	OK	180910	77
Oregon	41	OR	248770	36
Pennsylvania	42	PA	116690	67
Rhode Island	44	RI	2980	5
South Carolina	45	SC	80140	46
South Dakota	46	SD	200440	67
Tennessee	47	TN	108370	95
Texas	48	TX	682680	254
Utah	49	UT	219620	29
Vermont	50	VT	25220	14
Virginia	51	VA	100120	100
Washington	53	WA	168720	39
West Virginia	54	WV	62970	55
Wisconsin	55	WI	145780	72
Wyoming	56	WY	245100	23

of extended character sets, and many minor changes and improvements in terminology were also made.

The ANSI/X3L5/78-3F proposed draft¹ was the subject of an X3L5 ballot. It was approved, and the document was submitted to the X3 Committee on Computer Standards for consideration. In December 1977, the then current document was submitted to International Standards Organization Technical Committee T097 as a working paper, as a first step in establishing an ISO project to develop a standard on this subject.

The proposed draft standard was being implemented by IWGDE members. Laboratories submitting data to the SRL Light Water Reactor Environmental Effects Project received funding from that project because they were bearing the brunt of the software development. The remaining IWGDE members received partial support from the IWGDE funding.

The progress during FY77 and FY78 to date includes implementing prototype software and exchanging data tapes on an exploratory basis. This revealed that the major problems would be the use of ANSI Standard X3.27 (spanned record section) because of difficulties in handling ANSI tape labels within the existing CDC and IBM operating systems.

As these problems were revealed and the standards document became stabilized, it became possible through the SRL funding to plan multi-installation implementation. This effort encompasses the development of a CDC version in FORTRAN/Assembler by a joint effort⁸ of BNL and LASL. Unfortunately, the LLL operating system required some modification. An IBM version in PL/1 has been developed by ORNL.⁹ An IBM FORTRAN version was developed at SRL.¹¹ Late in the year PNL developed a PDP-11 version⁶ based primarily on the CDC version. All these versions are similar in design and will look as similar as possible to the user. The remaining two laboratories, ANL and LBL, are installing the standard with partial IWGDE funding.

Progress in FY77 included the documentation and virtual completion of the level 1 standard by BNL and LASL.⁸ The IBM prototypical version was extensively restructured, and documentation began.

In FY78, plans for levels 2 and 3 algorithms and software were developed at a BNL meeting in January 1978. These plans outlined the implementation in prototype form and distribution for incorporation into the level-1 software. Level 1 software and documentation have been completed for all versions.

Implementation of levels 2 and 3, with completion of documentation and user tutorial aids, was scheduled for FY79. ORNL and SRL have since extended their PL/1 and FORTRAN implementations to include level 2.

V. REFERENCES

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10. Dionne, P.J. and Mathisen, D.I., Inventory of Data Bases, Models, and Graphics Packages at the Pacific Northwest Laboratory, PNL-2560, Pacific Northwest Lab., Oct. 1978.
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VI. DATA BASE EXCHANGES

ANL to BNL (Fuja to Benkovitz) MED-X File (Centroids of Census Block Groups and Enumeration Districts)

ANL to LBL (Fuja to Merrill) MED-X File

ANL to LASL (Fuja to Wiley) MED-X File

ANL to ORNL (Lima to Olson) Digitized Ecoregions for the U.S. by State with Areas in Acres

ANL to SRL (Fuja to Suich) MED-X File

BNL to LASL (Benkovitz to Wiley) EPA SAROAD Monitoring Station Site Directory, in Standard Exchange Format

BNL to LBL (Calef to Wood) Energetics Atlas Data Base (Revised)

BNL to LBL (Benkovitz to Merrill) EPA SAROAD Monitoring Station Directory, in Standard Exchange Format

BNL to LBL (Merrill, Levine for LBL use) PARAP (Populations-at-Risk to Air Pollution) Data Base, for Loading in BDMS
(Berkeley Database Management System)

BNL to LLL (Benkovitz to Ries) CDC Exchange Standard Software

BNL to ORNL (Calef to Olson): Energetics Atlas Data Base

BNL to ORNL (Gunwaldsen to Parzyck) Coal Technologies Characteristics

BNL to ORNL (Benkovitz to Olson) Software and NICKEL File to Interface
County Outlines to DISSPLA

BNL to PNL (Benkovitz to Dionne, Hill) CDC Exchange Standard Software

DOE (Ed Miller) to ANL (John Hoover),
BNL (Leonard Hamilton),
LASL (Ron Lohrding),
LBL (Will Siri),
PNL (Darryl Hessel)
via ORNL (Dick Olson):

NCUA (National Coal Utilization Assessment) "Re-study" Tape
from SEAS Model, in IWGDE Exchange Standard Format

LASL to LBL (Wiley to Merrill) Software for CDC Implementation of
Exchange Standard

LASL to PNL (Wiley to Dionne, Hill): CDC Exchange Standard Software

LBL to BNL (Benson to Benkovitz) U.S. County and State outlines
(recommended IWGDE standard reference data base)

LBL to BNL (Merrill to Groncki) 1972 Employment Data for Input-Output
Industries

LBL to BNL (Merrill to Finch) 1960 Air Quality and Mortality Data
from Buffalo, New York

LBL to BNL (Austin to Benkovitz) Census Tract Boundaries for SMSAs
Eastern U.S.

LBL to BNL (Merrill to Benkovitz) EPA-to-FIPS County Geocode
Conversion File (Originally from Jerome Mersch, EPA)

LBL to BNL (Merrill to Benkovitz) County-to-AQCR Geocode Conversion
File

LBL to BNL (Merrill to Cederwall, Benkovitz) Approximate Digitized
Boundaries of Air Quality Control Regions (Aggregated
From County Boundaries)

LBL to BNL (Merrill, Levine for LBL use) PARAP Populations-at-Risk
to Air Pollution Data Base, for Loading in System 2000

LBL to LASL (Merrill, Benson to Wiley, Willerton) World Data Bank II

LBL to ORNL (Merrill to Olson, Strand) EPA-to-FIPS County Geocode
Conversion File

LBL to ORNL (Merrill to Honea) County-to-AQCR Geocode Conversion
File

LBL to ORNL (Merrill, Benson to Paul Johnson) World Data Bank II

LBL to PNL (Merrill, Benson to Dionne, Burnett) U.S. State and
County Outlines (originally from Bureau of Public
Roads)

LBL to PNL (Merrill, Benson to Dionne, Friedrichs) World Data Bank II

LLL to SRL (Lawson, Lyles to Johnson, Kern) 2/8/78 Light Water
Reactor Project Data

ORNL to ANL (McNeely to Fuja) IBM Exchange Standard Software

ORNL to ANL (Loebl to Fuja) 1969 NCHS Detailed Mortality Data

ORNL to BNL (Brooks, McNeely to Benkovitz) ORCHIS Data Base Inventory
 in Standard Exchange Format
 ORNL to BNL (Loebl to Rosen) Bureau of Census Survey of Purchases and
 Ownership
 ORNL to LBL (via ABAG, to Merrill) Routines for Conversion of UTM
 Coordinates to Latitude-Longitude
 ORNL to LBL (Brooks, McNeely to Austin, Merrill) ORCHIS Data Base
 Inventory, in Standard Exchange Format
 ORNL to PNL (Brooks to Dionne) Digitized County Outlines
 ORNL to PNL (Edwards to Dionne, Hill): Cartographic Software
 ORNL to PNL (McNeely to Dionne, Hill): Test Data in Standard Format
 ORNL to SRL (? to ?) Dept. of Transportation County DIME File
 ORNL to SRL (? to ?) 1970 Population Density on 0.05 Degree Grid
 PNL to BNL (Drewes, Hill to Benkovitz): Precipitation Test Data for
 MAP3S Project, in Standard Format
 PNL to SRL (Davis, Hill to Johnson) Alternative Fuel*
 Cycle Technology Study, in Standard Exchange Format
 SRL to HEDL (Johnson to Carlson via Hill): Watershed Populations
 via PNL for Alternative Fuel Cycle Technologies Program,*
 in Standard Exchange Format
 SRL to LBL (Suich to Merrill) Digitized Boundaries of Watersheds in
 Western U.S. (Originally FROM USGS)
 SRL to LLL (Kern to Dickerson) National Weather Service Observations,
 Southeast and Southwest U.S., 1975-1976
 SRL to LLL (Johnson to Lyles) 1/19/77 Light Water Reactor Project,
 Pollutant Deposition by County, in Standard Format

VII. CONCLUSIONS

The short history of the IWGDE has demonstrated the value of establishing reliable mechanisms for collaboration and cooperation among the national laboratories on new projects that encompass regional and national issues. Examples of such mechanisms include formal working groups charted to ensure that duplication of effort is minimized, a national (or international) data exchange standard to ensure the accurate and efficient sharing of data, and communications facilities such as electronic mail and computer-based teleconferencing to provide frequent contacts between geographically dispersed research groups. It is notable that although the IWGDE funding supported less than one-half full-time equivalent employee at each participating laboratory, there were thirty active participants from DOE, and many others from other federal and state agencies over the past two years. This indicates that the "seed money" invested in this effort was indeed cost effective, since it attracted willing contributions from other projects.

*Throughout this document, this project has also been referred to by its initial Title, Light Water Reactor Environmental Effects Project.

The solid accomplishments of the IWGDE include the following:

1. A rigorously defined data exchange standard, which is currently under consideration by ANSI for adoption as a national standard.
2. A set of software implementations of level 1 of this standard running on nine operating systems at eight national laboratories (and easily implementable on the DOE headquarters system and on the EIA machines).
3. A preliminary standard for Geographic Data Exchange, based on the above standard.
4. Documented cases of more than fifty data exchanges in support of energy/environmental studies among the participating laboratories.

Although difficult to document or quantify, the exchange of ideas and information among the participants and their co-workers is even more important and impressive. The IWGDE and its offspring, the Information Contact/Focal Point, formed a solid base for interlaboratory cooperation for several years.

VIII. FUTURE ACTIVITIES

Several areas require additional effort and could profit from the continuation of IWGDE. These areas include liaison among the national laboratories and DOE program managers, liaison with other federal and state agencies, implementation, maintenance, and upgrading of the Reference Data Bases, further refinement to the Geographic Exchange Standard, and further software implementation of the data exchange standard.

A. Liaison Activities

The exchange of ideas and information, in addition to the physical (and electronic) exchange of data, is one of the most important functions of the IWGDE. Any DOE program requiring coordination and collaboration of geographically dispersed research groups can benefit from these activities.

Liaison with other data collection agencies (Bureau of the Census, USGS, EPA, etc.) is particularly valuable for DOE because energy and environmental programs must depend on these agencies for information. There is currently no other mechanism to ensure availability of data sources to DOE programs.

B. Reference Data Bases

The concept of Reference Data Bases was enthusiastically received by IWGDE members when it was proposed. These data bases would provide a solid set of high quality information for all DOE programs and ensure availability to all DOE researchers of the latest and best data in several areas. There are many new candidates for inclusion in the list of Reference Data Bases, such as the SEAS model data bases, a new City-County Data Book, meteorological data bases, and relevant summaries of the 1980 Census of Population. Clearly the maintenance of Reference Data Bases would benefit DOE programs in both the short term and the long term. Just as clearly, such an effort requires financial and programmatic support.

C. Geographic Exchange Standard

Since much of the data used in energy/environmental studies is based on physical or political geography, the geographic base files are tremendously important. Often there is no other way to correlate data gathered by various agencies. Geographic entities such as point locations (air quality monitoring stations, power plants, etc.), census tracts, watershed boundaries, etc., offer a unique mechanism for correlating data into a comprehensive data base. Work on this geographic standard will provide the capability for sharing these files.

D. Implementation of the Standard

The most immediate need is the implementation of level 2 (arrays) and level 3 (hierarchical structures) of the proposed ANSI standard. Most data are stored and used in these structures, and these are crucial to the Geographic Exchange Standard.

Also, new operating systems are in use in the national laboratories which need the TWGDE software immediately. In particular, several DEC machines (VAX/VMS, UNIX), UNIVAC machines, and upgrades to the CDC and IBM systems require at least maintenance work.

IX. APPENDIX
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