NBS TECHNICAL NOTE 1156

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

The CSA Weatherization Demonstration Data Base: Contents and Descriptions

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[2]Some divisions within the center are located at Boulder, CO 80303.

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ABSTRACT

The Community Services Administration (CSA) National Optimal Weatherization Demonstration was conducted over a 3 1/2 year period (1977-1981) by the National Bureau of Standards and Community Action agencies in 12 areas around the Nation, principally to determine what reductions in residence space heating energy consumption could be achieved by extensive, economically cost-effective weatherization of dwellings. Because the project was funded by the CSA, it was conducted using houses occupied by low-income households. In addition to recording overall energy consumption (for the 1975-1980 period), the demonstration collected considerable additional energy-related measurements from approximately 240 houses (including some 40 unweatherized control houses) at the 12 sites. These measurements probably constitute the most extensive and comprehensive data base on real energy usage of real houses extant. The report describes the various measurements that were obtained and how they were obtained. It contains house-by-house inventories of the data actually present in the data base and, as an access aid for further study of the data, it describes the media in which the data exist.

Key Words: Community Services Administration Weatherization Demonstration; costs of weatherization; energy conservation; energy consumption data; energy related data; field measurement of building energy use; Optimal Weatherization Demonstration; residential energy consumption; space heating consumption; weatherization.

PREFACE

This report is one of a number presenting the findings and results of a national "optimal" weatherization demonstration sponsored by the Community Services Administration. The work represented in this document, consisting of inventorying and documenting the data assembled by the demonstration project, was supported by DoE/NBS Task Order 8 under Interagency Agreement DE-AI01-76-PR06010.

ACKNOWLEDGMENTS

Many people made valuable contributions in collecting, reporting, and clarifying the measurements contained in the data base herein described. Especially noteworthy was the care and cooperation with which data were obtained and verified by some of the demonstration site personnel: Larry Dodgen (Atlanta), Debra Hosier (Easton, PA), John Baker (Charleston, SC), Bradley Turk (Colorado) Springs), Kenneth Olsen, Bruce Hilbe and David Sharpe (Fargo, ND), John Zajac (Tacoma, WA), Maurice Hutchins and Melodie Fenwick (Hughesville, MD, the Washington, DC site).

The first version of the "balance point analysis" computer program was written by Dr. Richard A. Grot, while he was associated with Princeton University's Twin Rivers Project on residential energy conservation. Dr. Grot subsequently joined the NBS Center for Building Technology (CBT), where he developed and monitored the field implementation of the mechanical systems tests and the air infiltration tests used in the demonstration. Dr. Grot also conducted the thermographic surveys.

The building thermal performance models, used first to select the options and later to calculate the theretical energy consumption of the houses for comparison with actual measured consumption, were adapted from American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) methods by Richard Crenshaw, Project Manager of the demonstration, and now Manager of the Energy Efficient Buildings Program at the Lawrence Berkeley Laboratory, Berkeley, CA.

Section 5.11 of this report, documenting the options costs data, was prepared by Anne Hillstrom of the CBT Applied Economics Group. The task of obtaining and organizing the cost data was carried out by Dr. Stephen F. Weber, assisted by Michael J. Boehm and Barbara C. Lippiatt.

The author gratefully acknowledges the above contributions.

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1. INTRODUCTION

The Community Services Administration (CSA) Optimal Weatherization Demonstration, conducted by the National Bureau of Standards (NBS) from late 1977 to mid-1980, assembled what is probably the most comprehensive collection of measurements related to actual energy use in occupied houses available anywhere. A very large amount of data was collected on some 240 houses located in 12 geographic areas in the United States (excluding Alaska). The content of the data base is described and inventoried in this report.

The data prescribed to be collected by the CSA Demonstration project included, in addition to 5 years of whole-house utility consumption records, many other energy-use and energy use-related measurements: 1) 1 year or more of weekly readings of: furnace or space heater consumption, run times, and cycle counts; water heater energy consumption and hot water usage; utility (gas and electric) meters; (representative) temperatures on each floor; and indoor humidity; 2) 2 years of monthly measurements of natural air infiltration rates and of temperature stratification patterns in the house; 3) "before" and "after" measurements of furnace or heater steady-state efficiency; 4) "before" and "after" fan tests (induced depressurization of the house to measure tightness/leakiness); 5) thermography of all insulated walls; 6) measurements of possible by-pass leakage of heat into unheated attic spaces; 7) comprehensive costs of weatherization options; and 8) information about occupants' behaviors and attitudes that may affect house energy consumption.

As one would expect in a field study of this size, scope, and geographic dispersion, not all of the prescribed measurements were received for all of the houses. Furthermore, some of the data that were obtained contained ambiguities and obvious errors. To the extent possible, in ways described in this report, ambiguous and obviously faulty data have been purged or corrected. This report lists and describes, house-by-house, the information in the data base. The work was sponsored by the Buildings Division, Office of Buildings and Community Systems of the Department of Energy, in the hope that researchers interested in exploiting these data in the future will be able to do so efficiently and effectively. This report should also be of value to understanding and interpreting the data and conclusions reported in the final report of the demonstration [2].*

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* Numbers in brackets indicate references listed in section 9.

2. OVERVIEW OF THE COMMUNITY SERVICES ADMINISTRATION OPTIMAL WEATHERIZATION DEMONSTRATION

The CSA/NBS National Optimal Weatherization Demonstration was a 3 1/2-year field study of the effects of weatherization on energy consumption in houses, conducted in 12 site areas around the Nation. The sites were selected to be representative of the range of inhabited climates in the U.S. (except Alaska) where winter space heating is a significant energy user: Atlanta, GA; Charleston, SC; Chicago, IL; Colorado Springs, CO; Easton (Allentown/Bethlehem), PA; Fargo, ND; Minneapolis/St. Paul, MN; Oakland, CA; Portland, ME; St. Louis, MO; Tacoma, WA; and Washington, DC (represented by Hughesville, MD).

The principal goal of the demonstration was to show how much energy savings could be achieved in the various site areas by the installation of an "optimal set" of weatherization retrofits or techniques, "optimal set" being defined as all measures (both to the building shell and to the mechanical--space and water heating--systems) that an economic cost/benefit analysis found to be cost-effective: i.e., to pay for themselves within a specified number of years.

The overall approach was: 1) analyze 2 years (i.e., 1975-77) of archival fuel consumption readings from the selected houses to establish the "normal" pre-weatherization rate of energy consumption; 2) apply the prescribed "optimal set" of weatherization retrofits to each house; 3) measure the post-weatherization "normal" rate of energy consumption; and 4) compare the results of 3) with those of 1) and with the actual costs of weatherizing the houses, obtained as a part of step 2).

Since local site Community Action Agency (CAA) personnel would be available to make regular visits to the houses to perform tests and read meters, along with their involvement in carrying out the weatherization work, advantage was taken of the opportunity to collect considerable detailed energy-usage and energy-related data from the houses. Some of these data were directly related to a secondary goal of the demonstration: to try to analyze out the contribution of the several classes of options (e.g., infiltration, conduction, and mechanical systems) to the overall savings achieved in a house, i.e., measuring the mechanical efficiency of heating systems and water heaters before and after weatherization work, and measuring the natural air infiltration rate of a house monthly during the heating seasons. Other data were gathered as checks on the quality and effectiveness of the work performed, i.e., thermography of insulated walls and other possible areas of heat loss, a test for leakage of heated air to unheated spaces in the house, and ratings of the wintertime comfort and temperature impressions of occupants.

For a more complete understanding of how the demonstration was planned and carried out, the reader is referred to CSA Weatherization Demonstration Project Plan [1].

3. DATA MEDIA AND LOCATION

Most of the data discussed herein are in computer disk files. These are located on three 5-Mbyte removable Hawk disk packs and were written using a Perkin-Elmer 7/32 maxi-mini computer in the Computer Facility of the Center for Building Technology (CBT) at the NBS. The specific names of the disk volumes are listed wherever any of the computer data files are discussed in this report.

Disk volumes CSA1 and CSA2 each contain a file, called CSA[1 or 2]LIST., which is a list of all 1) data (including summary data, and the three inventory lists -- that are printed in this report) files, 2) CSS (Command Substitution system, for executing programs) files, and 3) FORTRAN program symbolic listing files. By editing the desired tape-writing parameters into these list files, either can be used as a command file to write all of the useful files from a disk volume to a tape. A paragraph at the beginning of these files discusses the record lengths of the data and program files and how to use the list so as to avoid truncating any files. The blocking factor can be prescribed as desired. The files will be written onto the tape in ASCII, and they can presumably be read by any computer capable of reading ASCII tapes.

Additional data, and backup hard copies of most of the data in the computer files, are located in a set of "house" files--one for each house, identified by the site code and the house number. (It is expected that these files will be retained in the custody of Dr. Richard Grot of the Building Physics Division of CBT.) To facilitate finding any particular piece of data in a house file, some effort has been put into organizing the data sheets in the house files as follows:

1 - Utility data:
  - space heating energy source
  - electricity
  - gas
  - water

2 - Balance point analysis outputs
3 - Fan tests
4 - Air infiltration (from tracer gas) data analysis sheets
5 - Minimum-maximum temperature data (for attic bypass test)
6 - Temperature stratification tests data
7 - Building measurements for thermal analysis (dimensions and descriptions)
8 - Exterior photos
9 - Mechanical systems tests data and photos
10 - Miscellaneous data:
  - CSA Building Weatherization Plan
  - Homeowner's release
  - Electrical system inspection sheets

11 - Occupant questionnaires
12 - Options cost summary sheet

Two sets of data are not in either of the above-described media: 1) files of 7 years of daily high/low temperatures for the sites. (In view of the length of these files, they are maintained on a tape, and a file copied onto a disk

when needed (for calculating degree days at specified balance point(s)--see sections 5.14 and 6.); and 2) thermography data (see section 5.10).

Symbolic listing copies of the FORTRAN program files discussed herein are included on the referenced disk volumes. Rather than risk filling up the disks by also retaining copies of the .TSK (relocatable, machine-language) versions, it is assumed that it would be more efficient for a future user to re-compile a program if or when its use is needed.

4. SITE AND HOUSE IDENTIFICATION SCHEME

For purposes of identifying and associating all data items throughout the demonstration, each house was identified by 1) a three-letter code associated with the site, and 2) a two-digit number. Since some sites submitted three-digit house numbers (existing project numbers out of their weatherization applications register), we had to do some renumbering in order to fit the identifications into our computer file structure. Although some data sheets have erroneous numbers printed thereon (e.g., some early balance point print-outs for Tacoma houses), all data have been carefully checked to be sure that they are, in fact, in the correct file and properly identified.

The three-digit codes for the 14 cities* from which some data were received are shown in table 1.

Table 1
City/site Identification Codes

ABE	Allentown/Bethlehem/Easton, PA (often referred to as "Easton," since the original demonstration project agency for the site was in that city; however, the weather data used came from Allentown)
ALB	Albuquerque*, NM
ATL	Atlanta (Forest Park), GA
CHA	Charleston, SC
CHI	Chicago, IL
CSP	Colorado Springs, CO
FAR	Fargo, ND
MSP	Minneapolis/St. Paul, MN (CAP Agency is located in St. Paul)
NOR	New Orleans (Kenner), LA*
OAK	Oakland, CA
POR	Portland, ME
STL	St. Louis, MO
TAC	Tacoma, WA
WAS	Washington, DC (actually a tri-county area around Hughesville, MD)

The reader will observe later that these three-digit codes are employed as extensions on the file names of summary data files, as file names (with the house number, preceded by some code letter, as extension) for files of data pertaining to a specific house, and as parameters for certain CSS (Command Substitution System) files to evoke data related to a particular site. They

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* Originally 16 cities were selected for the demonstration. Los Angeles was dropped by CSA for agency reasons, and it became evident that it did not really make sense to study space heating weatherization in Miami. Meaningful preweatherization data were received from the other 14 sites. However, Albuquerque and New Orleans did not complete the project; no weatherization work was ever done in New Orleans, and little or no "post" data were received on the Albuquerque dwellings.

also provided the basis (with some modification) for naming the weather (i.e., daily high/low temperature) files (see section 5.14). Wherever the use of one of these site codes is discussed in this report, the expression "[CTC]" is used (meaning, "substitute a city code").

5. DESCRIPTIONS AND INVENTORIES OF THE DATA

5.1 KEY DESCRIPTIVE DATA ABOUT THE BUILDINGS

To serve as a reference at various steps of the analysis process, a set of data files--one for each site--containing key descriptive information about the houses was written. This set of files also came to serve as the point of reference for keeping track of the status of a house vis-a-vis the demonstration, i.e., whether a house was in the "sample" (experimental) group, in the control group, or had been participating in the Demonstration but was "lost" for one reason or another.

Since this general descriptive data may be of value in a "ready reference" form, the latest, updated versions of these "house key data" files are included in this report as tables 2-13.

The code used for data in these tables is fairly extensive, so it is printed on the page before table 2.

These key data files are all resident on disk volume CSA1, with file names "HSKEYDTA.[CTC]". A CSS file, also on CSA1, will print any of the "house key data" files on the high-speed printer, complete with the heading and the footnotes (see exhibit 1, page __). This program is invoked by typing in "CSA1:PR2KYD [CTC]".

A few comments are necessary about the data in these files. Column 8, identified by an asterisk (*) in the heading of tables 2-13, describes the relationship of the house to the demonstration. All houses for which two years of "pre" data were received and a valid "balance point" analysis was obtained (see section 6) are listed in the key data files. (In other words, all houses appearing in the HSBPTDTA files should also appear in the HSKEYDTA files. If a house was selected as part of the sample to be weatherized, an "S" was entered in this column; houses selected as controls (the houses not to be weatherized, but the same tests and data collection to be carried out) were identified with a "C".

For all houses that are blank in column 8 (i.e., that were not selected for the demonstration) the descriptive data in the files comes mainly from CSA BWP (Building Weatherization Plan) forms or other "intake interview" type sources. Such data were not gathered or checked for scientific research purposes and cannot be considered highly reliable. In particular, only "living space" (area) and volume figures not enclosed in parentheses are derived from data specifically obtained for the research project on the Building Measurements for Thermal Analysis forms provided by NBS (see section 5.5). NBS made considerable efforts to verify the data on these forms.

As for all the other descriptive items in the files, for houses that were selected for the Demonstration, all of the data have been cross-checked against all available sources (i.e., construction type against the Building Measurements for Thermal Analysis forms, heating system type against the Mechanical Systems

Tests data sheets, number of occupants and number of occupied floors against the occupant questionnaires and floor plans therein).

By the end of the demonstration in June 1980, some attrition of the sample had occurred. Some homeowners changed their minds about putting up with the hassles of living in "demonstration houses," and declined further participation. One house collapsed and one was taken as part of a freeway right-of-way. In Chicago, some houses were removed from the sample by NBS because the site had insufficient resources to handle the originally selected sample.

When a house was "lost" early in the demonstration, and little useful data on the house had been obtained, the "S" or "C" in column 8 was replaced by a "-".

Some of the attrition that occurred related to specific problems with pre/post fuel consumption comparisons: 1) Insufficient--or insufficiently accurate--post-weatherization fuel data were received to enable us to get a reliable "fix" on post-weatherization consumption. These cases are indicated with an "X" in column 8. Note that, while pre/post energy consumption cannot be compared, other data on the house may be useful. 2) Since earlier dwelling energy consumption research (e.g., the Twin Rivers, New Jersey, study) had documented that a change of occupants could significantly affect the energy usage rate of a given house, it was clear that pre-post consumption comparisons of houses in which a household had moved out and another moved in during the demonstration could not be assumed to reflect only the effect of the weatherization of the house. Such houses were excluded from the "results" data in the report of the demonstration [2] and are indicated in the key data tables in this report by an "*" in column 8. 3) Weatherization work or other energy use-affecting work (such as replacing a furnace or installing storm windows) was done to a few control houses during the measurement period of the demonstration. This rendered the pre/post consumption comparisons of these houses invalid for "control" purposes--and they are identified with a "+" in column 8. Again, other data on these houses may well be of value.

CODES USED IN "HSKEYDTA" FILES/TABLES

*: S= Sample; C= Control group; -= lost from sample.
+= "AFTER" data contaminated by alteration of house;
*= Problem with occupancy or data coverage;
X= Problem with (or no) "AFTER" fuel data.

HSE TYP: D= Detached; A=Attached; E= end unit;
+= part of next higher floor used;
-= part of basement (below grade) occupied;
FL= Only indicated floor occupied. (Floor above not heated).

TYPE: C= Construction; F= Foundation; R= Roof.

FUEL: G = natural gas; O= oil; P= bottled gas (propane of LPG); E= electricity; K =kerosene; W =wood.

I: Observed infiltration condition: 1=P; 2=P-F; 3=F; 4=F-G; 5=G

HT: Heating System Type: Af =Forced air; Ag =Gravity air; Wp =Circulated water; Wg =Gravity water; U =Unvented SpH; V =Vented SpH; S =Space heater; F =Floor furnace; ST =Steam; BB =Baseboard; SV =Stove; WS =Water or steam (unspecified).

LVSP: Area in square feet. NOTE: Areas & volumes in parentheses () are from CSA BWP forms, and probably not accurate. Others are from Building Dimensions for Thermal Analysis data, checked by NBS.

AG: Age of the house (when house entered Demonstration--1977 in most cases)

O: Orientation: 2=NE; 4=SE; 6=SW; 8=NW

NO. OCC: '/' indicates changes during the Demonstration.
#= Occupancy (overall, or daytime) changed; see Questionnaire data.
-= No questionnaire data available for verification.

TABLE 2
ATLANTA KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	---------VOLUMES---------- TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
ATL	01	S	D1	FR	C	G	1	G	E	UV	869	6948	6948				65	N	1	-
ATL	02	S	D1	FR	C	H	1	G	E	UV	1392	13928	13928				99	E	2/1	
ATL	05C	+	D1	FR	C	G	3	G	E	U4	774	6191	6191				35	S	1	
ATL	07		D1	FR	C	G	1	P	P	S	(776)						35		1	-
ATL	08		D1	FR	C	G	3	P	P	S	(1292)						27		2	-
ATL	10		D1	FR	C	G	1	P	P	S	(841)						35		2	-
ATL	11	C	D1	FR	C	G	3	G	G	UV	1947	17823	?	?			40	W	1	
ATL	12C	+	D1	FR 3	C	G		WG	G	UV	1063	8501	8501				32	8?	3/2	
ATL	13		D1	FR	C	G	3	BG	E	S	(984)						35		3	-
ATL	16	-X	D1	FRMV	S	G	3	G	G	Af	(1368)						7	W	4	-
ATL	17	S	D1	MV	C	G	1	E	E	BB	1014	8110	8110				8	2	3	-
ATL	19	S	D1	MV	C	G		G	G	Af	1326	10608	10608				7	S	6/4	
ATL	20S	*	D1	MV	C	H	3	G	G	F	975	7803	7803				20	W	3	#
ATL	21	C	D1	FR	C	G		G	G	F	(720)						28	S	2	#
ATL	22	S	D1	FR	C	G	3	G	G	F	1170	9363	9363				27	W	2	#
ATL	23	S	D1	M	C	G	3	G	G	Af	835	6680	6680				16	E	2/6	#
ATL	24		D2	FR	B	G		G	G	S	(768)						22		1	-
ATL	25CX		D1	M	B	H	3	P	P	VU	1295	10360	10360				17		2	
ATL	27		D1	FR	C	G		G	G	Af	(1060)						13		9	-
ATL	28		D1	FR	C	G		P	E	S	(936)						16		1	-
ATL	29	-	D1	M	C	G	5	G	G	Af	1110	8878	8878				64	E	2	-
ATL	30	S	D1	FR	C	G	3	G	G	UF	1343	10746	10746				10	W	7/8	
ATL	31	S	D1	M	C	H	1	P	E	U2	900	7200	7200				23	E	3	
ATL	32SX		D1	FRMV	C	G	5	E	E	BB	1147	9176	9176				10	S	5	

TABLE 3
CHARLESTON KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	VOLUMES---------- TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
CHA	01SX		D1	FR	C	G		K	E	V2	1356	10848	10848				43	N	3	
CHA	02	S	D1	FR	C	G		P	P	U	1344	10752	10752				20	2?	2	
CHA	03	S	D1	M	S	G		P	E	V	1088	8604	8604				7	2	2	#
CHA	04		D1	MV				P	E	S	(1352)						10		3	-
CHA	05	C	D1	M	C	G		P	E	U2	1428	11424	11424				6	N	1	-
CHA	06		D1	FR		G		P		SP(	896)						6		4	-
CHA	07		D1	FR		H		P	E	GW(1176)							75		4	
CHA	08	S	D1	M	S	G		P	E	V	1088	8704	8704				7	2	8	
CHA	09SX		D1	MV	S	G		P	E	V	1088	8704	8704				6	2?	4	-
CHA	10		D1	M		G		P	P	S	(1107)						9		1	-
CHA	11		D1	MV		G		P	E	S	(1450)						36		5	-
CHA	12		D1	FR		G		P	G	S	(1050)						13		2	-
CHA	13		D1	FR		G		P		S	(660)						15		4	-
CHA	14		D1	M		H		P	P	S	(1560)						15		2	-
CHA	15		D1	M		G		P		S	(950)						28		3	-
CHA	16	S	D1	M	C	G		P	E	U	1276	9688	9688				7	S	6	-
CHA	17		D2	M		G		P	E	S	(816)						6		7	-
CHA	18	S	D1	M	C	G		P	N	U2	1120	8960	8960				10	4?	8/7	
CHA	19	C	D1	M	C	H		P	N	U2	816	6528	6528				11	8?	2	
CHA	20	S	D1	M	C	H		P	E	U4	1288	10304	10304				12	N	7	#
CHA	21	C	D1	M	C	G		P	P	U2	1176	9408	9408				8	4?	1/2	
CHA	22SX		D1	FR	C	G		WP	N	U	918	7344	7344				22	S?	4	
CHA	23	S	D1	MV	C	G		P	E	U2	1368	10944	10944				31	W	3	
CHA	24	C	D1	M	C	G		P	P	U3	660	4950	4950				14	6?	2/1	
CHA	25	S	D1	M	C	G		P	N	U2	675	5400	5400				20	2	3	
CHA	26		D1	M		G		P	E	S	(1118)	(7532)	(7532)				11		9	-
CHA	27SX		D1	FR	C	G		P	E	U2	(1076)	13296	13296				10	2	4	
CHA	28	C	D1	M	C	G		P	P	U3	1662						10	S	4	
CHA	29		D1	M		G		P	P	S	(1480)						15		6	-
CHA	30		D1	MV		H		P	E	S	(1538)						10		4	-
CHA	31		D1	MV		H		P	E	S	(1448)						10		3	-
CHA	32		D1	FR		G		PW		S	(1086)						27		8	-
CHA	33	S	D1	FR	C	G		KPWP		UV	1020	8160	8160				55	E	3	
CHA	33	S	D1	FR				P	P	UV										
CHA	34		D1	FR		G		P	G	S	(1504)						40		3	-
CHA	35		D1	FR		G		PW		S	(1298)						42		2	-

TABLE 3 (cont.)

CTY HS		HSE	--TYPE---				FUEL		---------VOLUMES----------							NO.
CDE NO	*	TYP	C	F	R	I	SP	W	HT LVSP	TOTAL	FL 1	FL 2	FL 3	ATTC	AG O	OCC
CHA 39	S	D1	MV	C	G		P	N	U 1092	8736	8736				46 E?	2/1
CHA 40		D1	MV		G		O	E	S (850)						7	4 -
CHA 42SX		D1	MV	C	U		P	E	U2 1371	9597	9597				12 S	3
CHA 43		D1	MV		G		P		S (1085)						6	2 -
CHA 44	S	D1	FR	C	G		PO	E	UV 1020	7140	7140				12 N	2
CHA 45		D1	MV		G		PO	E	S (1518)						20	1 -
CHA 46		D1	FR		G		P	E	S (1147)						30	1 -
CHA 47	S	D1	MV	C	G		WE	E	BB 1040	8320	8320				6 8?	5
CHA 48		D1	MV		H		PW	E	S (1356)						12	1 -
CHA 49	S	D1	MV	C	G		P	E	V 1026	8208	8208				6	5
CHA 50		D1	MV		G		P		S (1450)						7	10 -

TABLE 4
CHICAGO KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT LVSP TOTAL	VOLUMES FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
CHI	02		D1	MV	B	H	5	G	G	A (800)					27		2	-
CHI	03	SX	D1+	FR	B	G	5	G	G	AF(1907)					50		3	-
CHI	04	-X	A	MV	B	F	3	G	G?	WS?1980)					71		1	-
CHI	05	S	D1+	MV	B	G	5	G	G	AF(1714)					15		8	-
CHI	07	CX	A1+	M	B	H	5	G	G	AF(1848)					35		4	
CHI	08	SX	D1	FR	B	H	5	G	G	WG(1188)					50	E	4	
CHI	09	S	D2	MV	B		4	G	G	AF(1628)					60	W	3	
CHI	10	SX	D1+	FR	B	G	5	G	G	AF(1901)					80		2	-
CHI	11	S	D2	MV	B		3	G	G	WP 1800					50	S	6/4	
CHI	12	S	D1	FR	B	G	2	G	G	AG 1134					99	N	4	
CHI	13	-	D1	MV	B	G	3	G	G	WG(960)					85		3	-
CHI	14	S	D1	MV	B	G	5	G	G	WG 1984					60	W	2	
CHI	15	SX	D1	FR	B	G	3	G	G	WG(1364)					99	W	4/3	
CHI	16	SX	D1+	FR	B	H	5	G	G	AF(1546)					65	E	11/9	
CHI	17	CX	D1	FR	B	H	3	G	G	AF(1383)					7	E	7/6	
CHI	18	SX	D1+	MV	B	G	4	G	G	WP(2877)					47	S	14	
CHI	19	S	D2	FR	B	H	3	G	G	WP 2488					65	W	1/4	
CHI	20	-X	D1+	MV	B	G	5	G	G?	WS?1683)					85		5	-
CHI	22	-X	D1	MV	B	H	3	G	G	AF(1113)					17		1	-
CHI	23	SX	D1+	FR	B	G	3	G	G	WP(1134)					64		2	-
CHI	24	CX	D1+	M	B	H	3	G	G	WP(1344)					61	E	5	#
CHI	25	S	D2	MV	B	F	3	G	G	AG 1120					25	W	2	
CHI	26	SX	D1+	FR	B	G	3	G	G	AF(1392)					85		5	-
CHI	28		D2	MV	B	F	3	O	O	A (1936)					60	N	9	-
CHI	29	S	D2	FR	B		5	G	G+F	ST 1616					99	E	2/1	
CHI	30	-X	D2	MV	C	F	1	G	G	V2(1760)					85	S	5	-
CHI	31	-X	D2	FR	B	G	3	G	G	AF(2240)					99	S	3	-
CHI	32	S	D2	FR	B	H	3	G	G	AF 2580					60	E	5/6	
CHI	33	-X	D2	FR	B	G	3	G	G	VU(816)					50	E	1	-
CHI	34	-X	D2	FR	B	G	3	G	G?	ST?2219)					65	W	6	-
CHI	35	CX	D1+2	MV	B	G	3	G	G	AF(1100)					8	E	7	-
CHI	36		D1	FR	B	G	1	G	G	A (748)					75	W	1	-
CHI	37	SX	D1	FR	BC	G	5	G	G	AG(880)					60	N	4	
CHI	38	S	D1+	MV	B	G	3	G	G	WP 2136					65	E	7	
CHI	39	-X	D1+	MV	B	H	5	G	G?	A?(1100)					25	S	2	-
CHI	40		D1+	FR	B	G	3	G	G	A (8400)					60	E	4	-

TABLE 5
COLORADO SPRINGS KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	VOLUMES--- TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
CSP	01	C	D1+2	FRMV	BC	G	3	G	G	Af	1125	8766	5528	3238			9	E	3	
CSP	02		D1+	FR	C	G	3	G	G	Af(	894)						15		7	-
CSP	03		D1	FR	C	G	3	G	G	Af(1048)							29		1	-
CSP	04		D1+	ST	C	G	3	E	G	Af(1229)							40		3	-
CSP	05	C	D1	FR	B	G	4	G	G	Af	1391	11333	11333				80	N	6/4	
CSP	06C+		D1	M FR	C	F	5	G	G	Af	857	7030	7030				30	S	2	
CSP	07	S	D1	FR	BC	G	5	G	G	Af	688	5323	5323				60	S	2	
CSP	08	C	D1	FR	B	G	4	G	G	Ag	746	6263	6263				50	E	2/1	
CSP	09		D1	MV	B	G	3	G	G	BB(	577)						60		2	-
CSP	10	C	D1+	FRST	C	G	5	G	G	V2	1205	9697	5929	3769			99	N	1	
CSP	11	S	D1	FR	C	G	5	G	G	Af	833	6664	6664				6	4	1/2	#
CSP	12		D1+	FR	C	H	3	G	G	Af(	977)						60		1	-
CSP	13	S	D1	FR	BC	G	5	G	G	F	541	4351	4351				30	S	1	#
CSP	14	S	D2	FRMV	B	G	5	G	G	Af	1547	12104	5897	6207			6	W	8/7	#
CSP	16		D1	FR	S	G	3	G	G	S	(1460)						5		1	-
CSP	17	S	D1	FR	BC	F	3	G	G	F	682	5453	5453				65	S	2	
CSP	20	S	D1	FR	BC	G	5	G	G	FV	891	7841	7841				78	S	2/1	
CSP	21		D1	FR	B	G	3	G	G	Af(1085)							60		1	-
CSP	23	S	D2	FR	B	G		G	G	Af	1568	12330	5969	6361			6	E	2/7	
CSP	24	S	D1	FR	BC	H	3	G	G	Af	966	8696	8696				74	W	2	
CSP	26	S	D1+	FR	BC	G	3	G	G	Af	1136	9298	5135	4162			75	N	2	#
CSP	28	-	D1+	FRST	B	G	3	G	G	Af(1523)							75	E	2	-
CSP	31	S	D2	FRMV	B	G	3	G	G	Af	791?	6325?	?	?			7	N	5/3	
CSP	34S*		D1+	FR	BC	H	3	G	G	Ag	982	8273	5592	2681			60	W	3?	-
CSP	35		D2	FR	C	G	3	G	G	A	(1165)						85	N	5	-
CSP	37	S	D1	FR	BC	G	3	G	G	Af	915	7415	7415				60	S	1	
CSP	40		D1	FR	B	G	3	G	G		(1073)						8		8	-
CSP	41	S	D1	FRMV	C	G	3	G	G	Af	649	5188	5188				7	S?	4	
CSP	43	S	D1-	FR	B	G	3	G	G	Af	923?	7386?	?	?			15	W?	1/2	
CSP	44	S	D2	FR	B	G	3	G	G	Af	786?	6290?	?	?			8	S?	6/8/5	
CSP	47	S	D1	FR	BC	G	3	G	G	Af	585	4736	4736				70	E	1	#
CSP	49	S	D1	FRMV	B	G	3	G	G	Af	884	7072	7072				6	8	4	-
CSP	51		D1	FR	B	G	3	G	G	Ag	(1000)						99		1	-

TABLE 6
EASTON (ALLENTOWN, BETHLEHEM) KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	VOLUMES--------- TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
ABE	01		D2+	FR	B	H	4	P	E	S (1190)							99			-
ABE	03S	*	D1	FR	B	H	3	O	P	Af	890	7564	7564				60	N	2/0	-
ABE	04	S	A2E	M	B	H	4	O	G	Af	960	7680	3840	3840			65	N	4	
ABE	05		A	FR	B	G	4	G	G	A (696)							59			-
ABE	06		D2+	FR	B	H	4	O	F	WS(1584)							99			-
ABE	09		D2+	FR	B	G	4	G	G	A (1852)							32			-
ABE	11SX		A2	M	B	M	4	O	F	Wp	1951	17010	8505	8505			85	E	1/0	-
ABE	12	S	D2+	FR	B	G	2	G	G	Wp	1552	12416	?	?	?		70	S	4	
ABE	13		D1	FR	B	H	4	O	F	W (1102)							19			-
ABE	14		A	M	B	H	2	O	F	A (2450)							60			-
ABE	15		A	FR	B	G	3	G		A (768)							75			-
ABE	16		D2	M	B	G	3	G	G	A (1144)							99			-
ABE	17		A	FR	B	G	3	O	G	A (1296)							90			-
ABE	18		D2	FR	B	G	3	O	G	W (1745)							30			-
ABE	20	S	D2	FR	B	G	4	E	?	A?	1144	9152	4576	4576			7	W	2	
ABE	21		A	FR	B	G	3	O		A (1710)							53			-
ABE	22	S	A2E	M	B	G	5	O	F	Wp	1993	16940	8470	8470			60	S	1	
ABE	23	S	D2	FR	B	G	3	G	G	Af	1450	13050	6525	6525			75	2	2/1	
ABE	25	S	A2+E	M	B	H	3	O	G	Ag	960	7680	?	?			99	E	5	
ABE	26		A2	FR	B	G	3	G	E	W (1280)							70			-
ABE	27	S	A2E	FR	B	G	4	G	G	Af	1290	11610	5805	5805			60	W	2	
ABE	28	S	D2	FR	B	G	4	O	G	Af	1720	13760	?	?			70	E?	1	-
ABE	29		D2	M	B	G	4	O	F	Wp(2112)							40			-
ABE	30		A	FR	B	H	4	O	G	A (1316)							60			-
ABE	31	S	D1	FR	B	G	4	O	F	Wp	1218	9750	9750				30	W	1/3/1	
ABE	32	C	D1+	M	B	G	4	O	F	Wp	1492	11936	7400	4536			18	N	4	#
ABE	33	S	D1	FR	S	G	4	O	F	Wp	1152	9216	9216				21	4	1	
ABE	36		D2	M	B	G	3	O	F	W (1107)							99	E		-
ABE	37		D2	M	B	G	4	O		W (1680)							80	W		-
ABE	38	C	D2	M	B	H	5	G	G	Wg(1768)			(7955)	(7955)			50	W	3	
ABE	39	S	A2	M	B	F	4	O	F	Wp	1858	16479	8240	8240			99	S	3	
ABE	40		D2	M	B		4	O	E	A (1764)							80			-
ABE	41		A	M	B	F	4	O	F	W (1380)							45	N		-
ABE	42	S	D1	FR	B	G	5	E	?	A?	768	6144	6144				8	W	1	
ABE	43		A	M	B	F	4	G	G	W (1950)							65	W		-
ABE	44	S	D1	FR	B	H	3	G	G	Af	1274	10195	10195				65		2	-
ABE	45		D1	FR	B	G	5	O	E	A (910)							25			-
ABE	46	C	D2	M	B	H	3	O	F	Wp(1408)			(5632)	(5632)			50		2/3	

TABLE 7
FARGO KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	---------VOLUMES---------- TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
FAR	02	S	D1	FR	B	G	4	G	G	Af	614	4546	4546				50	S	1	
FAR	03		D1	FR	B	H	4	G	E	A	(864)						50	S	5	-
FAR	04		D2	FR	B	G	4	O	O	WS	(1768)						65	S	8	-
FAR	05S	*	D1	FR	C	G	3	G	G	Af	654	5228	5228				35	E	2	-
FAR	06	S	D1	FR	B	G	4	O	E	Ag	634	5709	5709				50	E	2	
FAR	09		D1	FR	B	G	3	O	E	A	(840)						40	E	1	-
FAR	10	S	D1	FR	B	H	4	O	E	Ag	650	5202	5202				50	W	1	
FAR	11	S	D1	FR	B	G	3	O	G	Af	1225	9800	9800				40	N	1	#
FAR	12		D2	FR	B	G	2	O	G	A	(1440)						75	S	4	-
FAR	13	C	D1	FR	B	G	3	G	G	Af	893	8037	8037				75	S	1	
FAR	15	S	D1	FR	B	G	4	O	G	Af	969	7753	7753				40	E	1	
FAR	17	S	D1	FR	C	G	3	G	E	Af	763	6108	6108				25	S	1/3	#
FAR	18		D1	FR	B	G	4	O	E	A	(785)						24	N	1	-
FAR	19		D1	FR	B	G	2	G	E	A	(432)						49	W	1	-
FAR	20		D1.5	FR	C	G	1	O	E	A	(1296)						60	S	8	-
FAR	21		D1	FR	B	H	3	P	P	A	(720)						50	W	1	-
FAR	22	C	D1	FR	C	G	2	G	G	V	492	3936	3936				50	W	1	
FAR	23	C	D1	FR	B	N	3	O	-	Af	1575	11663	11663				50	E	2/1	#
FAR	24		D1.5	FR	B	G	4	O	G	A	(1224)						70	E	5	-
FAR	25	S	D1	FR	B	G	3	O	G	Af	684	5472	5472				50	S	2/1/2	
FAR	26	C	D1	FR	B	G	3	G	E	Af	884	7072	7072				17	E	3/2	
FAR	27	S	D1	FR	B	G	3	O	E	Af	581	3698	3698				50	W	3	#
FAR	29		D1	FR	B	G	3	O	G	A	(800)						60	E	3	-
FAR	30	S	D1	FR	B	G	4	G	G	Af	747	5979	5979				60	N	1	
FAR	32	S	D1	FR	B	G	4	G	G	Af	945	8739	8739				50	S	1	
FAR	33		D1	FR	B	G	2	O	G	A	(672)						50	E	5	-
FAR	34	C	D1	FR	C	G		O	E	Af	805	5877	5877				15	E	1	
FAR	35	S	D1	FR	C	H	5	G	G	Wp	1225	9798	9798				20	S	3	
FAR	36	S	D1	FR	C	G	3	G	G	Af	517	4136	4136				15	E	1	
FAR	37		D2	FR	B	G		G												-

TABLE 8
MINNEAPOLIS/ST. PAUL KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	VOLUMES TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
MSP	01	S	D1+	FR	B	G	3	G	G	AF	1201	11269	?	?			70	E	4	-
MSP	02	S	D2	FR	B	H	3	G	G	WP	1248	10608	5304	5304			60	S	4	-
MSP	03	S	D1	FR		G	3	G	G	AF	960	7680	7680				40	W	6	-
MSP	04	S	D2	FR	B	G	3	G	G	WG	1944	15552	?	?			80	S	2	-
MSP	05-X		D2	FR	B	G	3	G	F?	W?(1280)							60	S	8	-
MSP	06C+		D1+	FR	B	G	5	O/G	G	WP	(880)						?	N	1/2	
MSP	07-X		D1	FR	B	H	3	G	?	A?(1080)							20	E	1	-
MSP	08	S	D2	FR	B	H	3	O	F	A	1560	14828	7414	7414			70	N	2	
MSP	08	S						G	G	WP										
MSP	09		A2	FR	B	H	3	G	G	W	(2240)						80	S	2	-
MSP	10		A2	FR	B	H	5	G	G	A	(3168)						67	E	4	-
MSP	11		D1+	FR	BC	G	5	O	G	S	(1890)						99	N	2	-
MSP	12-X		D2	FR	B	G	5	G	G	S?	(800)						50	N	4	-
MSP	13	S	D2	FR	B	G	5	G	G	V	1680	13440	?	?			80	N	4	
MSP	17		D2	FR	B	G	1	G		A	(1040)						99	W	3	-
MSP	19-X		MH	FR	S	F	3	O	E	A?	(500)						17		2	-
MSP	20	S	D1	FR	B	H	5	GW	G	AF	1260	9450	9450				15	N	4	
MSP	21	S	D2	FR		G		G	G	AF	1816	17296	8646	8646			45	S	5	
MSP	22		D2	FR	B	M	3	G	F	A	(650)						60	N	7	-
MSP	23	S	D2	FR	B	G	4	G	G	WG	2322	22114	?	?			61	W	4/7	
MSP	25	C	D1	FR	B	G	3	G	G	AG	(1215)						54	E	5	
MSP	26	S	D1+	FR	B	G	3	G	E	V	1344	11760	?	?			99	W	7	
MSP	27CX		D2	FR	B	G	3	O	G	W?(2560)							62	N	1	
MSP	28	C	D1+	FR	B	G	3	G	G	AG(1440)							77	S	1	
MSP	30		D1	FR	B	H	N	G	G	A	(1144)						30	W	2	-
MSP	31	C	D2	FR	B	G	3	G	G	AG(4032)							27	W	4	#
MSP	32		D1+	FR	B	G	3	G	F	A	(1080)						99	E	3	-
MSP	33	S	D1	FR	B	H	3	G	G	AG?	672	6048	6048				50	E	1	
MSP	34	S	D1+	FR	B	G	3	G	G	WG	2312	18496	?	?			67	S	2	
MSP	35		D2	FR	B	G	5	G	F	A	(3132)						80	S	1	-
MSP	36	C	D2	FR	B		3	G	G	WP(3780)							50	S	7	#
MSP	37	C	D2+	FR	B	G	5	G	G	?	(1980)						80	N	6	
MSP	38SX		D1+	FR	B	G	3	G	G	WG(1620)							85	N	1	-
MSP	39SX		D1	FR	B	G	3	O	G	A?	1200	9600	9600				80	N	2	
MSP	40	S	D1	FR	B			G	G	AF	1128	9024	9024				99	E	4	#
MSP	41		D1	FR	B	G	3	G		W	(1584)						70	S	2	-
MSP	42	S	D1+	FR	B	G	3	G	G	WG	1141	8921	?	?			50	S	2	

TABLE 8 (cont.)

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	VOLUMES TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
MSP	43		D1+	FR	B	G	3	O		W (2916)							30	W	6	-
MSP	44	S	D1	FR	B	H	5	G	G	AF	1314	10512	10512				18	S	6	
MSP	45	S	D2	FR	B	H	3	G	G	AG	1257	10061	5031	5031			50	S	4	
MSP	46	S	D1	FR	B	G	3	G	G	AG	1004	8032	8032				65	E	4	
MSP	47		D1+	FR	B	G	3	O		AF(2598)							87	W	1	-
MSP	49		D1+	FR	B	G	3	G	G	W	(1890)						22	E	6	-

TABLE 9
OAKLAND KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY HS CDE NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	VOLUMES TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
OAK 05	C	D2	FR	C	H	3	G	G?	S?(1482)							50		6/7	#
OAK 06	C	D1-	FR	B	G	3	G	G?	Ag?1104)							80		5	
OAK 07		D1	M	C	H	5	G	G?	? (1300)							65		1	-
OAK 09	C	D1+	FR	B	G	3	G	G?	S?(875)							65		7	#
OAK 12		D1+	FR	B	G	3	G	G?	S?(1008)							80		1	-
OAK 15		D1	FR			5	G	G?	S?(840)							50			-
OAK 17	S	D1	FR	C	H	5	G	G?	S? 660							45		3	
OAK 19	S	D1	FR		G		G	G?	S? 3300							70		6	-
OAK 20		D2	FR	B	H	3	G	E?	? (705)							78		3	-
OAK 24		D1	FR	B	G	5	G	G?	A?(1248)							62		1	-
OAK 25		D1+	FR		G	5	G	G?	S?(494)							50		3	-
OAK 26	S	D1	FR	B	H	5	G	G?	S? 1056							50		9	
OAK 28	SX	D1	FR	C	G	3	G	G?	S?(962)							50		5	-
OAK 29		D1	FR	B	H	3	G	G?	A?(1225)							50		5	-
OAK 31	S	D1	M	C	G	4	G	G?	S? 790							60		2	-
OAK 32		D1+	FR	B	G	3	G	G?	S?(1050)							60		5	-
OAK 33	S	D1	M	C	G	5	G	G?	S? 1318							60		2/3	
OAK 34	S	D1	M	S	G	5	G	G?	A? 1056							40		4	
OAK 35	S	D1	FR	C	G	4	G	G?	A? 805							40		2/1	
OAK 36	S*	D1+	M	B	G	5	G	G?	S? 1706							80		3	#
OAK 37	C	D1	FR	BC	G	5	G	G?	S?(1050)							40		3	-
OAK 38	S	D1	FR	B	G	4	G	G?	S? 1512							60		3/2/3	
OAK 39		D1	FR	B	G	4	G	G?	S?(999)									5	-
OAK 40		D1	FR	B	H	3	G	G?	S?(1066)							60		2	-
OAK 42		D1	FR	C	G	3	G	G?	A?(985)							70		1	-

TABLE 10
PORTLAND KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
POR	02SX		D2	FR	B	G	5	O	F?	WS?1440)							55	W	2	-
POR	03	-	D2	FR	B	G	4	OW	F?	WP(2000)							20	W	2	-
POR	04SX		D1+	FR	B	G	5	O	F?	WP(1620)							99	8	3	-
POR	07	S	D2	FR	B	M	3	O	E?	A?(1380)							75	8	6	-
POR	09	S	D2	FR	B	G	3	O	E?	WG(1716)							99	S	2	-
POR	10	S	D1	FR	C	H	3	G	G?	S?	743	5944?	5944?				75	W	1	-
POR	11	S	D1+	FR	B	G	5	OW	E?	AF	1130	8682?	5248?	3434?			50	8	3	-
POR	12	S	D2	FR	B	H	5	O	F?	WP?	864	7343?	2448?	4895?			70	2	5	-
POR	15	S	D2	FR	B	G	5	O	E?	AF(3256)							75	N	5	-
POR	16	S	D2	FR	B	G	5	O	E?	AF	1774	15372?	9134?	6238?			23	8	2	-
POR	17	S	D1	FR	B	G	1	O	?	AG?1060)		?	?				55	6	1	-
POR	17	S	D1	FR				O	?	AF?										
POR	18SX		D2	FR	B	G	1	OW	E?	AG(2160)							80	4	4	-
POR	19SX		D3	FR	B	G	3	OW	F?	WH?2178)							55	W	4Y	-
POR	20	S	D1	FR	B	G	5	O	F?	WP	990	7920?	7920?				40	S	2	-
POR	21	S	D1	FR	B	G	5	OW	E?	AF	468	3276?	3276?				30	S	4	-
POR	23	S	D1+	FR	B	G	5	O	E?	A?	1848	15708?	7854?	7854?			80	W	6	-
POR	25	S	D2	FR		G	5	O	F?	WP	1738	13468?	6906?	6562?			99	N	3	-
POR	26	S	D1+	FR	B	G	5	O	F?	WP	1697	12727?	6788?	5939?			99	N	2	-
POR	28	S	D3+1	FR	B	G	4	O	E?	ST	3640)						75	N	5	-
POR	29	C	D2	FR	B	H	3	O	E?	WG	?	?	?	?			60	W	6	-
POR	30	C	D2+1	FR	B	G	4	O	F?	WP	1948(15380)(8084)(7300)						50	E	4	-
POR	31	C	D2	FR	C	G	3	O	F?	WP	2540(21420(10710(10710)						99	2	4	-
POR	32CX		D2	FR		G	3	O	F?	ST	2200(18637)						75		3	-
POR	33	C	D2	FR	B	G	5	O	E?	AF	2204(18062)(9031)(9031)						75		7	-
POR	34		D1	FR	B	G	3	O	?	A?(	594)						60		7	-

TABLE 11
ST. LOUIS KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	VOLUMES TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
STL	02		D2	FR	B	G	1	G	G	S (1122)							80	N	3	-
STL	04C+		D3	M	B		2	G	G	AG(3500)		?	?	?	?		80	S	3	
STL	04C+		D3					G	G	AF										
STL	05	S	D2	FR	S	G	3	G	G	AF	1039	8104	?	?			7	S	5	
STL	06	S	D2	M	B	F	3	G	G	AF	1477	14922	?	?			55	S	7/6	
STL	07	S	D1	FR	B	G	1	G	G	AF	689	6690	6690				50		2/3	#
STL	08		D1	FR		G	3	G	G	A (1152)							30	E	5	-
STL	09		D2	M	B	H	3	G	G	WS(2430)							70	S	8	-
STL	10	C	D2+	M	B	G	3	G	G	AF(1440)		?	?	?	?		55	W	5	
STL	11SX		D2+	M	B	H	1	G	G	ST(2964)		?	?	?	?		55	S	1	
STL	13		D1	FR		G	3	G	G	S (750)							25	S	1	-
STL	14S*		D2+	M	B	H	2	G	G	AF(3402)		?	?	?	?		80	S	4	
STL	15SX		D1	M	B	F	2	G	G	V (1080)		?	?				55	N	4	
STL	17	S	D1	M	C	F	2	G	G	AF	1938	19347	19347				60	E	4	
STL	18SX		D1	M	B	F	3	G	G	AF(884)		?	?				50	W	2	
STL	23	C	1FL	M	B	F	3	G	G	AF(2117)							90	S	3/2	
STL	28	S	2FL	M	B	F	1	G	G	AF	1841	16319		16319			80	E	3	
STL	29	S	D2+	M	B	H	3	G	G	WP	2300	20935	?	?	?		80	S	2	
STL	34	S	D1+	FR	B	F	2	G	G	AG	1189	13260	?	?			40	E	7	
STL	34	S	D1+	FR				G	G	AF										
STL	37		D2	M	B	G	3	G	G	A (2880)							40	E	6	-
STL	38	S	D1+	FR	B	H	4	G	G	AF	1568	11961	?	?			99	W	8/7	
STL	39		D2	M	B	F	2	G		A (2280)							40	N	2	-
STL	40	S	1FL	M	B	F	1	G	G	AF	1929	18620	18620				57	N	1	
STL	41	S	D1	M	B	F	2	G	G	WG	1028	9256	9256				40	W	4/3	
STL	42	S	D2	FR	B	G	3	G	G	AF	1271	10695	?	?			60	E	1	
STL	43		D2	M	B	F	1	G	G	WS(1840)							60	W	1	-
STL	44-X		D2	M	B	F	3	G	G	AF(3400)		?	?	?			50	N	4	-
STL	46	S	D2	M	B	F	4	G	G	AG	2138	20256	?	?			90	W	1	
STL	49	S	D1+	FR	B		3	G	G	AF	1328	13282	8151	5133			71	N	2	
STL	50		D2	FR	B	G	2	G		S (1968)							50	E	6	-
STL	52		D1	M	B	F	4	G	G	S (816)							55		4	-
STL	55	S	D1	FR	B	G	1	G	G	AG	784	6436	6436				25	N	3	
STL	56	S	D1	M	B	M	2	G	G	AF	885	7085	7085				50	E	5/6	#
STL	62		D3	FR	B	H	3	G	G	A (5850)							70	S	5	-
STL	69		D1	FR	B	G	1	G	F	A (900)							20	W	1	-
STL	70SX		D2	M	B	H	3	G	G?	WG(1440)		?	?	?			70	N	5/3	

TABLE 11 (cont.)

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	VOLUMES TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
STL	71		D3	M	B	H	3	G	G	A (3654)							50	N	4	-
STL	77	S	D2	M	B	G	3	G	G	AF	1356	11633	?	?			60	W	4	
STL	78		D1	FR	B	G	3	G	G	A (850)							29		3	-
STL	92	S	D1	M	B	F	3	G	G	AF	946	8514	8514				60		3	
STL	93	S	D1	FR	B	G	2	G	G	AF	676	5412	5412				65		2	
STL	94		D1+	FR	B	H	3	G	G	A							60		7	-
STL	95		D1	FR	B	G	2	G	G	AF(1575)							65		7	-
STL	97		D1	FR	B	G	1	G		S							60		9	-

ABLE 12
TACOMA KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY HS		HSE	--TYPE---					FUEL				---------VOLUMES----------					NO.	
CDE NO	*	TYP	C	F	R	I		SP	W	HT	LVSP	TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O OCC
TAC 04	S	D1	FR	C	G	3		E	E	BB	1072	8254	8254				8	4
TAC 09		D1		C	G	3		EW	E	BB(1237)							15	1 -
TAC 21	S	D1	FR	C	H	2		G	G	AF	1660	12948	12948				25	1/2
TAC 37	C	D1	FR	C	H	2		E	E	BB	?	?	?				50	1
TAC 39	S	D1	FR	C		1		E	E	BB	960	6826	6826				12	2
TAC 45	S	D1	FR	C	F	3		G	G	V	900	7110	7110				29	3
TAC 49	S	D1	FR	B	G	3		G	E	V	646	5168	5168				45	1
TAC 55	S	1FL	FR	C		3		G	E	AF	928	7920	7920				80	1
TAC 57	S*	D1	FR	C	G	3		G	E	U	948	8514?	8514?				25	4/5
TAC 58	C	D1+	FR	C	G	3		G	E	V	?	?	?	?			60	? -
TAC 65		D1		C	H	2		E	E	BB(	925)						78	3 -
TAC 68		D1	FR			5		E	E	A	(1640)						5	4 -
TAC 75	C	D1	FR	C	G	3		G	G	V	(1083)	?	?				40	1
TAC 76	C	D1	FR	C	G	4		E	E	BB	(1426)	?	?				10	4/5/4
TAC 79		D1	FR	C	G	2		OE	E	ST	(1104)						99	-
TAC 81	S	D1	FR	C	F	5		E	E	BB	1008	7862	7862				8	4/6/4
TAC 83	S	D1	FR	C	H	3		G	E	AF	1080	8424	8424				24	1
TAC 87	S	1FL	FR	CB		4		G	G	U	546	4332	4332				50	1
TAC 98	C	1FL	FR	C	G	3		GW	E	AF	(1344)	?	?				35	2

TABLE 13
WASHINGTON (HUGHESVILLE, MD) KEY DATA

09/28/81

KEY (FIXED) DATA ON HOUSES PROPOSED FOR CSA DEMONSTRATION

(Houses for which at least 2 years of "prior" fuel data was received and run through 'BALPNT' analysis).

CTY CDE	HS NO	*	HSE TYP	--TYPE--- C	F	R	I	FUEL SP	W	HT	LVSP	VOLUMES TOTAL	FL 1	FL 2	FL 3	ATTC	AG	O	NO. OCC	
WAS	02	S	D1	FR	B	G	2	P	E	V	681	5448	5448				29	4	1	
WAS	03			FR	C		3	O	E	A (912)							80			-
WAS	05SX		D2	FR	C	G	2	K	E	V	1176	8938	4469	4469			55		2	
WAS	06	C	D1	M	C	G	5	O	F	WP(1040)		(8320)	(8320)				12		6	
WAS	07	S	D1	FR	C	H	3	O	E	AF	1056	8448	8448				45		1	
WAS	08SX		D1	FR	B	G	3	K	E	V	869	6949	6949				45	4	1	
WAS	09		D2	FR	C		3	K		S (2618)							99			-
WAS	11			FR	C		1	K		ST(5280)							90			-
WAS	14			FR	B		1	O	E								10		9	-
WAS	19			MV	C			O	E	ST							17			-
WAS	21			FR	C		3	O	E	A (672)							10			-
WAS	24SX		D1	FR	B	G,3		O	F	WP	1320	10560	10560				18		12/8	
WAS	27SX		D1	FR	C	G	2	K	P	V	680	4760	4760				10		2/6	
WAS	30			MV	C		5	O		WS(1577)							19		2	-
WAS	31			FR	C			K	E											-
WAS	40CX		D1	MV	C	G		P	P?	S? 1000)		(7059)					24		1	
WAS	41	S	D1	FR	C	G		K/P	P	V	1152	10242	10242				40		1	
WAS	44SX		D2	FR	B	G	4	O	E	AF	1456	11648	5824	5824			60		1	
WAS	47SX		D2-	FR	B	G	3	K	P	V	1264	10118	?	?			60		3	
WAS	53	S	D1+	FR	B	G	2	O	F	WP	772	6176	?	?			70		1	
WAS	54		D1	FR	B	G	3	O	E	A (998)							5			-
WAS	55			FR	C		3	K	E	(868)							26		1	-
WAS	56			FR	C		2	P	P	(960)							40			-
WAS	57	C	D1	FR	C	G	3	K	E	V (912)		(7296)					3		2	#
WAS	58CX		D1	FR	B	G	4	O	F	WP(1104)		(8832)					36		6	#
WAS	60		D1+	FR	C	G	2	OW	E	(1262)							90			-
WAS	62		D2	MFR	C	G	3	O	F	WS(1800)							32		2	-
WAS	63CX		D1	FR	C	G	5	O	E	AF(1564)		?	?				40		1	
WAS	64			MV	B		3	O	E	A (1247)							13		3	-
WAS	65			FR	B		4	O	E	WS(1000)							13		1	-
WAS	67			M	B		4	O	E	A (2240)							7		6	-
WAS	68			FR	C		3	K	E	S (616)							25		3	-

EXHIBIT 1

```
* CSS file "PR2KYD"
*    To print HSKEYDTA files (with heading) on PR2:
*    Use first parameter (@1) to specify site/city.
*    Use nonnull second parameter (@2) to evoke Versatec output, also.
*
XDELETE CSA1:TABLEDTE.
AL CSA1:TABLEDTE.,IN,20
D T ,CSA1:TABLEDTE.
XDELETE CSA1:PRNTKYDT
AL CSA1:PRNTKYDT,IN,80
CSA1:COPYA/P CSA1:TABLEDTE,CSA1:PRNTKYDT,,10
CSA1:APPEND/P CSA1:HSKEYDTA.HDG,CSA1:PRNTKYDT
CSA1:APPEND/P CSA1:HSKEYDTA.@1,CSA1:PRNTKYDT
CSA1:APPEND/P CSA1:HSKEYDTA.FNT,CSA1:PRNTKYDT
CSA1:COPYA/S CSA1:PRNTKYDT,PR2:
$IFNNULL @2
CSA1:UPPR
CSA1:COPYA/P CSA1:PRNTKYDT,PR:
CSA1:UPPR
$ENDC
DE CSA1:TABLEDTE;DE CSA1:PRNTKYDT
$EXIT
```

NOTES: "UPPR" is a utility routine that "page-ejects" the Versatec printer (PR:). It is used after a COPYA to that printer to avoid "washout" of final print lines.

"PR:" is a Versatec electrostatic printer in the Center for Building Technology (CBT) computer system. (It will print both upper and lower case letters, while the high-speed printer can print only upper case.)

5.2 UTILITY DATA

Clearly, the data needs of this demonstration started with a requirement for measurements of the space heating energy consumption of the houses. Specifically, we required 2 years of pre-demonstration space heating consumption readings (July 1975-July 1977, to cover two complete heating seasons) as part of the information to be submitted by local site agencies for proposed demonstration houses. These data came, variously, from utility company records (computer printouts, or hand copies), fuel company delivery and billing records (or delivery invoices), or homeowner-retained records.

Although the regular utility meter was read and reported as part of the weekly readings (see following section), the project staff requested site agencies to provide complete utility or fuel company records through the period of the demonstration--from July 1975 through June 1980, as backup data to the weekly readings. As indicated in the inventory (table 15, beginning page 30), some of the later data were entered into the computer files and some are available only in hard copies. The coding scheme used to identify fuel types, and the utility data computer files, is shown in table 14.

TABLE 14

CODES FOR FUEL/UTILITY AND ASSOCIATED FILE TYPES

G	natural gas in therms
M	natural gas in 100 ft^3 (i.e., "meter" readings)
O	oil in gallons
E	electricity in kWh
B	propane or LPG in gallons
P	propane or LPG in ft^3 (from line meters)
K	kerosene in gallons
D	(see discussion below)

All computer disk-based utility data files are located on disk CSA1, and are named as follows:

[CTC].[F][NM]

where:

CTC is the site/city code (discussed above);
F is the one-letter code for fuel/file type; and
NM is the two-digit house number.

When we originally began writing space heating consumption data files, a convention was adopted to identify the file containing the measurements of the principal space heating energy source by a ".D" ("dwelling"), regardless of the fuel type. Thus, for a house that originally used two fuel types, such as Charleston no. 33, there is a CHA.D33 file containing the bottled gas consumption data and a CHA.K33 file with the kerosene data.

To most efficiently serve the needs of the "balance point" analysis program, each record in a utility data file contained, in addition to the city code, house number, and fuel type, a beginning date (i.e., last previous reading or delivery date) the current reading or delivery date, and the fuel amount. (Obviously, delivery data were used on the assumption that the tank was filled, thus accurately reflecting consumption since the last "filling" of the tank. Analysis by the "balance point" program showed that, in many cases, this assumption was valid, but for some it was not--at least, in some cases the delivery records vs. degree days displayed a very poor fit to a straight line.)

Thus, the standard record in a utility data file has the following format (dates being printed: month, day, year):

CTC MN F 07 01 75 08 03 75 001.0 [E] ([ ] = optional)

The optional "E" at the end identifies the record to the Balance Point analysis program as an estimated reading, not to be used as a measurement by itself, but to be cumulated with subsequent reading(s) until no E occurs. Such E's were also sometimes inserted in the files as an editing procedure: if the initial analysis run resulted in an unsatisfactorily low R^2 and examination of the tabular printout (see section 6.0) showed one or more pairs of successive data points with high followed by low or low/high residuals, it was assumed that in the first record of the pair, either 1) the meter was misread (or misrecorded) or 2) the date was misreported. In such cases, the first record was combined with the one following by inserting "E" in the proper column, and the analysis rerun. The rationale for this procedure is that meters accumulate consumption--thus, an erroneously reported meter reading is corrected by the next (correct) reading. This resulted in one (or more) fewer data points, but often a much improved R^2.

A CSS file on disk CSA1 uses the COPY32 utility (loaded from an appropriate source) to print any utility data file (any file, for that matter) with the file name shown as a heading. This CSS file is invoked by "RPPRPRNT.[CSS] [FILENAME.EXT]" (see exhibit 2).

Having in mind that the operation of electrical or gas devices or appliances contributes to the internal heat gains of a building, we requested that sites provide 1975-1980 records for consumption for all energy sources. As shown by the inventories, these supplementary utility data were received from some, but not all, sites.

Also, since we were measuring 1) hot water consumption and 2) water heating fuel consumption, we requested records of total water consumption as a background. Again, these were received from some, but not all, of these sites.

One note concerning natural gas consumption records: Originally we tended to assume gas consumption records from utilities were in therms, unless clearly stated otherwise, so the "G" fuel code was used. Closer examination of the original submissions in the inventorying process has revealed this assumption to be incorrect in some cases. For example, the data from Colorado Springs is in the form of "meter readings" and "differences"--thus, the consumption is, by

implication, in $100ft^3$, not therms. The implications of incorrect use of "G" or "M" are 1) the labels on the "balance point" analysis printout will be incorrect and 2) all Btu conversions of the data will be in error by roughly 3 percent. Every effort was made to check and correct the utility and the summary data files (see section 6.0), but all utility files incorporating the "G" code should be cross checked against the original data before future use.

EXHIBIT 2

```
* CSS file "RPRPRNT"
*    To print (on PR:--Versatec printer) any file,
*    with file name listed at top, and number of records shown at bottom.
*
$BUILD CSA1:RCOPY.CMD
COPY CSA1:@1,PR:
END
$ENDB
LO CSA1:COPY32
ST,COMMAND=CSA1:RCOPY.CMD,LIST=C:
CSA1:UPPR
$EXIT
```

TABLE 15

File CSA1:UTILINVY.

INVENTORY OF UTILITY DATA

CTC	Hse. No.	Space Heating Fuel*	From+	To	No.	Medium#	Electricity From	To	No.	Medium	Gas From	To	No.	Medium	Water From	To	No.	Medium
ABE	01	B	04/75	11/77	22	ABE.D01	04/75	08/77	14	ABE.E01	B-See Space Heating---				----------			
ABE	03	O	02/74	08/75	11	HC	----------				B09/75	03/79	43	HC	----------			
			08/75	07/77	18	ABE.D03												
			02/78	04/79	7	HC												
ABE	04	O	12/75	04/77	10	ABE.D04	----------				05/75	09/77	14	ABE.G04	----------			
			09/78	03/80	11	ABE.D04												
ABE	11	O	04/75	04/80	29	ABE.D11	----------				----------				----------			
ABE	12	M	05/75	09/77	27	ABE.D12	----------				--See Space Heating---				----------			
			09/79	05/80	8	HC$												
ABE	20	E	09/75	09/77	12	ABE.D20	--See Space Heating---				----------				----------			
			07/78	05/79	7	HC												
			07/79	04/80	9	HC												
ABE	22	O	09/75	04/77	10	ABE.D22	----------				----------				----------			
			06/78	04/80	10	ABE.D22												

NOTES:
* See fuel code on page 26.
No. = number of readings
# Name of computer disk file (on CSA1:) or Hard Copy (HC).
B (at beginning of GAS entry) = bottled gas (LPG or propane).
$ Specific reading dates not reported. (Sometimes they can be approximated from other available data.)
"E" Mostly "estimated" readings.

TABLE 15 (cont.)

ABE 23	M	05/75-08/77	14	ABE.D23	--See Space Heating---
		08/78-03/80	20	HC	
ABE 25	O	10/75-10/77	15	ABE.D25	10/75-08/77 11 ABE.G25
ABE 27	M	09/75-09/77	24	ABE.D27	--See Space Heating---
		08/78-04/80	19	HC	
ABE 28	O	08/75-04/77	10	ABE.D28	09/75-09/77 12 HC
		06/78-03/80	9	ABE.D28	
ABE 31	O	05/75-10/77	27	ABE.D31	
		08/78-05/79	12	HC	
		09/79-04/80	10	ABE.D31	
ABE 32	O	09/75-05/77	16	ABE.D32	
		11/78-05/80	12	ABE.D32	
ABE 33	O	04/75-06/75	1	HC	
		06/75 07/77	11	ABE.D33	
		09/78-10/79	5	HC	
		10/79-03/80	3	ABE.D33	
ABE 38	M	05/75-10/77	29	ABE.D38	--See Space Heating---
		07/78-03/79	8	HC	
		07/79-04/80	8	HC	
ABE 39	O	02/75-09/77	20	ABE.D39	
		10/78-02/79	4	HC	
		10/79-04/80	6	ABE.D39	
ABE 40	O	05/75-12/77	15	ABE.D40	
ABE 41	O	09/73-12/77	32	ABE.D41	
ABE 42	E	04/75-10/77	31	ABE.D42	--See Space Heating---
		07/78-07/79	10	HC	
		07/79-04/80	8	ABE.D42	

TABLE 15 (cont.)

ABE 44	M	05/75-12/77	31	ABE.D44	----------	--See Space Heating---	----------	----------	----------
		08/ ?-08/ ?	13	HC					
ABE 46	O	08/77-08/78	13	ABE.D46	----------	----------	----------	----------	----------
		10/79-05/80	14	ABE.D46					
ATL 01	M	03/75-10/77	31	ATL.D01	05/75-10/79	53	HC	--See Space Heating---	----------
		10/77-08/79	23	HC					
		10/79-11/79	1	HC					
ATL 02	M	03/75-10/77	31	ATL.D02	03/75-10/77	31	ATL.E02	--See Space Heating---	----------
		10/77-03/80	30	HC	11/77-10/79	24	HC		
					12/79-06/80	9	HC		
ATL 05	M	03/75-10/77	27	ATL.D05	03/75-10/77	31	ATL.E05	--See Space Heating---	----------
		10/77-04/80	29	HC	11/77-10/79	24	HC		
					01/80-04/80	3	HC		
ATL 11	M	03/75-10/77	31	ATL.D11	01/75-03/75	2	HC	--See Space Heating---	----------
		10/77-06/80	33	HC	03/75-10/77	31	ATL.E11		
					10/77-05/80	30	HC		
ATL 12	M	03/75-10/77	31	ATL.D12	01/75-03/75	2	HC	--See Space Heating---	----------
		10/77-08/78	9	HC	03/75-10/77	31	ATL.E12		
		10/78-06/80	19	ATL.D12	10/77-06/80	32	HC		
ATL 16	M	03/75-11/77	32	ATL.D16	05/75-10/77	29	ATL.E16	--See Space Heating---	----------
ATL 17	E	04/75-10/77	30	ATL.D17	--See Space Heating---	----------	----------	----------	----------
		10/77-02/80	28	HC					
ATL 19	M	03/75-11/77	32	ATL.D19	04/75-10/77	30	ATL.E19	--See Space Heating---	----------
		12/77-09/78	10	HC	10/77-07/79	21	HC		
		09/78-06/80	17	ATL.D19	11/79-05/80	6	HC		

TABLE 15 (cont.)

ATL 20	M	03/75-11/77	32	ATL.D20	12/74-04/75	4	HC	--See Space Heating---	----------
		11/77-09/78	10	HC	04/75-11/77	31	ATL.E20		
		09/78-06/80	21	ATL.D20	11/77-06/80	31	HC		
ATL 21	M	03/75-11/77	31	ATL.D21	01/75-04/75	3	HC	--See Space Heating---	----------
		12/77-06/79	18	HC	04/75-10/77	30	ATL.E21		
		06/79-12/79	NO	SVC.	11/77-07/79	20	HC		
		12/79-06/80	6	HC	07/79-12/79	0	VACANT		
ATL 22	M	05/75-10/77	29	ATL.D22	04/75-11/75	7	HC	--See Space Heating---	----------
		10/77-08/78	10	HC$	11/75-10/77	30	ATL.E22		
		09/78-06/80	20	HC	10/77-06/80	29	HC		
ATL 23	M	03/75-11/77	32	ATL.D23	12/74-04/75	4	HC	--See Space Heating---	----------
		11/77-06/80	31	HC	04/75-10/77	30	ATL.E23		
					10/77-10/79	24	HC		
ATL 25	B	04/75-05/80	29	ATL.D25	01/75-04/75	3	HC	B-See Space Heating---	----------
					04/75-10/77	31	ATL.E25		
					10/77-05/80	30	HC		
ATL 29	G	12/75-10/77	22	ATL.D29	01/75-01/76	12	HC	--See Space Heating---	----------
		10/77-08/78	10	HC$	01/76-10/77	21	ATL.E29		
		09/78-09/79	11	ATL.D29	10/77-10/79	23	HC		
		09/79-11/79	2	HC					
		11/79-		NO SVC.	10/79-		NO SVC.		
ATL 30	M	03/75-10/77	31	ATL.D30	12/74-03/75	3	HC	--See Space Heating---	----------
		11/77-08/78	10	HC$	03/75-10/77	31	ATL.E30		
		09/78-06/80	22	HC	11/77-06/80	32	HC		
ATL 31	B	04/75-10/80	23	ATL.D31	01/75-04/75	3	HC	B-See Space Heating---	----------
					04/75-10/77	30	ATL.E31		
					11/77-03/80	29	HC		
ATL 32	E	01/75-04/75	3	HC	--See Space Heating---			----------	----------
		04/75-10/77	30	ATL.D32					
		11/77-05/80	30	HC					

TABLE 15 (cont.)

CHA 01	O	02/74-01/75 3 HC 01/75-01/80 22 CHA.D01	05/75-04/80 59 HC	----------
CHA 02	B	12/74-04/75 3 HC 04/75-05/80 26 CHA.D02	04/75-04/80 60 HC	B-See Space Heating---
CHA 03	B	07/74-03/75 4 HC 03/75-04/80 36 CHA.D03	04/75-04/80 60 HC	B-See Space Heating---
CHA 05	B	02/73-04/75 13 HC 04/75-03/80 28 CHA.D05	05/75-04/80 59 HC	B-See Space Heating---
CHA 08	B	10/74-04/75 5 HC 04/75-03/80 36 CHA.D08 03/80-04/80 1 HC	04/75-04/80 60 HC	B-See Space Heating---
CHA 09	B	12/74-02/75 1 HC 02/75-04/77 10 CHA.D09 01/79-03/80 3 HC	04/75-04/80 60 HC	B-See Space Heating---
CHA 16	B	03/75-04/80 33 CHA.D16	04/75-04/80 60 HC	B-See Space Heating---
CHA 18	B	04/75-03/80 40 CHA.D18 03/80-04/80 1 HC	04/75-04/80 60 HC	B-See Space Heating---
CHA 19	B	10/74-03/75 5 HC 03/75-03/80 31 CHA.D19 03/80-04/80 1 HC	04/75-04/80 60 HC	B-See Space Heating---
CHA 20	B	03/75-02/80 30 CHA.D20	01/75-04/80 63 HC	B-See Space Heating---
CHA 21	B	12/74-03/75 4 HC 03/75-02/80 47 CHA.D21	01/75-04/80 62 HC	B-See Space Heating---
CHA 22	B	09/74-02/75 5 HC 02/75-03/80 35 CHA.D22	04/75-04/80 60 HC	B-See Space Heating---

TABLE 15 (cont.)

CHA 23	B	02/75-03/80 49 CHA.D23	01/75-04/80 62 HC	B-See Space Heating---	----------
CHA 24	B	08/74-04/75 7 HC 04/75-03/80 46 CHA.D24	04/75-04/80 60 HC	B-See Space Heating---	----------
CHA 25	B	11/74-02/75 3 HC 02/75-03/80 34 CHA.D25 03/80-05/80 1 HC	04/75-04/80 60 HC	B-See Space Heating---	----------
CHA 27	B	10/73-03/75 7 HC 03/75-03/80 26 CHA.D27	07/77-01/80 30 HC	B-See Space Heating---	----------
CHA 28	B	09/73-02/75 10 HC 02/75-03/80 35 CHA.D28	04/75-06/77 26 HC$ 07/77-01/80 30 HC	B-See Space Heating---	----------
CHA 33	B K	07/74-03/80 33 CHA.D33 02/74-02/75 3 HC 02/75-11/78 14 CHA.K33	04/75-04/80 60 HC	B-See Space Heating---	----------
CHA 39	B	01/75-03/75 3 HC 03/75-02/80 44 CHA.D39	04/75-04/80 60 HC	B-See Space Heating---	----------
CHA 42	B	01/75-02/75 1 HC 02/75-03/80 30 CHA.D42	04/75-07/77 27 HC$ 07/77 11/79 28 HC	B-See Space Heating---	----------
CHA 44	B	10/74-02/75 3 HC 02/75-02/80 34 CHA.D44	04/75-04/80 60 HC	B-See Space Heating---	----------
CHA 47	E	04/75-04/80 60 CHA.D47	--See Space Heating---	----------	----------
CHA 49	B	10/74-03/75 4 HC 03/75-05/80 24 CHA.D49	04/75-04/80 60 HC	B-See Space Heating---	----------
CHI 03	M	09/75-09/77 24 CHI.D03	----------	--See Space Heating---	----------
CHI 04	M	09/75-09/77 24 CHI.D04	----------	--See Space Heating---	----------

TABLE 15 (cont.)

CHI 05	M	09/75-04/80	55	CHI.D05	07/76-12/77	15 HC	--See Space Heating---	----------
					08/78-06/80	17 HC		
CHI 07	M	09/75-08/77	22	CHI.D07	07/75-11/76	14 HC	--See Space Heating---	----------
		10/77-05/80	31	CHI.D07	11/78-06/80	15 HC		
CHI 08	M	10/75-05/80	52	CHI.D08	07/75-06/80	34 HC	--See Space Heating---	----------
CHI 09	M	01/76-05/80	52	CHI.D09	01/76-06/80	34 HC	--See Space Heating---	----------
CHI 10	M	09/75-09/77	24	CHI.D10	----------		--See Space Heating---	----------
CHI 11	M	09/75-05/80	55	CHI.D11	07/75-06/80	36 HC	--See Space Heating---	----------
CHI 12	M	09/75-05/80	57	CHI.D12	08/75-06/80	37 HC	--See Space Heating---	----------
CHI 13	M	09/75-09/77	24	CHI.D13	----------		--See Space Heating---	----------
CHI 14	M	09/75-05/80	57	CHI.D14	07/75-10/77	14 HC	--See Space Heating---	08/75-04/80 22 HC
					08/78-06/80	20 HC		
CHI 15	M	07/75-05/80	54	CHI.D15	07/75-06/80	33 HC	--See Space Heating---	----------
CHI 16	M	08/75-05/80	55	CHI.D16	07/75-06/80	37 HC	--See Space Heating---	----------
CHI 17	M	08/75-05/80	51	CHI.D17	06/75-06/80	38 HC	--See Space Heating---	----------
CHI 18	M	09/75-05/80	50	CHI.D18	07/75-06/80	38 HC	--See Space Heating---	----------
CHI 19	M	10/75-05/76	57	CHI.D19	07/75-06/80	36 HC	--See Space Heating---	----------
		08/76-05/80	45	HC				
CHI 20	M	09/75-09/77	24	CHI.D20	----------		--See Space Heating---	----------
CHI 22	M	09/75-09/77	24	CHI.D22	----------		--See Space Heating---	----------

TABLE 15 (cont.)

CHI 23	M	08/75-09/77	23	CHI.D23	----------	--See Space Heating---	----------				
CHI 24	M	09/75-04/77	19	CHI.D24	07/75-06/80	38	HC	--See Space Heating---	----------		
		08/77-05/80	33	CHI.D24							
CHI 25	M	09/75-05/80	55	CHI.D25	05/75-06/80	38	HC	--See Space Heating---	----------		
CHI 26	M	09/75-09/77	24	CHI.D26	----------	--See Space Heating---	----------				
CHI 29	M	12/74-05/80	65	CHI.D29	09/75-06/80	33	HC	--See Space Heating---	----------		
CHI 30	M	11/74-06/75	5	CHI.D30	----------	--See Space Heating---	----------				
		10/75-05/78	28	CHI.D30							
CHI 31	M	11/74-04/78	39	CHI.D31	----------	--See Space Heating---	----------				
CHI 32	M	11/74-01/75	2	CHI.D32	08/75-07/80	36	HC	--See Space Heating---	----------		
		08/75-05/80	54	CHI.D32							
CHI 33	M	12/74-05/78	41	CHI.D33	----------	--See Space Heating---	----------				
CHI 34	M	09/74-06/75	6	CHI.D34	----------	--See Space Heating---	----------				
		01/76-04/78	27	CHI.D34							
CHI 35	M	09/74-04/78	41	CHI.D35	----------	--See Space Heating---	----------				
CHI 37	M	01/75-05/80	66	CHI.D37	07/75-06/80	36	HC	--See Space Heating---	----------		
CHI 38	M	12/74-04/80	63	CHI.D38	08/75-06/80	34	HC	--See Space Heating---	----------		
CHI 39	M	12/74-05/78	40	CHI.D39	----------	--See Space Heating---	----------				
CSP 01	M	12/73-06/75	18	HC	12/73-06/80	78	HC	--See Space Heating---	12/73-06/80	66	HC
		06/75-08/78	38	CSP.D01							
		08/78-06/80	22	HC							
CSP 05	M	12/73-06/75	17	HC	12/73-06/80	78	HC	--See Space Heating---	12/73-06/80	78	HC
		06/75-09/78	31	CSP.D05							
		09/78-06/80	21	HC							

TABLE 15 (cont.)

CSP 06	M	12/73-06/75 18 HC 06/75-07/78 36 CSP.D06 07/78-06/80 21 HC	12/73-06/80 76 HC	--See Space Heating--- 12/73-06/80 77 HC
CSP 07	M	05/75-06/75 1 HC 06/75-07/78 37 CSP.D07 07/78-06/80 23 HC	05/75-06/80 61 HC	--See Space Heating--- 05/75-06/80 61 HC
CSP 08	M	03/75-06/75 3 HC 06/75-08/78 35 CSP.D08 08/78-05/80 21 HC	03/75-05/80 59 HC	--See Space Heating--- 03/75-05/80 59 HC
CSP 10	M	12/73-06/75 18 HC 06/75-07/78 37 CSP.D10 07/78-06/80 23 HC	12/73-06/75 18 HC 06/75-07/78 37 CSP.E10 07/78-06/80 23 HC	--See Space Heating--- 12/73-06/80 78 HC
CSP 11	M	09/74-06/75 9 HC 06/75-07/78 37 CSP.D11 07/78-06/80 23 HC	09/74-06/75 9 HC 06/75-07/78 37 CSP.E11 07/78-06/80 23 HC	--See Space Heating--- 09/74-06/80 69 HC
CSP 13	M	12/73-06/75 17 HC 06/75-08/78 38 CSP.D13 08/78-06/80 21 HC	12/73-06/80 76 HC	--See Space Heating--- 12/73-06/80 74 HC
CSP 14	M	12/73-05/75 15 HC 05/75-08/78 39 CSP.D14 08/78-06/80 22 HC	12/73-05/75 15 HC 05/75-08/78 39 CSP.E14 08/78-06/80 22 HC	--See Space Heating--- 12/73-06/80 76 HC
CSP 17	M	12/73-06/75 17 HC 06/75-08/78 38 CSP.D17 08/78-06/80 22 HC	12/73-06/80 77 HC	--See Space Heating--- 12/73-06/80 77 HC
CSP 20	M	01/75-06/75 5 HC 06/75-07/78 37 CSP.D20 07/78-06/80 23 HC	01/75-06/80 65 HC	--See Space Heating--- 01/75-06/80 65 HC

TABLE 15 (cont.)

CSP 23	M	12/73-05/75 14 HC 05/75-08/78 39 CSP.D23 08/78-06/80 22 HC	12/73-05/75 14 HC 05/75-08/78 39 CSP.E23 08/78-06/80 22 HC	--See Space Heating--- 12/73-06/80 75 HC
CSP 24	M	12/73-06/75 17 HC 06/75-08/78 36 CSP.D24 08/78-06/80 22 HC	12/73-06/80 77 HC	--See Space Heating--- 12/73-06/80 77 HC
CSP 26	M	12/73-06/75 18 HC 06/75-08/78 38 CSP.D26 08/78-06/80 22 HC	12/73-06/80 78 HC	--See Space Heating--- 12/73-06/80 78 HC
CSP 28	M	12/73-06/75 17 HC 06/75-09/78 39 CSP.D28 09/78-06/80 21 HC	12/73-06/80 77 HC	--See Space Heating--- 12/73-06/80 77 HC
CSP 31	M	12/73-05/75 14 HC 05/75-07/78 38 CSP.D31 07/78-06/80 23 HC	12/73-05/75 14 HC 05/75-07/78 38 CSP.E31 07/78-06/80 23 HC	--See Space Heating--- 12/73-06/80 75 HC
CSP 34	M	04/74-05/75 11 HC 05/75-07/78 30 CSP.D34 07/78-06/80 19 HC	04/74-06/80 68 HC	--See Space Heating--- 04/74-06/80 68 HC
CSP 37	M	12/73-06/75 18 HC 06/75-07/78 34 CSP.D37 07/78-06/80 23 HC	12/73-06/80 78 HC	--See Space Heating--- 12/73-06/80 78 HC
CSP 41	M	12/73-05/75 17 HC 05/75-07/78 38 CSP.D41 07/78-06/80 23 HC	12/73-05/75 17 HC 05/75-07/78 38 CSP.E41 07/78-06/80 23 HC	--See Space Heating--- 12/73-06/80 78 HC
CSP 43	M	12/73-06/75 18 HC 06/75-08/78 38 CSP.D43 08/78-06/80 22 HC	12/73-06/80 78 HC	--See Space Heating--- 12/73-06/80 78 HC

TABLE 15 (cont.)

CSP 44	M	12/73-05/75 17 HC 05/75-07/78 37 CSP.D44 07/78-06/80 23 HC	12/73-06/80 78 HC	--See Space Heating---	12/73-06/80 78 HC
CSP 47	M	12/75-06/76 6 HC 06/76-07/78 25 CSP.D47 07/78-06/80 23 HC	12/75-06/76 6 HC 06/76-07/78 25 CSP.E47 07/78-06/80 23 HC	--See Space Heating---	12/75-06/80 54 HC
CSP 49	M	07/74-05/75 10 HC 05/75-07/78 38 CSP.D49 07/78-06/80 22 HC	07/74-06/80 70 HC	--See Space Heating---	07/74-06/80 68 HC
FAR 02	M	01/73-06/75 29 HC 06/75-08/77 26 FAR.D02 08/77-06/80 34 HC	02/75-06/80 63 HC	--See Space Heating---	03/75-06/80 21 HC
FAR 05	M	01/73-06/75 29 HC 06/75-09/77 27 FAR.D05 09/77-06/80 33 HC	01/75-06/80 64 HC	--See Space Heating---	12/74-03/80 21 HC
FAR 06	O	01/73-09/75 16 HC 09/75-02/80 28 FAR.D06	01/75-06/80 64 HC	----------	03/75-06/80 18 HC
FAR 10	O	01/73-07/80 29 FAR.D10	01/75-06/80 64 HC	----------	01/75-04/80 21 HC
FAR 11	O	01/73-09/75 14 HC 09/75-04/80 23 FAR.D11	01/75-06/80 64 HC	01/75-06/80 63 HC	01/75-04/80 21 HC
FAR 13	M	01/73-06/75 29 HC 06/75-09/77 27 FAR.D13 09/77-06/80 33 HC	01/75-09/78 44 HC	--See Space Heating---	01/75-03/80 21 HC
FAR 15	O	01/73-10/75-15 HC 10/75-03/80 24 FAR.D15	01/75-06/80 64 HC	01/75-06/80 64 HC	02/75-05/80 21 HC
FAR 17	M	01/73-06/75 29 HC 06/75-09/77 27 FAR.D17 09/77-05/80 30 HC	01/75-06/80 64 HC	--See Space Heating---	12/74-06/80 20 HC

TABLE 15 (cont.)

FAR 22	M	01/73-06/75 29 HC 06/75-09/77 27 FAR.D22 09/77-06/80 33 HC	01/75-06/80 62 HC	--See Space Heating---	12/74-03/80 21 HC
FAR 23	O	09/73-06/80 72 FAR.D23	01/75-06/80 64 HC	----------	10/79-05/80 ?
FAR 25	O	01/73-04/80 29 FAR.D25	01/75-06/80 64 HC	01/75-06/80 64 HC	01/75-03/80 18 HC
FAR 26	M	01/73-06/75 29 HC 06/75-09/77 27 FAR.D26 09/77-06/80 33 HC	01/75-06/80 64 HC	--See Space Heating---	12/74-06/80 22 HC
FAR 27	O	04/74-09/80 19 FAR.D27	01/75-06/80 64 HC	----------	02/75-04/80 18 HC
FAR 30	M	01/73-06/75 29 HC 06/75-09/77 27 FAR.D30 09/77-05/80 32 HC	01/75-06/80 64 HC	--See Space Heating---	12/74-06/80 18 HC
FAR 32	M	01/73-08/77 55 FAR.D32 08/77-06/80 34 HC	01/75-06/80 64 HC	--See Space Heating---	03/75-06/80 18 HC
FAR 34	O	12/75-03/80 22 FAR.D34	01/75-06/80 64 HC	----------	03/75-05/80 21 HC
FAR 35	M	01/75-03/75 3 HC 03/75-08/78 41 FAR.D35 08/78-06/80 22 HC	01/75-06/80 64 HC	--See Space Heating---	02/75-05/80 21 HC
FAR 36	M	01/75-03/75 3 HC 03/75-08/78 41 FAR.D36 08/78-06/80 22 HC	01/75-06/80 64 HC	--See Space Heating---	12/74-06/80 22 HC
MSP 01	M	03/75-08/77 29 MSP.D01 08/77-07/78 11 HC 07/78-05/80 22 MSP.D01	04/75-09/77 29 HC$ 01/78-05/80 26 HC	--See Space Heating---	----------

TABLE 15 (cont.)

MSP 02	M	06/76-02/77	7	HC$	06/76-02/77	7	HC$	--See Space Heating---			08/78-06/80	8	HC("E")
		02/77-09/77	7	MSP.D02	02/77-09/77	7	MSP.E02						
		09/77-12/77	3	HC$	09/77-12/77	3	HC$						
		12/77-01/79	13	HC	12/77-01/79	13	HC						
		06/79-06/80	12	MSP.D02	06/79-06/80	12	HC						
MSP 03	M	04/75-09/77	29	MSP.D03	04/75-09/77	29	HC$	--See Space Heating---			----------		
		09/77-07/78	10	HC	12/77-05/80	29	HC						
		07/78-05/80	22	MSP.D03									
MSP 04	M	06/76-01/77	6	HC$	06/76-01/77	6	HC$	--See Space Heating---			05/78-05/80	7	HC
		01/77-08/77	7	MSP.D04	01/77-08/77	7	MSP.E04						
		12/77-01/79	13	HC	12/77-01/79	13	HC						
		05/79-05/80	12	MSP.D04	05/79-05/80	12	HC						
MSP 06	O	04/75-02/77	13	MSP.D06	07/76-06/78	23	HC	07/76-06/78	23	HC	06/78-05/80	5	HC
					05/79-05/80	12	HC	05/79-05/80	12	MSP.G06			
MSP 08	O	11/75-04/77	15	MSP.D08	07/76-08/77	13	HC	07/76-08/77	13	HC	----------		
		04/77-04/78	7	HC	12/77-01/79	13	HC	12/777/01-79	13	HC			
MSP 13	M	06/76-02/77	7	HC$	06/76-03/77	8	HC$	--See Space Heating---			05/78-05/80	7	HC
		02/77-09/77	7	MSP.D13	03/77-09/77	6	MSP.E13						
		09/77-01/78	4	HC$	09/77-01/78	4	HC$						
		01/78-01/79	12	HC	01/78-01/79	12	HC						
		06/79-06/80	7	MSP.D13	06/79-06/80	12	HC						
MSP 20	M	06/76-02/77	7	HC$	06/76-02/77	7	HC$	--See Space Heating---			06/78-06/80	6	HC
		02/77-09/77	7	MSP.D20	02/77-09/77	7	MSP.E20						
		12/77-01/79	13	HC	12/77-01/79	13	HC						
		06/79-06/80	8	MSP.D20	06/79-06/80	12	HC						
MSP 21	M	01/77-08/77	7	MSP.D21	01/77-08/77	7	MSP.E21	--See Space Heating---			05/78-05/80	6	HC
		12/77-12/78	13	HC	12/77-12/78	13	HC						
		05/79-05/80	12	MSP.D21	05/79-05/80	13	HC						

TABLE 15 (cont.)

MSP 23	M	04/75-08/77	13	MSP.D23	04/75-09/77	29	HC$	--See Space Heating---			
		08/77-08/78	7	HC	11/77-05/80	30	HC				
		08/78-05/80	9	MSP.D23							
MSP 25	M	04/75-09/77	19	MSP.D25	04/75-09/77	29	HC$	--See Space Heating---			
		09/77-07/78	8	HC	12/77-01/79	13	HC				
		07/78-05/80	12	MSP.D25	04/79-05/80	13	HC				
MSP 26	M	07/76-02/77	6	HC$	07/76-02/77	6	HC$	--See Space Heating---	05/78-05/80	7	HC
		02/77-09/77	7	MSP.D26	02/77-09/77	7	MSP.E26				
		11/77-12/78	13	HC	11/77-12/78	13	HC				
		06/79-06/80	10	MSP.D26	06/79-06/80	13	HC				
MSP 27	O	10/75-04/77	13	MSP.D27	06/76-01/79	31	HC	06/76-01/79	31	HC	05/78-05/80 4 HC
		04/77-05/78	8	HC	06/79-05/80	12	HC	06/79-05/80	12	HC	
MSP 28	M	04/75-08/77	16	MSP.D28	04/75-09/77	28	HC$	--See Space Heating---			
		08/77-07/78	11	HC	12/77-01/79	13	HC				
		07/78-05/80	15	MSP.D28	05/79-05/80	13	HC				
MSP 31	M	04/75-09/77	15	MSP.D31	04/75-09/77	29	HC$	--See Space Heating---			
		09/77-07/78	8	HC	12/77-01/79	13	HC				
		07/78-05/80	12	MSP.D31	04/79-05/80	13	HC				
MSP 33	M	03/75-08/77	19	MSP.D33	04/75-09/77	29	HC$	--See Space Heating---			
		09/77-07/78	10	HC	12/77-01/79	13	HC				
		07/78-05/80	16	MSP.D33	04/79-05/80	13	HC				
MSP 34	M	07/75-09/77	13	MSP.D34	04/75-09/77	29	HC$	--See Space Heating---			
		09/77-07/78	10	HC	12/77-01/79	13	HC				
		07/78-05/80	11	MSP.D34	04/79-05/80	13	HC				
MSP 36	M	07/76-02/77	7	HC$	07/76-02/77	7	HC$	--See Space Heating---	06/78-06/80	8	HC
		02/77-09/77	7	MSP.D36	02/77-09/77	7	MSP.E36				
		09/77-01/78	4	HC$	09/77-01/78	4	HC$				
		01/78-01/79	13	HC	01/78-01/79	13	HC				
		04/79-05/80	12	MSP.D36	04/79-05/80	13	HC				

TABLE 15 (cont.)

MSP 37	M	07/76-01/77	6	HC$	07/76-01/77	6	HC$	--See Space Heating---	05/78-05/80	3	HC
		01/77-08/77	5	MSP.D37	01/77-08/77	7	MSP.E37				
		08/77-11/77	4	HC$	08/77-11/77	4	HC$				
		11/77-12/78	13	HC	11/77-12/78	13	HC				
		04/79-05/80	11	MSP.D37	04/79-05/80	13	HC				
MSP 38	G	07/76-02/77	7	HC$	07/76-02/77	7	HC$	--See Space Heating---	----------		
		02/77-09/77	7	MSP.D38	02/77-09/77	7	MSP.E38				
		09/77-12/77	3	HC$	09/77-12/77	3	HC$				
		12/77-01/79	13	HC	12/77-01/79	13	HC				
MSP 39	O	04/75-04/77	18	MSP.D39	06/76-12/77	18	HC$	06/76-12/77	18 HC$	05/78-05/80	5 HC
		04/77-05/78	9	HC	12/77-01/79	13	HC	12/77-01/79	13 HC		
					05/79-05/80	13	HC	05/79-05/80	13 HC		
MSP 40	M	07/76-01/77	6	HC$	07/76-01/77	6	HC$	--See Space Heating---	07/78-03/80	6	HC
		01/77-08/77	6	MSP.D40	01/77-08/77	7	MSP.E40				
		08/77-11/77	3	HC$	08/77-11/77	3	HC$				
		11/77-12/78	13	HC	11/77-12/78	13	HC				
		04/79-05/80	12	MSP.D40	04/79-05/80	13	HC				
MSP 42	M	07/76-01/77	6	HC$	07/76-01/77	6	HC$	--See Space Heating---	07/78-04/80	5	HC
		01/77-08/77	7	MSP.D42	01/77-08/77	7	MSP.E42				
		08/77-12/77	4	HC$	08/77-12/77	4	HC$				
		12/77-01/79	13	HC	12/77-01/79	13	HC				
		04/79-05/80	8	MSP.D42	04/79-05/80	13	HC				
MSP 44	M	07/76-02/77	7	HC$	07/76-02/77	7	HC$	--See Space Heating---	06/78-06/80	6	HC
		02/77-09/77	7	MSP.D44	02/77-09/77	7	MSP.E44				
		09/77-12/77	3	HC$	09/77-12/77	3	HC$				
		12/77-01/79	13	HC	12/77-01/79	13	HC				
		04/79-05/80	13	MSP.D44	04/79-05/80	13	HC				
MSP 45	M	06/76-02/77	8	HC$	06/76-02/77	8	HC$	--See Space Heating---	08/78-05/80	6	HC
		03/77-09/77	6	MSP.D45	02/77-09/77	7	MSP.E45				
		09/77-12/77	3	HC$	09/77-12/77	3	HC$				
		12/77-01/79	13	HC	12/77-01/79	13	HC				
		04/79-05/80	12	MSP.D45	04/79-05/80	13	HC				

TABLE 15 (cont.)

MSP 46	M	03/75-08/77	16	MSP.D46	04/75-09/77	29	HC$	--See Space Heating---	----------
		08/77-06/78	9	HC	11/77-12/78	13	HC		
		08/78-05/80	11	MSP.D46	04/79-05/80	13	HC		
OAK 05	G	03/76-04/78	25	OAK.D05	03/76-05/80	50	HC	--See Space Heating---	12/75-06/80 28 HC
		04/78-05/79	13	HC					
		05/79-05/80	12	OAK.D05					
OAK 06	G	03/76-04/78	25	OAK.D06	03/76-05/80	50	HC	--See Space Heating---	05/75-07/80 32 HC
		04/78-05/79	13	HC					
		05/79-05/80	12	OAK.D06					
OAK 09	G	03/76-03/78	24	OAK.D09	03/76-05/80	50	HC	--See Space Heating---	05/75-07/80 33 HC
		03/78-06/79	15	HC					
		06/79-05 80	11	OAK.D09					
OAK 17	G	03/76-03/78	24	OAK.D17	03/76-05/80	50	HC	--See Space Heating---	05/75-07/80 33 HC
		03/78-06/79	15	HC					
		06/79-05/80	11	OAK.D17					
OAK 19	G	03/76-05 78	23	OAK.D19	03/76-05/80	50	HC	--See Space Heating---	04/75-06/80 33 HC
		05/78-05/79	12	HC					
		05/79-05/80	12	OAK.D19					
OAK 26	G	03/76-03/78	24	OAK.D26	03/76-05/80	50	HC	--See Space Heating---	05/75-07/80 32 HC
		03/78-05/79	14	HC					
		05/79-05/80	12	OAK.D26					
OAK 28	G	03/76-03/78	24	OAK.D28	03/76-04/80	50	HC	--See Space Heating---	04/75-06/80 33 HC
		03/78-10/79	19	HC					
		10/79-04/80	7	OAK.D28					
OAK 31	G	04/75-03/78	35	OAK.D31	04/75-05/80	61	HC	--See Space Heating---	05/75-07/80 33 HC
		03/78-10/79	19	HC					
		10/79-05/80	7	OAK.D31					

TABLE 15 (cont.)

OAK 33	G	04/75-06/78 38 OAK.D33 06/78-08/79 14 HC 08/79-05/80 9 OAK.D33	04/75-05/80 62 HC	--See Space Heating---	05/75-06/80 33 HC
OAK 34	G	03/75-06/78 39 OAK.D34 06/78-08/79 14 HC 08/79-05/80 9 OAK.D34	03/75-05/80 61 HC	--See Space Heating---	05/75-07/80 33 HC
OAK 35	G	03/76-04/78 25 OAK.D35 05/78-10/79 18 HC 10/79-05/80 6 OAK.D35	03/76-05/80 51 HC	--See Space Heating---	05/75-07/80 33 HC
OAK 36	G	03/75-05/80 61 OAK.D36	03/75-05/80 50 HC	--See Space Heating---	06/77-08/78 9 HC
OAK 37	G	03/75-05/78 38 OAK.D37 05/78-06/79 13 HC 06/79-05/80 12 OAK.D37	03/75-05/80 62 HC	--See Space Heating---	05/75-07/80 33 HC
OAK 38	G	04/75-04/78 37 OAK.D38 04/78-09/79 17 HC 09/79-05/80 8 OAK.D38	04/75-05/80 58 HC	--See Space Heating---	05/75-07/80 33 HC
POR 02	O	04/75-05/77 28 POR.D02	04/75-01/78 33 HC$	----------	03/77-09/80 14 HC$
POR 03	O	02/75-10/75 4 HC 10/75-04/77 11 POR.D03	08/75-01/78 29 HC$	----------	01/77-04/80 12 HC$
POR 04	O	10/75-06/77 17 POR.D04	04/75-06/80 62 HC$	----------	----------
POR 07	O	11/74-04/75 9 HC 04/75-09/77 21 POR.D07	04/75-01/78 33 HC$	----------	03/77-03/80 12 HC$
POR 09	O	04/75-08/75 3 HC 08/75-08/77 28 POR.D09	04/75-05/77 25 HC$ 06/77-08/80 38 HC	----------	----------
POR 10	G	04/75-06/75 2 HC 06/75-08/77 26 POR.D10 12/77-05/78 5 POR.D10	04/75-05/77 25 HC$ 06/77-07/80 37 HC	--See Space Heating---	03/77-06/80 13 HC$

TABLE 15 (cont.)

POR 11	O	04/75-03/77 12 POR.D11	04/75-01/78 33 HC$	----------	----------
POR 12	O	07/75-09/77 26 POR.D12	04/75-05/77 25 HC$	----------	03/77-09/80 14 HC$
			06/77-07/80 37 HC		
POR 15	O	04/75-04/75 1 HC	04/75-01/78 33 HC$	----------	02/77-08/80 14 HC$
		04/75-05/77 24 POR.D15			
POR 16	O	10/76-12/77 7 POR.D16	04/75-05/77 25 HC$	----------	01/77-04/80 13 HC$
			06/77-07/80 37 HC		
POR 17	O	10/75-04/78 14 POR.D17	04/75-05/77 25 HC$	----------	03/77-06/80 13 HC$
			06/77-07/80 37 HC		
POR 18	O	04/75-03/76 11 POR.D18	04/76-05/77 13 HC$	----------	01/77-07/80 14 HC$
			06/77-07/80 37 HC		
	W	10/78-03/79 19 HC			
POR 19	O	04/75-05/78 30 POR.D19	----------	----------	----------
	W	10/78-12/78 8 HC			
POR 20	O	05/75-05/78 26 POR.D20	04/75-05/77 25 HC$	----------	03/77-06/80 13 HC$
			06/77-07/80 37 HC		
POR 21	O	03/75-04/78 16 POR.D21	04/75-05/77 25 HC$	----------	01/77-07/80 14 HC$
			06/77-07/80 37 HC		
POR 23	O	07/75-04/77 26 POR.D23	04/75-01/78 33 HC$	----------	03/77-06/80 13 HC$
POR 25	O	07/74-05/75 19 HC	09/77-01/78 5 HC$	----------	01/77-07/80 14 HC$
		05/75-03/77 32 POR.D25			
		08/77-04/78 12 HC			
POR 26	O	10/74-05/75 11 HC	04/75-01/78 33 HC$	----------	03/77-09/80 14 HC$
		05/75-04/78 42 POR.D26			
POR 28	O	01/76-05/77 23 POR.D28	08/75-01/78 29 HC$	----------	01/77-07/80 14 HC$
		11/77-05/78 15 HC			

TABLE 15 (cont.)

POR 29	O	11/75-05/78 37 POR.D29	----------	----------	03/77-06/80 13 HC$	
POR 30	O	04/75-09/78 34 POR.D30	06/77-07/80 37 HC	----------	03/77-06/80 13 HC$	
POR 31	O	01/76-12/78 32 POR.D31	----------	----------	01/77-07/80 13 HC	
POR 32	O	07/75-05/78 39 POR.D32	----------	----------	01/77-07/80 14 HC$	
POR 33	O	11/75-04/78 29 POR.D33	06/77-07/80 37 HC	----------	01/77-07/80 14 HC$	
STL 04	G	06/75-09/77 27 STL.D04	----------	--See Space Heating---	----------	
		10/77-04/78 6 HC				
		10/79-03/80 5 HC				
STL 05	G	03/75-05/75 2 HC	----------	--See Space Heating---	----------	
		05/75-09/77 28 STL.D05				
		10/77-05/78 7 HC				
		07/79-03/80 8 HC				
STL 06	G	03/75-05/75 2 HC	----------	--See Space Heating---	----------	
		05/75-09/77 27 STL.D06				
		10/77-05/78 7 HC				
STL 07	G	04/75-09/77 29 STL.D07	----------	--See Space Heating---	----------	
		10/77-05/78 7 HC				
		07/79-03/80 7 HC				
STL 10	G	05/75-09/77 28 STL.D10	----------	--See Space Heating---	----------	
		10/77-04/78 5 HC				
		07/79-03/80 8 HC				
STL 11	G	03/75-05/75 2 HC	----------	--See Space Heating---	----------	
		05/75-04/77 23 STL.D11				
		10/77-02/78 4 HC				

TABLE 15 (cont.)

STL 14	G	03/75-05/75	2	HC	--See Space Heating---	
		07/75-09/77	27	STL.D14		
		10/77-05/78	6	HC		
		08/79-04/80	8	STL.D14		
STL 15	G	03/75-05/75	2	HC	--See Space Heating---	
		05/75-09/77	28	STL.D15		
		10/77-04/78	6	HC		
		07/79-03/80	8	STL.D15		
STL 17	G	06/75-09/77	27	STL.D17	--See Space Heating---	
		10/77-05/78	7	HC		
		09/79-04/80	7	HC		
STL 18	G	03/75-06/75	3	HC	--See Space Heating---	
		06/75-09/77	27	STL.D18		
		10/77-05/78	7	HC		
		09/79-04/80	7	STL.D18		
STL 23	G	03/75-05/75	2	HC	--See Space Heating---	
		05/75-09/77	27	STL.D23		
		10/77-05/78	6	HC		
		07/79-03/80	8	HC		
STL 28	G	06/75-08/77	26	STL.D28	--See Space Heating---	
		10/77-05/78	6	HC		
		08/79-04/80	8	STL.D28		
STL 29	G	03/75-05/75	2	HC	--See Space Heating---	
		05/75-09/77	28	STL.D29		
		10/77-05/78	6	HC		
		07/79-03/80	8	STL.D29		
STL 34	G	04/75-09/77	29	STL.D34	--See Space Heating---	
		10/77-05/78	6	HC		
		08/79-04/80	7	HC		

TABLE 15 (cont.)

STL 38	G	07/75-09/77	25	STL.D38	--See Space Heating---
		10/77-04/78	7	HC	
		07/79-04/80	9	HC	
STL 40	G	03/75-06/75	3	HC	--See Space Heating---
		06/75-09/77	27	STL.D40	
		10/77-05/78	7	HC	
		06/79-04/80	10	HC	
STL 41	G	03/75-06/75	3	HC	--See Space Heating---
		06/75-09/77	27	STL.D41	
		07/79-04/80	9	HC	
STL 42	G	03/75-06/75	3	HC	--See Space Heating---
		06/75-09/77	27	STL.D41	
		10/77-05/78	7	HC	
		06/79-04/80	9	HC	
STL 44	G	03/75-05/75	2	HC	--See Space Heating---
		05/75-09/77	27	STL.D44	
		10/77-05/78	7	HC	
STL 46	G	03/75-05/75	2	HC	--See Space Heating---
		05/75-09/77	27	STL.D46	
		10/77-05/78	8	HC	
STL 49	G	03/75-05/75	2	HC	--See Space Heating---
		05/75-09/77	28	STL.D49	
		07/79-03/80	8	HC	
STL 55	G	03/75-04/75	1	HC	--See Space Heating---
		04/75-09/77	29	STL.D55	
		10/77-04/78	6	HC	
		07/79-04/80	8	HC	
STL 56	G	03/75-04/75	1	HC	--See Space Heating---
		05/75-09/77	24	STL.D56	
		10/77-05/78	7	HC	
		01/80-04/80	4	HC	

TABLE 15 (cont.)

STL 70	G	03/75-05/75	2	HC	----------	--See Space Heating---	----------
		05/75-09/77	28	STL.D70			
		10/77-04/78	6	HC			
		07/79-03/80	8	STL.D70			
STL 77	G	03/75-05/78	34	HC	----------	--See Space Heating---	----------
		07/79-04/80	9	STL.D77			
STL 92	G	04/75-05/75	1	HC	----------	--See Space Heating---	----------
		05/75-10/77	29	STL.D92			
		10/77-04/78	6	HC			
		07/79-03/80	8	HC			
STL 93	G	04/75-05/75	1	HC	----------	--See Space Heating---	----------
		05/75-10/77	29	STL.D93			
		10/77-05/78	7	HC			
		07/79-03/80	9	HC			
TAC 04	E	01/75-03/75	1	HC	--See Space Heating---	----------	----------
		03/75-09/78	21	TAC.D04			
		09/78-05/80	10	HC			
TAC 21	G	04/75-07/79	51	TAC.D21	06/77-06/80	18 HC	--See Space Heating---	11/73-07/79	34 HC
TAC 37	E	06/77-06/80	18	TAC.D37	--See Space Heating---	----------	12/74-06/79	21 HC
TAC 39	E	09/75-09/77	12	TAC.D39	--See Space Heating---	----------	01/76-07/79	42 HC
		09/77-07/80	17	HC			
TAC 45	G	04/75-08/76	17	HC	----------	--See Space Heating---	04/75-07-79	52 HC$
		08/76-08/77	12	TAC.D45			
TAC 49	M	04/75-10/77	30	TAC.D49	06/77-06/79	12 HC	--See Space Heating---	----------
		10/77-06/80	32	HC			
TAC 55	G	04/75-09/77	28	TAC.D55	06/77-06/79	12 HC	--See Space Heating---	----------
		09/77-03/79	18	HC			
		03/79-06/80	15	TAC.D55			

TABLE 15 (cont.)

TAC 57	G	01/76-12/77	23	TAC.D57	10/77-06/79	11	HC	--See Space Heating---	04/75-06/79 46 HC
		12/77-05/78	UNOCCUP.						
		05/78-08/78	3	TAC.D57					
		08/78-01/79	4	HC$					
		01/79-06/80	17	HC					
TAC 58	G	04/75-07/79	51	TAC.D58	06/77-06/79	12	TAC.E58	--See Space Heating---	----------
TAC 75	G	04/75-06/80	62	TAC.D75	07/77-07/79	12	TAC.E75	--See Space Heating---	----------
TAC 76	E	10/77-06/80	16	TAC.D76	--See Space Heating---			----------	----------
TAC 81	E	08/75-08/77	12	TAC.D81	--See Space Heating---			----------	01/78-05/79 8 HC
		08/77-06/78	5	HC					
		06/78-06/80	12	TAC.D81					
TAC 83	G	04/75-09/77	29	TAC.D83	----------			--See Space Heating---	12/73-08/79 33 HC
TAC 87	G	04/75-07/77	27	TAC.D87	01/75-06/79	54	HC	--See Space Heating---	----------
		07/77-06/80	35	HC					
TAC 98	M	04/75-10/77	22	TAC.D98	06/77-06/79	12	HC	--See Space Heating---	----------
		10/77-06/79	20	HC					
		06/79-06/80	12	TAC.D98					
WAS 02	B	04/75-07/76	9	HC$	04/75-03/77	23	HC$	B-See Space Heating---	----------
		07/76-06/78	23	WAS.D02	03/77-02/78	11	WAS.E02		
		01/79-08/80	16	HC	02/78-01/79	11	HC$		
					01/79-08/80	19	HC		
WAS 05	K	04/75-10/76	7	HC	01/75-01/79	48	HC$	----------	----------
		10/76-04/80	20	WAS.D05	01/79-08/80	19	HC		
WAS 06	O	03/75-11/76	6	HC	01/76-01/79	36	HC$		
		11/76-04/80	18	WAS.D06	01/79-08/80	19	HC		
WAS 07	O	10/76-05/80	18	WAS.D07	01/77-08/80	43	HC	----------	----------

TABLE 15 (cont.)

WAS 08	K	04/75-10/76 9 HC	01/75-01/79 48 HC$	----------
		10/76-03/80 24 WAS.D08	01/79-08/80 19 HC	
WAS 24	O	07/75-08/76 6 HC	01/75-01/79 48 HC$	----------
		08/76-03/80 21 WAS.D24	01/79-08/80 19 HC	
WAS 27	K	09/76-03/78 10 WAS.D27	01/75-01/79 48 HC$	B06/75-07/79 45 HC$ ----------
		10/79-03/80 2 HC	01/79-09/80 20 HC	
WAS 40	B	04/76-04/78 24 WAS.D40	01/75-08/80 68 HC$	B--See Space Heating--- ----------
		10/79-04/80 5 HC		
WAS 41	B	12/75-06/76 3 HC	03/75-06/79 51 HC$	B--See Space Heating--- ----------
		06/76-06/78 12 WAS.D41		
		06/78-04/79 5 HC$		
		04/79-10/79 3 HC		
		10/79-08/80 10 WAS.D41		
	K	04/75-11/76 11 HC		
		11/76-03/78 13 WAS.K41		
		03/78-03/79 4 HC		
WAS 44	O	04/75-11/76 9 HC	01/75-01/79 45 HC$	----------
		11/76-04/80 15 WAS.D44	01/79-09/80 20 HC	
WAS 47	K	04/75-10/76 4 HC	01/75-01/79 47 HC$	----------
		10/76-03/80 19 WAS.D47	01/79-08/80 17 HC	
WAS 53	O	01/75-05/75 8 HC	01/75-01/77 24 HC$	----------
		05/75-04/80 51 WAS.D53	01/77-09/78 20 WAS.E53	
			09/78-01/79 4 HC$	
			01/79-08/80 19 HC	
WAS 57	K	11/76-03/78 8 WAS.D57	07/76-01/77 6 HC$	----------
			01/77-09/78 20 HC	
			09/78-01/79 4 HC$	
			01/79-08/80 19 HC	

TABLE 15 (cont.)

WAS 58	0	02/75-04/75	3	HC	01/75-01/77	24	HC$	----------	----------
		04/75-05/80	26	WAS.D58	01/77-09/78	20	HC		
					09/78-01/79	4	HC$		
					01/79-08/80	19	HC		
WAS 63	0	09/76-02/80	13	WAS.D63	01/77-09/78	20	WAS.E63	----------	----------
					01/79-10/80	21	HC		

5.3 WEEKLY READINGS DATA

In order to obtain measurements for the purpose of being able to break out the contribution of different weatherization options--or at least classes of options--considerable metering of the major energy-using systems in the houses (e.g., space heating and service water heating) was carried out: (appropriate) fuel meters on principal (and any secondary) gas, propane, or electric furnaces (or heating units); run-time meters on furnaces; cycle counters on furnaces; a water meter on (the cold water supply line to) the water heater; and a fuel meter on the water heater. A thermometer was to be installed near the center of each occupied floor, to provide "representative" temperatures over the course of the heating season. The instructions for meter installations and for making weekly readings are listed on page 41 of the Project Plan [1]--although those were not followed to the letter in all cases. To maximize the number of data points available, and increase flexibility in the analysis process, all of these meters were to be read and reported weekly.

Since a meter reader visited each house weekly, advantage was taken of the opportunity to also record the utility (electric, gas--if present) meters. Thus, for most of the houses, for at least most of the last heating season (i.e., once meters had been installed and weekly reading began), the data include weekly readings of the utility meters, to which the utility data discussed in the previous section constitute a backup.

A standard 80-column coding sheet was modified into a special purpose recording/reporting form for the weekly readings data (see exhibit 3). When the sheets with data were received, they were looked over for obvious editing problems (correct city code, reasonable data entries, right-justification of entries in fields), and then given directly to professional keypunchers for conversion to computer-readable form.

Once a mass of weekly readings was in the computer, the individual records had to be distributed to appropriate "house" files as the first step in the analytic process: that process has to start with a chronological set of weekly meter (or thermometer) readings for a house. A program, called SORTWRRC.FTN, was written to do this sorting. (A symbolic listing of SORTWRRC.FTN is on disk CSA3, and also in [6]. Since each weekly reading record was set up to include the city code and the house number, SORTWRRC could use that information to construct the appropriate "house weekly readings" file name for a record. If that file existed, the program opened the file, went to the end of the file, compared the date in the new record with the last meter reading date in the file, and added the new record to the end of the file. Two features of the program affected the contents of the "house weekly readings" file: 1) if the interval since the last previous reading data was greater than 10 but less than 17 days (indicating that one "weekly reading" had been missed, a dummy record with "0" in each field was written before the new record. If the interval was greater than 17 days, the dummy record contains "00" in each field--indicating that two or more weekly readings had been missed. Thus, a glance at the printout of a "house weekly readings" file readily shows how consistently "weekly" the data are. 2) When a new record being written to a house file contained an earlier date than the last record in the file, the program wrote an appropriate message to a log.

Thus it is reasonably certain that all cases of "out of chronological order" records have been caught and corrected.

Although the format of the weekly readings file record is entirely different from that of the utility data files, a decision was made to use the same file name format as for the utility data files, with a "W" as the first character of the extension. These files are all located on disk volume CSA3--thus, an example volume:file name would be CSA3:CSP.W49.

The format of the data in the file is shown exactly as by the field recording and reporting form (exhibit 3).

Originally a "W" was entered in column 6 of each record so it could be identified by any program as a weekly readings record. Later, it was necessary, for the operation of analysis programs, to make changes in this convention: 1) An "S" in column 6 indicated "skip" (do not process) this record. (This was necessary for the dummy records with "0"'s or other possibly "bad" records); 2) A "B" was used to tell the program to "begin" determining consumption anew with the current record (i.e., do not relate it to the previous reading). (This was necessary when a meter went bad and was replaced with a new one.)

A comment is required regarding the humidity data, that should appear in columns 71 and 72 (percentage, expressed by a two-digit integer). Some sites never obtained the capability of converting wet/dry-bulb temperatures to relative humidity and simply reported the two temperatures (requiring, of course, four columns). It will be observed that there were a few spare columns at the right-hand side of the recording/reporting form. These could be defined for a specifically needed use for a given house (e.g., a fifth electric-heating circuit meter). With humidity data that were reported as wet/dry-bulb temperatures one of two conventions was used: 1) "11" was entered in columns 71, 72 and the two temperatures in columns 77-80; or 2) "12" was entered in columns 71, 72 and the two temperatures in columns 73-76. In either case, an analysis program can be suitably instructed to read the temperatures in the appropriate columns and determine the relative humidity.

A CSS file present on the CSA3 disk will print out any house weekly readings file with a heading identifying the many columns in the file (see exhibit 4). This action is invoked by the command "CSA3:PRNTWRF [CTC], [house number]". See exhibit 5 for an example printout of the headings with some weekly readings records.

The "mass" files of weekly readings, that were sorted into the "house" files, are recorded on a tape made using the BACKUP utility. These files are named MASS[n].WRD, n being a number from 1 to 9 identifying the chronological order of the files. If it should be necessary to reconstruct a single house weekly readings file, a modification of SORTWRRC named FINDWRRC.FTN is available on disk volume CSA3 (see exhibit 6 for the CSS file that runs this program) that will do this. This is run by the command "FINDWRRC [mass weekly readings file name], [city code], [house number]". The CSS file supplies the "W" to create the house weekly readings file name. (Note that this CSS file is presently written to read the "mass" file from a disk volume called CAL, and to write the

EXHIBIT 3

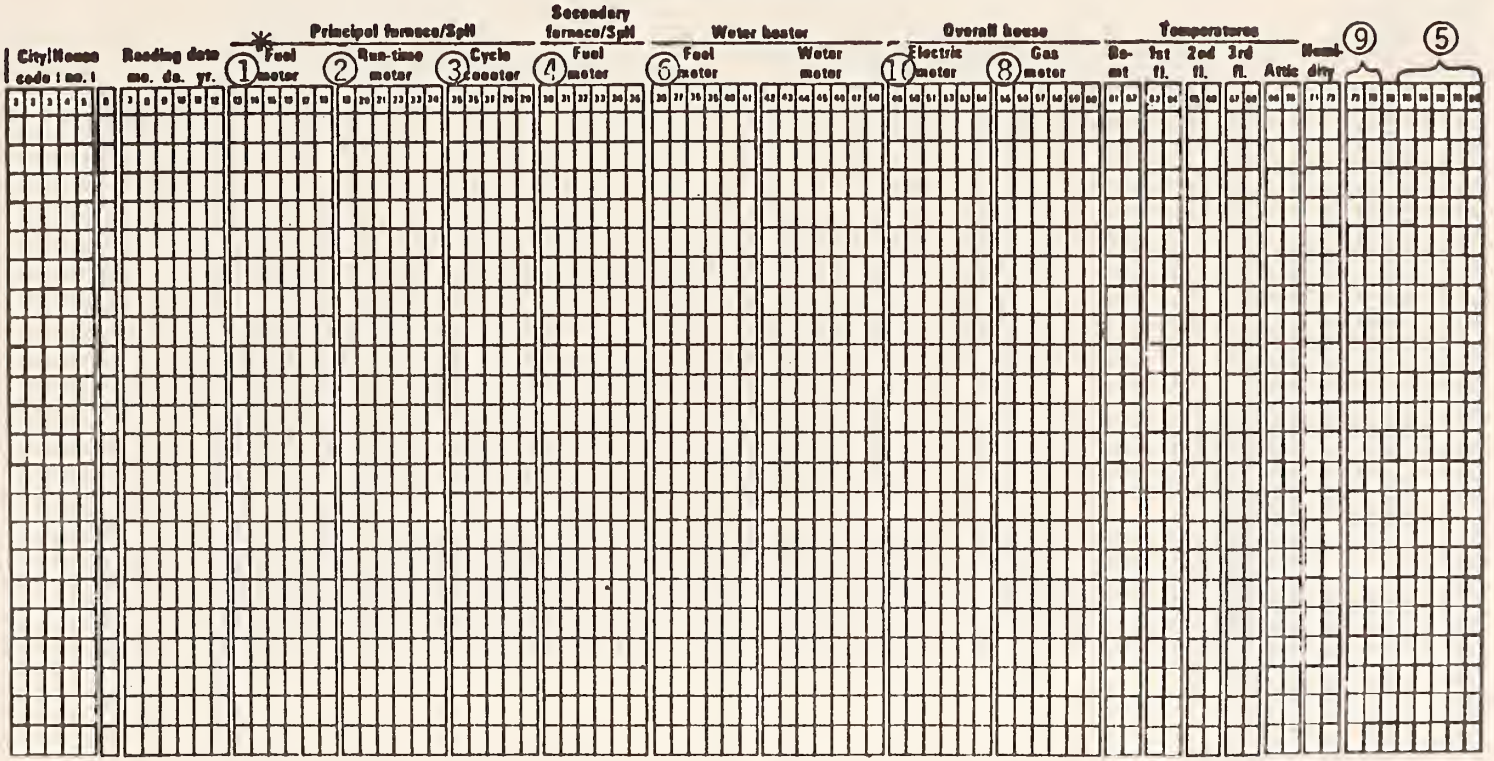
WEEKLY READINGS RECORDING/REPORTING FORM
(Reduced from original 8 1/2 x 14 inch size)

City _____
Date _____

NBS Coding Form

CSA WEATHERIZATION DEMONSTRATION
Building Sample Weekly Data

Coder _____
Data coded _____



* These field numbers are referred to in section 6.1.

EXHIBIT 4

```
*   CSS file "PRINTWRF"
*
*    Prints (on PR:) "House Weekly Readings" files--with heading.
*
XDELETE CSA3:PRDUMMY.;AL CSA3:PRDUMMY.,IN,80
CAL:APPEND CSA3:PRINTWRF.HDG,CSA3:PRDUMMY.
CAL:APPEND @1.W@2,CSA3:PRDUMMY.
CSA3:RCOPYA CSA3:PRDUMMY.,PR:
$EXIT
```

EXHIBIT 5

EXAMPLE PRINTOUT OF HOUSE WEEKLY READINGS DATA WITH HEADINGS

CTCNO	RDGDT	PRINC.FRN./SPH FUEL 1	R-T 2	C.C. 3	2 F/S FUEL 4	WAT. HTR. FUEL 6	WATER 7	TOT. HSE. ELECT. 16	GAS 8	TEMPS. BS 1 2 3A MTFLFLFL	HU MI TDT9	5
CSP05W010279							00713100390170087516984				09	71310
CSP05W010979			6657	858				39175	89997082		17	71740
CSP05W011679			12292	1930				39224	91337082		24	72180
CSP05W012379		7942	16882	2895		1235	000130	39466	92466269		19	72540
CSP05W013079		9465	22641	3939		2655	000239	39610	93805766		38	72810
CSP05W020679		0164	2799004993			4053	000345	39755	95066473		29	73100
CSP05W021379		7727	31748	5843		5807	000486	39891	96046874		30	73520
CSP05W022079		4341	35012	6520		7099	000585	40012	96886774		21	73800
CSP05W022779		1824	38696	7428		8404	000692	40130	97807275		27	74080
CSP05W030679		8935	42182	8313		9952	000825	40251	98707074		27	74430
CSP05W031379		4277	44770	8960		1563	000962	40365	99447070		23	74800
CSP05W032079		9681	47378	9601		3097	001088	40471	00187071		30	75120
CSP05W032779		6181	5055710342			4559	001217	40583	00997576		34	75500
CSP05W040479		3511	5413511166			5518	001293	40686	01847478		25	75740
CSP05W041079		7255	5592211656			6285	001356	40757	02306969		53	75950
CSP05W041779		0682	5752912103			7845	001484	40863	02826974		30	76400
CSP05W042479		2369	5826712319			91510015928		40954	03147077		27	76740
CSP05W050179		5523	5973712744			06930017164		41063	03667275		32	77170
CSP05W050879		9202	6149313172			21320018241		41164	04207776		27	77420
CSP05W051579		3307	6347513595			37990019513		41269	04827071		42	77940
CSP05W052279		3829	6363013617			54100020754		41358	05076668		38	78390
CSP05W052979		4713	6396613719			6902	21892	41445	05326872		42	78760
CSP05W060579		6598	6481213954			8444	23141	41541	05706872		37	79110
CSP05W 61279		8530	6568714130			9896	24234	41630	06076973		34	79510
CSP05W 61979		8761	6569214135			1185	25242	41699	06256972		31	79810
CSP05W 62679		8981	6569114135			2692	26485	41781	06476969		55	80150
CSP05W 7 379		8981	6569114135			4324	27831	41856	06666977		40	80630
CSP05W 71079		8981	6569114135			6005	29195	42945	06876976		38	81067
CSP05W 71779		9193	6569114135			7457	30416	42039	07076974		48	81616
CSP05W 72479		9403	6569114135			8513	31219	42123	07237078		49	81918
CSP05W 73179		9774	6576914158			0089	32493	42211	07487171		52	82614
CSP05W 8 779		9986	6576914158			1297	33467	42285	07647389		20	83011
CSP05W 81479		0194	6576914158			2461	34400	42362	07887273		59	83445

EXHIBIT 6

```
* CSS file for program "FINDWRCS"
*    Specify input (Weekly Readings "Mass" file) by:
*        (Vol "CAL:" assumed)
*        @1 = "Mass" Weekly Readings filename
*        (extension "WRD" will be supplied.)
*    Specify sought-for house weekly readings by:
*        @2 [CTC], @3 [HSE. NO.]
*    (NOTE: House file will be written on CAL:, for COPYA to CSA3:)
$IFNULL @1
$COPY
** NO 'MASS' WEEKLY DATA FILE SPECIFIED **
$N
$EXIT
$ENDC
$IFNULL @2
$COPY
** MISSING PARAMETER: CITY CODE **
$NOC
$EXIT
$ENDC
$IFNULL @3
$COPY
** MISSING PARAMETER: HOUSE NUMBER **
$NOC
$EXIT
$ENDC
$IFNX CAL:@1.WRD
$COPY
** 'MASS' DATA FILE ERROR **
$N
$EXIT
$ENDC
$IFX CAL:@2.W@3
$COPY
** HOUSE FILE @2.W@3 ALREADY PRESENT ON CAL: **
$NOC
$ENDC
$IFNX CAL:@2.W@3
$BUILD CAL:@2.W@3
      010177
$ENDB
$COPY
** REMEMBER TO EDIT OUT FIRST RECORD OF @2.W@3 **
$NOC
$ENDC
XDELETE CAL:SORTWRRC.SCR
AL CAL:SORTWRRC.SCR,IN,20
XDELETE CAL:SORTWRRC.INF
AL CAL:SORTWRRC.INF,IN,20
```

EXHIBIT 6 (cont)

```
XDELETE CAL:SORTWRRC.ERR
AL CAL:SORTWRRC.ERR,IN,80
$BUILD CAL:SORTWRRC.INF
@1.WRD
@2 @3
$ENDB
LO .BG,CAL:FINDWRCS
T .BG
AS1,CAL:@1.WRD,ERO
AS2,CAL:SORTWRRC.ERR
AS3,C:
AS4,CAL:SORTWRRC.SCR
AS5,CAL:@2.W@3
AS6,C:
AS7,CAL:SORTWRRC.INF
ST
$IFE 0
CAL:COPYA CAL:SORTWRRC.ERR,PR2:
DE CAL:@1.WRD
$EXIT
$ENDC
CAL:COPYA CAL:SORTWRRC.ERR,PR2:
$EXIT
```

"house" file on CAL for COPYA to CSA3. It is necessary to "BACKUP" the "mass" weekly readings onto a disk, in order for the FINDWRRC program to read them. The CSS file could be modified to write the reconstructed "house" file directly on CSA3.) (Note also that some editing has been done to some of the "house weekly readings files"; thus, a file reconstructed from the "mass" files may contain uncorrected errors.)

The inventory tables show the beginning and ending dates of the weekly reading records, the number of records, and whether the readings for the various fields are essentially complete ("C"), partial ("P"), some ("S"), or absent ("-").

The only data in these files that have been subjected to the rigor, and consequently checking, of any mathematical analysis are the readings on space heating energy consumption run through the balance point analysis to measure "post" consumption. For houses heated with natural gas or electricity, these were the utility meter data (for comparability with the whole house, utility "pre" data). For houses heated with oil (or a kerosene furnace with an electrically driven burner), these were the run-time meter data. These analyses pointed up some errors that were corrected in the data. The final analysis results from the weekly readings data (in terms of fit as indicated by the R^2) can be seen by examining the Balance Point Summary Data Files (HSBPTDTA--see section 6.0), where runs based on weekly readings data are identified by a "W" immediately following the ending date of the analysis period. None of the other "weekly readings" data have been subjected to any careful examination or checking, let alone analysis.

TABLE 16

File CSA1:WKRDINVY.

INVENTORY OF WEEKLY READINGS DATA

C = complete (>90%) P = partial (50-90%) S = some (<50%) - = none
WDB = wet/dry bulb temps. TW = house total water SGV = 2nd stage gas valve
W = wood (ft**3) (?) = Check original Weekly Data sheets for what these data represent.

CTC	Hse. No.	From	To	No. Rdgs.	Furn. Fuel	Run-t.	Cycles	Scnd. Furn.	----SHW---- Fuel	Water	--Utility-- Elect.	Gas	--Temps.- B	1	2	3	A	Hum.	Field 5	Field 9
ABE	03	09/79	05/80	33	-	C	C	-	P	P	C	-	C	C	-	-	-	C		C(WDB)
ABE	04	10/79	05/80	15	-	C	C	-	C	C	C	C	C	C	C	C	-	C		C(WDB)
ABE	11	11/79	05/80	26	-	C	C	C	-	C	C	C	C	C	C	?	?	C		C(WDB)
ABE	12	07/79	05/80	42	C	P	P	-	C	C	C	C	C	C	C	-	P	C		C(WDB)
ABE	20	09/79	05/80	36	-	-	-	-	-	C	C	-	C	C	C	-	P	C		C(WDB)
ABE	22	08/79	05/80	43	-	C	C	-	-	-	C	-	C	C	C	-	P	C		C(WDB)
ABE	23	09/79	05/80	35	C	C	C	-	C	C	C	C	C	C	C	-	P	C		C(WDB)
ABE	25	09/79	05/80	37	-	C	C	-	C	C	C	C	C	C	C	C	-	C		C(WDB)
ABE	27	10/79	05/80	32	C	C	C	-	C	C	C	C	C	C	C	-	P	C		C(WDB)
ABE	28	09/79	05/80	36	-	C	C	-	C	C	C	C	C	C	C	-	P	C		C(WDB)
ABE	31	09/79	05/80	35	-	C	C	-	C	C	C	C	C	C	-	-	P	C		C(WDB)
ABE	32	08/79	09/79	7	-	-	-	-	-	-	C	-	C	C	C	-	-	C		
		+09/79	05/80	34	C	P	C	C	-	C	C	-	C	C	C	-	-	C		C(WDB)
ABE	33	08/79	05/80	40	-	C	C	-	-	C	C	C	-	C	-	-	P	C		C(WDB)
ABE	38	08/79	09/79	8	-	-	-	-	-	S	C	C	C	C	C	-	S	P		S(WDB)
		+09/79	05/80	34	P	C	C	-	C	C	C	C	C	C	C	-	P	C		C(WDB)
ABE	39	08/79	05/80	43	-	C	C	-	-	C	C	C	C	C	C	-	S	C		C(WDB)
ABE	41	08/79	09/79	8	-	-	-	-	-	-	-	P	C	C	C	-	-	C		C(WDB)
ABE	42	08/79	01/80	42	-	-	-	-	-	P	C	-	C	C	-	-	P	C		C(WDB)
		+01/80	05/80	15	C	-	-	-	C	C	-	C	C	C	-	-	P	P		
ABE	44	08/79	03/80	28	P	P	P	-	-	P	C	C	C	C	-	-	S	C		C(WDB)
ABE	46	09/79	05/80	36	-	C	C	-	-	C	C	C	C	C	C	-	C	C		C(WDB)
ATL	01	11/78	06/80	74	C	-	-	-	C	P	C	?	-	P	-	-	-	P		
ATL	02	11/78	06/80	74	C	-	-	-	C	P	C	C	-	C	-	-	-	C		

TABLE 16 (cont.)

ATL 05	11/78-06/80	75	P	-	-	-	C	-	C	C	-	C	-	-	-	P		
ATL 11	12/78-06/80	72	P	-	-	-	-	P	C	C	-	C	-	-	-	C		
ATL 12	12/78-06/80	74	C	-	-	-	C	P	C	C	-	C	-	-	-	C		
ATL 16	12/78-01 79	6	-	-	-	-	-	-	P	P	-	S	-	-	-	S		
ATL 17	11/78-05/80	65	C	C	C	C	C	P	P	-	-	C	-	-	-	C		
ATL 19	12/78-06/80	73	C	-	-	-	C	P	C	C	-	C	-	-	-	C		
ATL 20	12/78-06/80	77	C	-	-	-	C	P	C	C	-	C	-	-	-	C		
ATL 21	01/79-06/79	21	P	-	-	-	-	S	-	C	-	P	-	-	-	P		
ATL 22	12/78-06/80	77	C	-	-	-	C	-	C	C	-	C	-	-	-	C		
ATL 23	12/78-06/80	74	C	-	-	-	C	P	C	C	-	C	-	-	-	C		
ATL 25	12/78-06/80	74	C	-	-	-	C	C	C	-	-	C	-	-	-	-	P(?)	P(?)
ATL 29	12/78-05/79	43	P	-	-	-	-	P	C	P	-	C	-	-	-	C		
ATL 30	12/78-06/80	74	C	-	-	-	C	P	C	C	-	C	-	-	-	C		
ATL 31	12/78-06/80	74	C	-	-	-	C	P	C	?	-	C	-	-	-	C	S	
ATL 32	12/78-06/80	74	C	C	C	C	C	P	C	-	-	C	-	-	-	C	S(?)	
CHA 01	12/79-08/80	82	-	-	-	-	C	C	C	-	S	C	-	-	C	C		
CHA 02	11/79-08/80	83	C	-	-	-	C	C	C	-	S	C	-	-	C	C		
CHA 03	02/79-08/80	82	C	-	-	-	C	C	C	-	-	C	-	-	C	C		
CHA 05	02 79-08/80	80	C	-	-	-	C	C	C	-	S	C	-	-	C	C		
CHA 08	01/79-08/80	81	C	-	-	-	C	C	C	-	-	C	-	-	C	C		
CHA 09	02/79-08/80	81	C	-	-	-	P	P	C	-	-	C	-	-	C	C		
CHA 16	02/79-08/80	79	C	-	-	-	C	C	-	-	S	C	-	-	-	C		
CHA 18	02/79-08/80	80	C	-	-	-	-	-	C	C	S	C	-	-	C	C		
CHA 19	02/79-08/80	80	C	-	-	-	-	-	C	-	S	C	-	-	S	C		
CHA 20	02/79-08/80	80	C	-	-	-	C	C	C	-	S	C	-	-	C	C		
CHA 21	02/79-08/80	81	C	-	-	-	P	P	C	-	S	C	-	-	C	C		
CHA 22	02/79-08/80	81	P	-	-	-	-	-	C	-	S	C	-	-	-	C		
CHA 23	02/79-08/80	81	C	-	-	-	C	C	C	-	S	C	-	-	C	C		
CHA 24	02/79-08/80	82	C	-	-	-	C	C	C	-	S	C	-	-	C	C		
CHA 25	02/79-08/80	81	C	-	-	-	-	-	C	-	S	C	-	-	C	C		
CHA 27	01/79-08/80	81	C	-	-	-	C	C	C	-	S	C	-	-	P	C		
CHA 28	01/79-08/80	81	C	-	-	-	C	C	C	-	-	C	-	-	C	C		
CHA 33	02/79-08/80	82	C	-	-	-		C	C	C	S	C	-	-	C	C		
CHA 39	02/79-08/80	82	C	-	-	-	-	-	C	-	-	C	-	-	C	C		
CHA 42	02/79-08/80	82	C	-	-	-	C	C	C	-	S	C	-	-	C	C		
CHA 44	02/79-08/80	83	C	-	-	-	C	C	C	-	S	C	-	-	C	C		

TABLE 16 (cont.)

CHA 47	02/79-08/80	83	-	-	-	-	C	P	C	-	S	C	-	-	C	C	
CHA 49	01/79-08/80	83	C	-	-	-	C	C	C	-	S	C	-	-	C	C	
CHI 01	05/79-12/79	7	C	C	C	-	C	C	C	C	C	C	C	-	-	P	
CHI 05	05/79-06/80	20	C	C	C	-	C	C	C	C	C	C	C	-	-	P	
CHI 07	11/79-06/80	8	C	C	C	-	C	C	C	C	C	C	C	-	-	P	
CHI 08	04/79-06/80	22	C	C	C	-	C	C	C	C	C	C	S	-	C	P	
CHI 09	05/79-06/80	18	C	C	C	-	C	C	C	C	C	C	C	-	-	P	
CHI 10	05/79-12/79	6	P	-	-	-	C	C	C	C	C	C	C	-	-	P	
CHI 11	05/79-06/80	22	C	C	C	-	C	C	C	C	C	C	C	-	-	P	
CHI 12	05/79-06/80	16	C	P	P	-	P	C	C	C	C	C	-	-	-	P	
CHI 14	04/79-06/80	14	C	C	C	-	C	C	C	C	C	C	P	-	C	P	
CHI 15	05/79-06/80	13	C	C	C	-	C	C	C	C	C	C	-	-	-	P	
CHI 16	11/79-06/80	16	P	P	P	-	P	P	C	C	C	C	C	-	-	P	
CHI 17	05/79-06/80	13	C	C	C	-	C	C	C	C	C	C	C	-	-	P	
CHI 18	05/79-06/80	22	C	C	C	-	P	C	C	C	C	C	C	-	-	P	
CHI 19	05/79-06/80	23	C	C	C	-	C	C	C	C	C	C	C	-	S	P	
CHI 23	04/79-11/79	4	C	C	C	-	C	C	C	C	C	C	-	-	S	S	
CHI 24	04/79-06/80	22	C	C	C	-	C	C	C	C	C	C	C	-	-	P	
CHI 25	04/79-06/80	21	-	C	C	C	C	C	C	C	C	C	C	-	-	P	
CHI 26	08/79-12/79	4	C	P	P	-	C	C	C	C	P	P	P	-	-	P	
CHI 29	05/79-06/80	23	C	C	C	-	C	C	C	C	C	C	C	-	-	P	
CHI 32	05/79-06/80	18	C	C	C	-	P	C	C	C	C	C	C	-	S	P	
CHI 35	05/79-03/80	17	C	C	C	-	C	C	C	C	C	C	C	-	-	P	
CHI 37	05/79-06/80	20	C	C	C	-	C	C	C	C	C	C	-	-	-	P	
CHI 38	05/79-06/80	30	C	-	-	-	C	C	C	C	C	C	C	-	-	P	
CSP 01	01/79-07/80	77	C	C	C	-	C	C	C	C	C	C	C	-	-	C	C(TW)
CSP 05	01/79-07/80	77	C	C	C	-	C	C	C	C	C	C	-	-	-	C	C(TW)
CSP 06	01/79-07/80	77	C	C	C	-	C	C	C	C	P	C	-	-	-	C	C(TW)
CSP 07	01/79-07/80	77	C	C	C	-	C	C	C	C	C	C	-	-	-	C	C(TW)
CSP 08	12/78-06/80	77	C	C	C	-	C	C	C	C	C	C	-	-	-	C	C(TW)
CSP 10	01/79-07/80	77	C	C	C	-	C	C	C	C	S	C	C	-	-	C	C(TW)
CSP 11	12/78-06/80	78	C	C	C	-	C	C	C	C	P	C	-	-	-	C	C(TW)
CSP 13	12/78-06/80	78	C	-	-	-	C	C	C	C	C	C	-	-	-	P	C(TW)
CSP 14	12/78-06/80	78	C	C	C	-	C	C	C	C	C	C	-	-	-	C	C(TW)
CSP 17	12/78-06/80		C	P	P	-	C	C	C	C	C	C	-	-	-	C	C(TW)

TABLE 16 (cont.)

CSC 20	12/78-06/80	78	C	C	C	-	C	C	C	C	C	C	-	-	-	P	C(TW)	
CSP 23	01/79-07/80	77	C	C	C	-	C	C	C	C	-	C	C	-	-	C	C(TW)	
CSP 24	12/78-06/80	79	C	C	C	-	C	C	C	C	C	C	-	-	-	C	C(TW)	
CSP 24	*01/80-06/80	22	-	C(SGV)	C(SGV)													
CSP 26	01/79-07/80	77	C	C	C	-	C	C	C	C	C	C	C	-	-	C	C(TW)	
CSP 28	01/79-11/79	47	P	C	C	-	P	P	C	C	C	C	C	-	-	C	C(TW)	
CSP 31	01/79-07/80	77	C	C	C	-	C	C	C	C	-	C	C	-	-	C	C(TW)	
CSP 34	01/79-07/80	76	C	C	C	-	C	C	C	C	C	C	C	-	-	C	C(TW)	
CSP 37	12/78-06/80	77	C	C	C	-	C	C	C	C	C	C	-	-	-	C	C(TW)	
CSP 41	01/79-07/80	77	C	C	C	-	C	C	C	C	P	C	-	-	-	C	C(TW)	
CSP 43	01/79-07/80	77	C	C	C	-	C	C	C	C	C	C	-	-	-	C	C(TW)	
CSP 44	01/79-07/80	77	C	C	C	-	C	C	C	C	-	C	C	-	-	C	C(TW)	
CSP 47	12/78-06/80	78	C	C	C	-	C	C	C	C	C	C	-	-	-	C	C(TW)	
CSP 47	*01/80-12/80	22	-	C(SGV)	C(SGV)													
CSP 49	12/78-06/80	78	C	C	C	-	C	C	C	C	P	C	-	-	-	C	C(TW)	
FAR 02	11/78-06/80	71	-	C	C	-	C	C	C	C	C	C	-	-	-	C		
FAR 05	11/78-06/80	83	-	C	C	-	C	C	C	C	-	C	-	-	-	C		
FAR 06	11/78-06/80	82	-	C	C	-	C	C	C	-	C	C	-	-	-	C		
FAR 10	11/78-06/80	82	-	C	C	-	C	C	C	-	C	C	-	-	-	C	S(?)	S(?)
FAR 11	11/78-07/80	67	-	C	C	-	C	C	C	C	C	C	-	-	-	C	S(?)	S(?)
FAR 13	11/78-06/80	82	-	C	C	-	C	C	C	C	C	C	-	-	-	C	S(?)	S(?)
FAR 15	11/78-07/80	83	-	C	C	-	C	C	C	C	C	C	-	-	-	C	S(?)	
FAR 17	11/78-06/80	83	-	C	C	-	C	C	C	C	-	C	-	-	-	C	S(?)	S(?)
FAR 22	11/78-06/80	83	C	-	-	-	C	C	C	C	-	C	-	-	-	C	S(?)	S(?)
FAR 23	11/78-06/80	82	-	C	C	-	-	-	C	C	C	C	C	-	-	C	S(?)	
FAR 25	11/78-06/80	82	-	C	C	-	S	C	C	C	C	C	-	-	-	C	S(?)	S(?)
FAR 26	01/79-06/80	75	C	C	C	-	C	C	C	C	C	C	-	-	-	C	S(?)	
FAR 27	11/78-06/80	82	-	C	C	-	C	C	C	-	C	C	-	-	-	C	S(?)	S(?)
FAR 30	11/78-06/80	85	C	C	C	-	C	C	C	C	C	C	-	-	-	C	S(?)	
FAR 32	11/78-06/80	83	C	C	C	-	C	C	C	C	C	C	-	-	-	C	S(?)	
FAR 34	11/78-07/80	82	-	C	C	S(?)	C	C	C	-	-	C	-	-	-	C		
FAR 35	11/78-06/80	83	-	C	C	C	C	C	C	C	C	C	-	-	-	C		
FAR 36	11/78-06/80	83	C	C	C	-	C	C	C	C	-	C	-	-	-	C	S(?)	

* Gas furnaces were retrofitted with two-stage gas values.

TABLE 16 (cont.)

MSP 01	02/79-05/79	15	-	-	-	-	-	-	C	-	C	C	C	-	-	C	C(WDB)
	+05/79-06/80	54	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 02	03/79-07/79	17	-	-	-	-	-	C	-	-	S	S	S	-	-	S	S(WDB)
	+07/79-06/80	45	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 03	02/79-05/79	15	-	-	-	-	-	C	-	-	-	P	-	-	-	P	P(WDB)
	+05/79-06/80	52	C	C	C	-	C	C	-	C	-	S	-	-	-	S	S(WDB)
MSP 04	03/79-07/79	18	-	-	-	-	-	C	-	-	S	S	S	-	-	S	S(WDB)
	+07/79-07/80	37	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 06	04/79-07/79	17	-	-	-	-	C	-	-	-	-	-	-	-	-	-	
	+07/79-07/80	40	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 08	04/79-07/79	15	-	-	-	-	-	C	-	-	-	S	S	-	-	S	S(WDB)
	+07/79-11/79	18	C	C	C	-	C	C	-	C	-	-	-	-	-	-	
MSP 13	04/79-07/79	16	-	-	-	-	-	C	-	-	S	S	S	-	-	S	S(WDB)
	+07/79-06/80	34	C	-	-	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 20	03/79-07/79	17	-	-	-	-	-	C	-	-	S	S	-	-	-	S	S(WDB)
	+07/79-07/80	44	C	C	C	-	C	C	-	C	S	S	-	-	-	S	S(WDB)
MSP 21	03/79-07/79	18	-	-	-	-	-	C	-	-	S	S	S	-	-	S	S(WDB)
	+07/79-06/80	44	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 23	02/79-07/79	14	-	-	-	-	-	C	-	-	P	P	P	-	-	P	P(WDB)
	+07/79-06/80	52	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 25	02/79-05/79	14	-	-	-	-	-	C	-	-	S	S	-	-	-	S	S(WDB)
	+05/79-06/80	53	C	P	P	-	C	C	-	C	S	S	-	-	-	S	S(WDB)
MSP 26	03/79-07/79	19	-	-	-	-	-	C	-	-	S	S	S	-	-	S	S(WDB)
	+07/79-06/80	41	C	-	-	-	C	C	C	C	P	P	P	-	-	P	P(WDB)
MSP 27	04/79-07/79	15	-	-	-	-	-	C	-	-	-	-	-	-	-	-	
	+07/79-06/80	33	C	-	-	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 28	02/79-05/79	14	-	-	-	-	-	C	-	-	-	-	-	-	-	-	
	+05/79-06/80	53	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 31	02/79-05/79	14	-	-	-	-	-	C	-	-	-	-	-	-	-	-	
	+05/79-06/80	54	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 33	02/79-05/79	14	-	-	-	-	-	C	-	-	P	P	-	-	-	P	P(WDB)
	+5/79-07/80	52	C	C	C	-	C	C	-	C	S	S	-	-	-	S	S(WDB)
MSP 34	02/79-05/79	15	-	-	-	-	-	C	-	-	S	S	S	-	-	S	S(WDB)
	+05/79-06/80	50	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)
MSP 36	04/79-07/79	16	-	-	-	-	-	C	-	-	-	-	-	-	-	-	
	+07/79-06/80	44	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)

TABLE 16 (cont.)

MSP 37	04/79-07/79	15	-	-	-	-	-	C	-	-	-	-	-	-	-	-		
	+07/79-06/80	42	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)	
MSP 38	03/79-07/79	17	-	-	-	-	-	C	-	-	S	S	S	-	-	S	S(WDB)	
	+07/79-11/79	9	C	C	C	-	C	C	-	C	-	-	-	-	-	-		
MSP 39	04/79-07/79	14	-	-	-	-	-	C	-	-	S	S	-	-	-	S	S(WDB)	
	+07/79-07/80	42	-	-	-	-	C	C	-	C	S	S	-	-	-	S	S(WDB)	
MSP 40	03/79-07/79	18	-	-	-	-	-	C	-	-	-	S	-	-	-	S	S(WDB)	
	+07/79-07/80	45	C	C	C	-	C	C	-	C	S	S	-	-	-	S	S(WDB)	
MSP 42	03/79-07/79	19	-	-	-	-	-	C	-	-	S	S	S	-	-	S	S(WDB)	
	+07/79-07/80	42	C	C	C	-	C	C	-	C	S	S	S	-	-	S	S(WDB)	
MSP 44	03/79-07/79	17	-	-	-	-	-	C	-	-	S	S	-	-	-	S	S(WDB)	
	+07/79-06/80	40	C	C	C	-	C	C	-	C	S	S	-	-	-	S	S(WDB)	
MSP 45	03/79-07/79	17	-	-	-	-	-	C	-	-	S	S	S	-	-	S	S(WDB)	
	+07/79-07/80	46	C	C	C	-	C	C	-	C	S	S	-	-	-	S	S(WDB)	
MSP 46	02/79-05/79	14	-	-	-	-	-	C	-	-	P	P	-	-	-	P	P(WDB)	
	+05/79/06/80	53	C	C	C	-	C	C	-	C	S	S	-	-	-	S	S(WDB)	
OAK 05	10/79-02/80	6	-	-	-	-	-	-	C	C	-	S	-	-	-	-		
OAK 06	10/79-02/80	5	-	-	-	-	-	-	C	C	S	S	-	-	-	-		
OAK 09	10/79-02/80	6	-	-	-	-	-	-	C	C	-	S	S	-	-	-		
OAK 17	10/79-02/80	5	-	-	-	-	-	C	C	C	-	S	-	-	-	-		
OAK 19	11/79-02/80	4	-	-	-	-	-	C	C	C	-	-	-	-	-	-		
OAK 26	10/79-02/80	5	-	-	-	-	-	-	C	C	-	S	-	-	-	-		
OAK 28	10/79-02/80	5	-	-	-	-	-	-	C	C	-	-	-	-	-	-		
OAK 31	10/79-02/80	5	-	-	-	-	-	-	C	C	-	-	-	-	-	-		
OAK 33	10/79-02/80	6	-	-	-	-	-	-	C	C	-	S	-	-	-	-		
OAK 34	10/79-02/80	6	-	-	-	-	-	-	C	C	-	S	-	-	-	-		
OAK 35	10/79-02/80	6	-	-	-	-	-	-	C	C	-	S	-	-	-	-		
OAK 36	10/79-02/80	6	-	-	-	-	-	-	C	C	-	S	S	-	-	-		
OAK 37	10/79-02/80	5	-	-	-	-	-	-	C	C	-	-	-	-	-	-		
OAK 38	10/79-02/80	6	-	-	-	-	-	C	C	C	-	-	-	-	-	-		
POR 02	10/78-04/80	67	-	C	-	-	P	P	P	C	C	C	P	-	-	-		S(?)
POR 03	05/78-07/78	9	-	-	-	-	-	-	-	-	C	C	-	-	-	-		
	+07/78-10/79	51	-	C	P	-	-	-	S	-	C	C	-	-	-	-		S(?)

TABLE 16 (cont.)

POR 04	11/77-01/78	7	C																
	+10/78-11/78	6		C					C			C	C	-	-	-	-		
	+11/78-02/79	11	-	C	-	-	-	-	-	-		C	C	C	-	-	-		
	+02/79-05/80	61	-	C	C	-	-	C	C	-		C	C	C	-	-	-		
POR 07	10/78-12/78	11		C				C				P	C	P	-	-	-		
	+12/78-02/79	11	-	C	-	-	-	-	-	-		C	C	C	-	-	-		
	+02/79-05/80	64	-	C	C	-	C	C	C	-		C	C	S	-	-	-		
POR 09	11/77-01/78	7	C																
	+10/78-02/79	21	-	C	C	C	C	C	C	C		P	C	C	-	-	-		
	+02/79-05/80	62	-	C	C	-	C	C	C	-		C	C	P	-	-	-		
POR 10	11/77-01/78	7	C																
	+10/78-12/78	11	C									-	C	-	-	-	-		
	+02/79-07/79	19	C	-	-	-	C	C	P	-		-	C	-	-	-	-		
	+07/79-05/80	45	-	-	-	-	C	C	C	C		-	C	-	-	-	-		
POR 11	11/77-12/77	6	C																
	+10/78-02/79	17	-	C	-	-	-	-	-	-		P	C	C	-	-	-		S(?)
	+02/79-05/80	74	-	C	C	-	P	C	P	-		C	C	C	-	-	-		
POR 12	11/77-01/78	7	C																
	+05/78-06/78	6	-	-	-	-	-	-	-	-		C	C	C	-	-	-		
	+06/78-02/79	31	-	C	-	-	-	-	-	-		C	C	C	-	-	-		S(?)
	+02/79-05/80	63	-	C	C	-	-	C	C	-		C	C	C	-	-	-		
POR 15	10/78-04/79	12	-	C	-	-	-	-	-	-		P	C	P	S	-	-		
	+04/79-05/80	51	-	C	C	-	C	C	C	-		C	C	-	-	-	-		
POR 16	11/77-01/78	7	C																
	+10/78-02/79	16	-	C	-	-	-	-	-	-		P	C	C	-	-	-		P(?)
	+02/79-05/80	60	-	C	C	-	S	P	P	-		C	C	C	-	-	-		
POR 17	10/78-01/79	15	-	C	-	-	-	-	-	-		S	C	-	-	-	-		S(?)
	+02/79-05/80	64	-	C	C	-	C	C	P	-		C	C	-	-	-	-		
POR 18	11/77-01/78	7	C																
	+10/78-02/79	13	-	C	-	-	-	-	-	-		S	C	S	-	-	-	P(W)	S(?)
	+02/79-05/80	55	-	C	C	-	S	C	P	-		C	C	S	-	-	-		
POR 19	08/78-06/79	35	-	C	-	-	-	S	S	-		P	P	P	-	-	-	S(W)	S(?)
POR 20	11/77-01/78	7	C																
	+07/78-02/79	21	-	P	-	-	-	-	-	-		C	C	-	-	-	-		S(?)
	+02/79-05/80	56	-	C	C	-	-	C	P	-		C	C	-	-	-	-		

TABLE 16 (cont.)

POR 21	11/77-01/78	7	C																
	+10/78-02/79	21	-	C	-	-	-	-	-	-	C	C	-	-	-	-			P(?)
	+03/79-05/80	55	-	C	C	-	S	C	P	-	C	-	-	-	-	-			
POR 23	11/77-01/78	7	C																
	+10/78-02/79	14	-	C	-	-	-	-	-	-	C	C	C	-	-	-			P(?)
	+02/79-05/80	60	-	C	C	-	C	C	P	-	C	C	P	-	-	-			
POR 25	10/78-02/79	12	-	C	-	-	-	-	-	-	C	C	C	-	-	-		P(?)	
	+02/79-05/80	53	-	C	C	-	-	C	P	-	C	C	P	-	-	-			
POR 26	11/77-01/78	7	C																
	+06/78-09/78	13	-	C	-	-	-	-	-	-	-	-	-	-	-	-			
	+10/78-05/80	82	-	C	P	-	P	P	P	S	C	C	P	-	-	-			S(?)
POR 28	11/77-12/77	6	C																
	+09/78-02/79	23	-	C	-	-	-	-	-	-	C	P	P	-	-	-			
	+03/79-05/80	58	-	C	C	-	P	C	P	-	C	C	-	-	-	-			
POR 29	01/79-05/79	13	-	C	-	-	-	-	-	-	P	C	P	-	-	-			
	+05/79-05/80	48	-	C	-	-	-	P	C	-	C	C	-	-	-	-			
POR 30	01/79-05/79	12	-	C	-	-	-	-	-	-	C	C	C	-	-	-			
	+05/79-05/80	46	-	C	-	-	-	P	C	-	C	C	P	-	-	-			
POR 31	01/79-05/79	13	-	C	-	-	-	-	-	-	P	C	C	-	-	-			
	+05/79-05/80	47	-	C	-	-	-	P	C	-	C	C	S	-	-	-			
POR 32	02/79-04/79	7	-	C	-	-	-	-	-	-	P	C	P	-	-	-			
	+07/79-05/80	43	-	C	-	-	-	P	C	-	C	C	-	-	-	-			
POR 33	01/79-05/79	13	-	C	-	-	-	-	-	-	P	C	P	-	-	-			
	+07/79-05/80	55	-	C	-	-	-	P	C	-	C	C	-	-	-	-			
STL 04	12/78-06/80	34	C	C	C	-	C	C	C	C	P	P	S	S	-	S		S(WDB)	
STL 05	12/78-06/80	46	C	C	C	-	C	C	C	C	-	P	P	-	-	P		P(WDB)	
STL 06	12/78-06/80	45	C	C	C	-	C	C	C	C	P	C	P	-	-	P		P(WDB)	
STL 07	12/78-06/80	36	C	-	-	-	C	C	S	C	P	P	-	-	-	S		S(WDB)	
STL 10	02/79-06/80	29	C	C	C	-	C	C	P	C	P	P	P	-	-	S		S(WDB)	
STL 11	12/78-06/80	52	C	C	C	-	C	P	-	C	C	C	C	S	-	S		S(WDB)	
STL 14	12/78-06/80	37	C	C	C	-	C	P	P	P	C	P	P	P	-	S		S(WDB)	
STL 15	12/78-06/80	50	-	-	-	C	C	C	C	-	P	P	-	-	-	S		S(WDB)	
STL 17	12/78-06/80	53	C	C	C	-	C	C	C	C	C	C	-	-	-	S		S(WDB)	
STL 18	12/78-06/80	52	C	C	C	-	C	P	C	C	C	C	-	-	-	S		S(WDB)	
STL 23	12/78-06/80	43	C	C	C	-	C	C	C	C	C	C	-	-	-	S		S(WDB)	

TABLE 16 (cont.)

STL 28	12/78-06/80	54	C	C	C	-	C	P	C	C	C	S	P	-	-	S	S(WDB)
STL 29	12/78-06/80	54	C	C	C	-	C	P	P	P	C	C	C	P	-	S	S(WDB)
STL 34	02/79-06/80	45	C	C	C	-	C	C	C	P	C	C	P	-	-	S	S(WDB)
STL 38	12/78-06/80	52	C	P	P	-	C	P	P	P	P	P	P	-	-	S	S(WDB)
STL 40	12/78-06/80	42	C	C	C	-	C	C	C	C	P	P	-	-	-	S	S(WDB)
STL 41	12/78-06/80	64	C	C	C	-	C	C	C	C	P	C	-	-	-	S	S(WDB)
STL 42	12/78-06/80	54	C	C	C	-	C	C	C	C	P	C	C	-	-	S	S(WDB)
STL 44	12/78-05/79	9	C	P	P	-	C	P	P	P	P	S	S	-	-	S	S(WDB)
STL 46	12/78-06/80	50	C	C	C	-	C	C	P	C	P	P	S	-	-	S	S(WDB)
STL 49	12/78-06/80	57	C	C	C	-	C	C	C	C	C	C	P	-	-	S	S(WDB)
STL 55	12/78-06/80	53	C	P	P	-	C	P	P	P	C	C	-	-	-	S	S(WDB)
STL 56	12/78-06/80	52	C	P	P	-	C	P	P	P	C	C	-	-	-	S	S(WDB)
STL 70	12/78-06/80	58	C	P	P	-	C	P	P	P	C	C	P	S	-	S	S(WDB)
STL 77	12/78-06/80	52	C	C	C	-	C	C	C	C	C	C	P	-	-	S	S(WDB)
STL 92	12/78-06/80	57	C	P	P	-	C	P	C	P	C	C	-	-	-	S	S(WDB)
STL 93	12/78-06/80	60	C	P	P	-	C	P	C	C	C	C	C	-	-	S	S(WDB)
TAC 04	01/79-06/80	73	C	-	-	-	C	C	C	-	-	P	C	-	C	C	
TAC 21	10/79-11/79	4	-	-	-	-	-	-	-	-	C	C	-	-	S	C	
	+11/79-06/80	31	C	C	C	-	C	C	C	C	P	C	-	-	P	C	
TAC 37	10/79-11/79	5	-	-	-	-	-	-	-	-	C	C	-	-	C	C	
	+11/79-06/80	30	-	-	-	-	-	-	C	-	P	C	-	-	P	C	
TAC 39	01/79-06/80	73	C	-	-	-	C	C	C	-	P	C	-	-	C	C	
TAC 45	01/79-06/80	74	C	C	-	-	C	C	C	C	P	C	-	-	-	C	
TAC 49	01/79-06/80	72	C	C	C	-	C	C	C	C	P	C	-	-	S	C	
TAC 55	01/79-06/80	73	C	C	C	-	C	C	C	C	P	C	C	-	P	C	
TAC 57	01/79-03/79	8	C	-	-	-	C	C	C	C	-	C	-	-	-	C	
	+03/79-06/80	66	C	C	C	-	C	C	C	C	P	C	-	-	-	C	
TAC 58	10/79-11/79	6	-	-	-	-	-	-	-	-	C	C	P	-	-	C	
	+11/79-04/80	21	C	-	-	-	P	C	C	C	P	C	P	-	-	P	
TAC 75	10/79-11/79	7	-	-	-	-	-	-	-	-	C	C	-	-	-	C	
	+12/79-06/80	28	P	-	-	-	-	-	C	C	P	C	-	-	P	C	
TAC 76	10/79-11/79	6	-	-	-	-	-	-	-	-	C	C	-	-	P	C	
	+11/79-06/80	30	-	-	-	-	-	C	C	-	P	C	-	-	P	C	
TAC 81	01/79-06/80	74	C	-	-	-	C	C	C	-	P	C	-	-	C	C	
TAC 83	01/79-03/79	6	C	-	-	-	C	C	C	C	-	C	-	-	C	P	
	+03/79-06/80	67	C	C	C	-	C	C	C	C	P	C	-	-	C	C	

TABLE 16 (cont.)

TAC 87	01/79-06/80	73	C	-	-	-	C	C	C	C	P	C	C	-	S	C		
TAC 98	01/79-06/80	73	C	C	C	-	C	C	C	C	P	C	P	-	C	C		
WAS 02	11/78-12/78	7	-	-	-	-	C	-	-	-	-	C	-	-	-	C	C(?)	
	+12/78-07/80	79	C	S	C	-	C	C	C	C	C	C	-	-	-	C		
WAS 05	11/78-01/79	10	-	-	-	-	C	-	-	-	-	C	C	-	-	C		
	+01/79-07/80	75	P	P	C	-	C	C	C	-	C	C	C	-	-	C		
WAS 06	02/79-11/79	36	-	C	C	-	-	-	C	C	-	C	-	-	S	C		
	+11/79-07/80	36	C	C	C	-	-	C	C	-	-	C	-	-	C	C		
WAS 07	02/79-07/79	21	-	C	C	-	C	C	C	-	C	C	-	-	-	C		
	+07/79-01/80	27	-	-	-	-	C	C	C	-	C	C	-	-	C	C		
	+02/80-07/80	24	C	C	C	-	C	C	C	-	C	C	-	-	S	C		
WAS 08	11/78-07/80	85	-	-	S	-	C	C	C	P	C	C	-	-	P	C		
WAS 24	02/79-07/80	24	-	S	C	-	C	C	C	-	C	C	-	-	P	C		
WAS 27	02/79-07/80	73	-	-	-	-	P	C	C	-	-	C	-	-	P	C		
WAS 40	01/79-07/80	70	-	-	-	-	-	-	C	-	-	C	-	-	P	C		
WAS 41	11/78-07/80	84	-	-	-	S	C	P	C	-	-	C	C	-	-	C		
WAS 44	11/78-01/79	10	-	-	-	-	C	S	S	-	-	C	C	-	-	C		
	+01/79-07/80	74	-	C	C	-	C	C	C	-	C	C	C	-	P	C		
WAS 47	11/78-07/80	86	-	S	S	-	C	C	C	-	C	C	C	S	-	C		
WAS 53	02/79-07/80	73	-	C	C	-	-	S	C	-	C	C	C	-	P	C		
WAS 57	02/79-01/80	46	-	-	-	-	C	C	C	-	-	C	-	-	S	C		
	+01/80-07/80	25	-	C	-	-	C	C	C	-	-	C	-	-	C	C		
WAS 58	02/79-07/80	70	-	P	C	-	-	C	C	-	C	C	-	-	S	C		
WAS 63	02/79-07/80	72	-	C	C	-	C	C	C	-	C	C	-	-	P	C		

5.4 MECHANICAL SYSTEMS TESTS DATA

To provide part of the basis for selecting mechanical (heating and hot water) systems options, a set of tests was prescribed to be performed on these systems. These tests are described on pages 42-46 of the project plan [1]. The purposes of the tests were to determine 1) the steady-state combustion efficiency of the furnace or heater (before and after cleaning and adjusting); 2) the efficiency of the distribution system (air or water); 3) the combustion efficiency of a (fuel-fired) water heater; 4) the recovery time of the water heater; and 5) the rate of flow of showers.

Appropriate data recording and reporting forms (illustrated on pages 47-54 of the project plan) were provided to the field agencies, along with the test instructions ("Building Heating System Data--Data Sheet 'A'", Air Distribution System (Plenum with Rectangular Cross Section)--Data sheet 'B'", etc., through "Hot Water Heater--Data Sheet 'H'").

These data exist only in the hard copy originals (in the "house files"); none were entered into any computer--all analysis of the data was accomplished by hand calculations.

The inventory (table 17, beginning on page 102) shows whether at least the "A" (furnace combustion efficiency) and "H" (water heater) data sheets are present in the file. Researchers interested in studying these data further will have to determine whether appropriate--and adequate--distribution system measurements are available for a given house.

5.5 BUILDING DIMENSIONS AND DESCRIPTIONS DATA, AND PHOTOGRAPHS

As part of the original submission of the data for nomination of a house for participation in the demonstration, site personnel were asked to submit photographs of each side of the house. These served to 1) help characterize the configuration of the house, 2) show any large areas of glass (the compass orientation of which could be determined by reference to the orientation of the front of the house), and 3) provide some suggestion of the condition of the house. During the demonstration, these photographs were placed in clear plastic folders and retained in "site" notebooks, for ready reference. The folders with the photos in them now have been placed in the "house" files--so they should be readily locatable therein.

Site personnel were also requested to provide, as part of the mechanical systems tests data, photographs of the furnace or heater, the water heater, and any other significant features of the heating system. These pictures are co-located with the mechanical systems test data sheets in the house files.

To be able to perform thermal load calculations of the houses, for comparison with actual measured load, field personnel were requested to provide complete, detailed dimensional and descriptive information on the houses. (For details on this aspect of the study, see the final report of the demonstration [2].) For recording and reporting these data, a set of forms labelled "Building Measurements for Thermal Analysis" (shown on pages 69-71 of the project plan

[1]) was prepared, and copies, along with some instructions, sent out to the site agencies.

Essentially, these data were to describe: the overall dimensions of the living (heated) space of the house, the area of windows and of doors facing each compass direction, and the composition (construction) of each of the building components enclosing the heated area (walls, attic, floor, basement, windows, etc.). At several sites, some difficulty was experienced in obtaining complete and adequate building description data. Consequently, one or two "improved" copies of the forms were received from some sites. Unfortunately, none of the forms were dated, no systematic effort was made to purge the earlier inadequate data sheets, and two or three sets may be found in a house file. For convenience, the latest received data sheets were placed in front of any others in the file. Beyond that, it is hoped that examination of the data sheets will reveal which ones were inadequate or incomplete.

The raw data from these forms were never entered into a computer. They were reduced by hand calculations to such gross quantities as (areas of) "windows south", "windows east and west", "total window", "door", "walls", "basement wall", "floor", "roof", and "surface". These data, together with the appropriate R-values for "before" and "after" weatherization, were written into a set of files named "[CTC]THERM.", which are located on disk volume CSA1. The data items in these records are listed as shown below. Note that the first 12 records of each [CTC]THERM file contain weather data for use in the thermal load calculations. The building description data then follow, and each "before" or "after" set of data occupies two records:

First line: "1", CTC, House Number, "B" or "A" [solid--no spaces]; window south area; window east and west area; total window area; door area; wall area; basement wall area; (exterior) floor area; roof area; volume; floor.

Second line: Surface area; R-values for: window, door, wall, basement wall, floor, roof; infiltration rate (taken from measured average); ?; mechanical system efficiency (from tests), ?, average indoor temperature (from "eyeballing" weekly readings records) [solid].

These data are also published in appendix A of the final report [2]. Some errors have been found in these data in the course of subsequent analysis. Consequently, it would seem advisable to re-check them against the raw information on the Building Measurements for Thermal Analysis data sheets before making further use of them.

The availability of Building Measurements for Thermal Calculations data sheets is indicated on the Inventory of Miscellaneous Data, table 17 (beginning on page 102).

5.6 AIR INFILTRATION MEASUREMENTS AND FAN TEST DATA

The raw "data" pertinent to "natural" air infiltration measurements were received in the form of air samples in mylar sample bags. (See the project plan [1], pages 34, 35, for a description of how this test was to be conducted).

As the air samples were analyzed in the laboratory at NBS, the gas chromatograph readings were entered on a standard data sheet (see exhibit 7). Other necessary information (city ID, house number, date of test, floor, time the sample was collected) had to be copied onto the data sheet from labels on the bags (where it was occassionally incomplete). Data on the prevailing weather conditions (outdoor temperature, wind direction, and wind speed) were also supposed to be entered on the labels. However, these measures (with the exception of the temperature) were generally made by "eyeball" and are of questionable value. (The standard guide for estimating wind speed on the Beaufort scale was provided to site personnel.)

As can be seen on exhibit 7, the form contained a format to aid in carrying out the calculations to convert a pair of SF_6 concentration readings into an air infiltration reading in "air changes/hour".

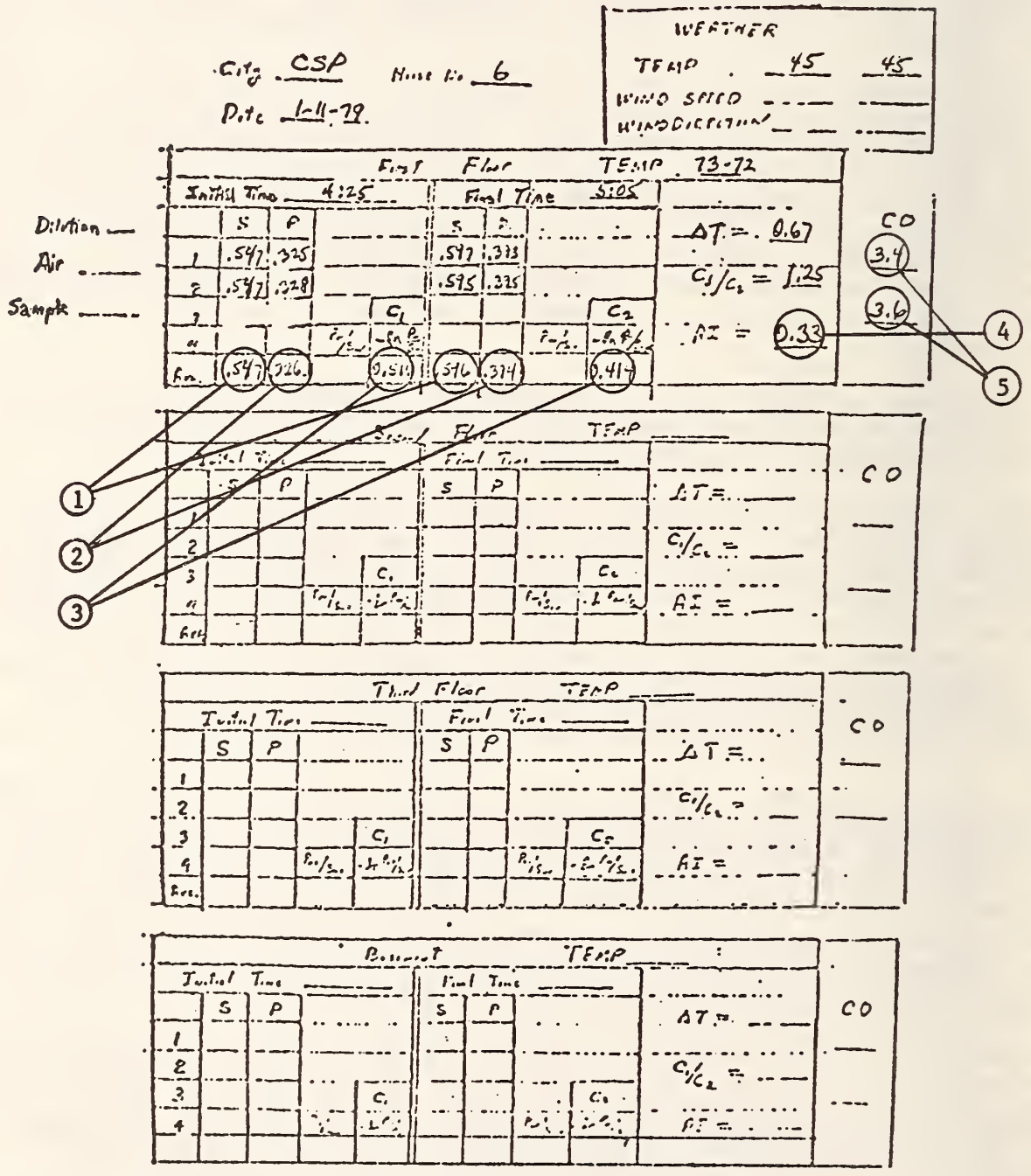
Initially, these calculations were carried out by hand calculator. Subsequently, a program was written to process these data (using a Cromemco Z-2D microcomputer). (This program is listed in [6].) The raw data from the data sheet (1 - identifying data and times, 2 - chromatograph readings, and 3 - exterior temperature--if available) would be typed in, and the computer then calculated the air exchange rate and wrote a record containing 1) and 3), above, and the air exchange rate (for each floor of multi-floor houses). Note that separate air infiltration measurements (each requiring a pair of time-separated air samples) were specified to be made for each floor of two- or three story houses.

Other computer programs were written to 1) produce (unweighted) "house average" air exchange rates for multi-floor houses, and 2) collect all "house" readings for a house into a single record, listing a) the (unweighted) average of the individual readings, b) the number of readings, and c) the individual readings. The inventory data reported in table 17 are taken from the above listings (which are on "floppy disk" volumes)--i.e., these constitute "successful" tests. Note that the inventory shows how many readings were obtained "before," "during," and "after" the carrying out of infiltration work on the house.

It should be noted that some "bags received" did not result in air infiltration readings, for such reasons as: 1) crucial data (e.g., time) missing from a bag label, 2) inability to obtain usable SF_6 concentration data from the air sample bag (due either to oversaturation or too low a concentration), or 3) finding a higher concentration in the second bag than in the first (mislabeling? contamination from a local source? non-representative collection of the air sample?).

The fan test is described in the project plan [1, p. 35]. The data from these tests were recorded and reported on forms as shown in exhibit 8a.

EXHIBIT 7
AIR INFILTRATION (BY SAMPLE BAG) DATA WORKSHEET
(Reduced from original 8 1/2 x 11 size.)



NOTES:
1 - Average "standing current"
2 - Average SF_6 reading
3 - SF_6 concentration
4 - Air exchange rate (air changes/hour)
5 - Carbon monoxide concentration (parts per billion)

EXHIBIT 8a

CSP

Fan Pressurization Test Data Form

City COLORADO SPRINGS Location of Fan MAIN DOOR - SOUTH

House # 6 Door & Windows Closed - YES X NO ___
(If NO explain)

12/3/79

ΔP Pressure in. of water	Fan Speed - rpm			Powerstat Setting
	Reading #1	Reading #2	Reading #3	
0.05	998	997	957	53
0.10	1454	1450	1442	79
0.15	1967	1878	1960	109
0.20	2167	2153	2174	135
0.25				
0.3				
MAX .230	2510	2478	2574	141

Basically, a fan test was to be performed before any infiltration work was done to the house, and a second test performed after infiltration work was completed. Some sites recognized the usefulness of the fan test as a diagnostic tool and carried out and reported several tests over the course of the demonstration. Unfortunately, the data form as originally distributed did not have a blank for the "date," and field personnel tended not to record the date. In some cases there may be ambiguity about the chronology of reported tests, or about their relationship to infiltration work. On the other hand, some field personnel, fortunately, had the presence of mind to record on the data sheet, not only the date, but also something about the situation (i.e., "with fireplace cover in place", or "without fireplace cover"). Where it has been possible to determine that a fan test was "before commencement of infiltration work" or "after completion of such work", that is indicated in the "B" and "A" columns of the inventory in table 17. (In cases where the data form does not contain a date, the staff determined an approximate date when the data were processed, and such dates were entered in the computer files.

The data from these tests were analyzed, using the Cromemco micro-computer, to obtain a "standard induced air exchange rate at 50 Pa indoor-outdoor pressure difference." An example of the output of this analysis program is shown as exhibit 8b. (This program is listed in [6].)

Most, but not all, of the raw data are recorded on Cromemco-compatible floppy disks. Where several "post" fan tests were reported for a house, not all have been entered into the computer files.

5.7 TEMPERATURE STRATIFICATION DATA

The "temperature stratification" test was originally conceived as one form of quality check on weatherization work: it would be expected that extremes of interior temperatures under severe winter conditions would be reduced by the installation of many of the weatherization options. Before weatherization, such extremes obviously could occur as inordinately low temperatures, but also possibly as undesirably high temperatures in certain areas, resulting from occupants turning up their thermostats to try to attain comfortable temperatures in much-used living spaces. The collection of temperature profiles of the houses became of even more value for future study in connection with some of the data obtained later through the occupant questionnaires (see below, section 5.12)--namely, that on occupant attitudes about comfort and temperature impressions.

The instructions for this test in the project plan [1, page 36] were incomplete and inadequate to obtain useful temperature stratification data. More complete instructions (see exhibit 9) were sent to the field agencies for guidance in obtaining these measurements. Again, a special-purpose data recording and reporting form was designed and provided to the field personnel (see exhibit 10a). Although this in no way resembled a standard 80-column coding sheet, the small numbers indicating card and column locations for the data provided sufficient guidance that keypunchers were able to punch these data efficiently directly from the coding sheets. (Some editing of the data sheets was generally required before they were given to the keypunchers: ensuring right-justification

EXHIBIT 8b
EXAMPLE OUTPUT OF FAN TEST ANALYSIS PROGRAM

```
FAR 13     DATE OF TEST 12-10-78   LOCATION OF FAN -- FD
 HOUSE VOLUME =  7600. FT**3

 COEFFICIENTS OF THE EQUATION: Q=C*(DP)**B

 C =  .3972E+02     (+/-  .3367E+01)
 B =  .4192E+00     (+/-  .3420E-01)
 Q25 =      15.13 /HR
 Q50 =      20.23 /HR

 R**2 =  .9678E+00
```

PRESS	Q	PRED Q	RESID	RPM
.025	7.85	8.46	.61	555.
.050	11.67	11.31	-.36	870.
.075	14.25	13.41	-.84	1118.
.100	15.98	15.13	-.86	1320.
.150	18.66	17.93	-.73	1708.
.200	18.76	20.23	1.47	1904.
.225	20.50	21.25	.75	2191.

```
                                                R**2 =      .9568

STD. ERROR =     1.020
```

EXHIBIT 9
INSTRUCTIONS FOR TAKING TEMPERATURE
STRATIFICATION MEASUREMENTS

Subjects: Procedures for taking temperature stratification measurements

Reporting location of water heater

Recording/reporting dates of weatherization work

Temperature stratification measurements

Please follow these instructions when making temperature stratification measurements and reporting stratification data.

These measurements are to be made with the electric digital thermometer. Each stratification measurement consists of three readings:

1. one at about 1" (one inch) above the floor. (We are interested in the possible presence of a thin layer of cold air on the floor that can exacerbate arthritis problems of occupants.)

2. one at midlevel—about chest height of a standing person.

3. one about a foot below the ceiling.

These measurements are to be made monthly, in the center of each living space (room). (Do not bother with spaces smaller than about 5 x 8 feet, closets, etc.) In addition, in each space that has an exterior wall, we want a measurement (set of readings) taken near the middle of each exterior wall, approximately 4 to 6" from the wall. Thus, if a space is a corner room, three measurements should be taken in that space—one at the center and one by each of the exterior walls. If there is a regularly used living space in the basement, measurements should be taken in that room.

In order for us to make meaningful use of these measurements, it is important that: 1) the measurements be taken at the same locations each month, and 2) we have some supplementary information: the date and the time of day, the outdoor temperature, the wind condition, and the sunniness. Over the several months that you take these measurements, it is desireble that you try to get readings at different times of day in each house—i.e., early morning vs. midday vs. late afternoon.

Please record and submit the data on the enclosed form. You should first sketch, on a blank sheet, each occupied floor of the house. Indicate the (compass) orientation of the front of the house. Then mark on the sketch where the measurements will be taken—so that the locations will be consistent from month to month. (Send us a copy of the sketch with your first set of stratification data.) Then mark up a set form for each house (writing in the house number and listing each location where you will be taking readings), and make enough copies for your remaining stratification measurements (i.e., January theough June).

The necessary codes for filling in the data sheet are given on the attached page. For time, record the nearest hour. Please record the outside temperature at the house by thermometer (the digital one can be used—but just record the nearest whole degrees). If you can obtain the latest wind speed and direction by telephoning for a local weather report, fine; otherwise, just observe the speed by the indications shown on the enclosed "codes" sheet. You can also tell by observing whether it is "clear", "partly cloudy," or "completely overcast." Note that for measurements taken near exterior walls, you should enter "Y" or "N" in the column "By a Window?" The interior temperature readings are to be recorded to the nearest tenth of a degree.

EXHIBIT 10a
TEMPERATURE STRATIFICATION DATA
RECORDING/REPORTING FORM

TEMPERATURE STRATIFICATION MEASUREMENTS

CARD 1 CITY ___ HOUSE NO. ___ DATE ___/___/ 79 (mo. day) TIME ___ A(M) P(M) (hr.)

OUTSIDE TEMP. ___ WIND* ___ WIND DIRECTION* (if known) ___ CLOUD COVER* ___

	FLOOR*	ROOM*	LOCATION*	BY A WINDOW?*	TEMPERATURES FLOOR	MIDLEVEL	CEILING
CARD 2							
CARD 3							
CARD 4							
CARD 5							
CARD 6							

* Use codes provided on separate sheet.

of numbers in the heading information on card 1; ensuring that the time was recorded as a two-digit (nearest) hour in columns 13, 14; with larger houses, where the readings continued over to a second page, crossing out the heading (card 1) section of the second page).

Along with the instructions for obtaining the measurements, a set of codes was provided for recording the descriptive data (see exhibit 10b). (The list of room-type codes was extended several times during the course of the demonstration.)

We were not concerned about comparability of temperatures between houses for particular types of rooms, but were concerned about test-to-test comparability of the readings for a given house--i.e., consistency in the locations at which temperatures were recorded and the room designations--thus, the request that sketches showing the arrangement and designations of rooms (for each occupied floor) of the houses be prepared, that the locations of temperature stratification readings be marked thereon, a copy sent to NBS, and a copy be used as guidance for field personnel when they took the monthly measurements. (One site missed the point, and for several months sent in new floor diagrams, each with somewhat different reading locations.)

We did encounter a few problems with changed room designations as room uses actually changed over the two years of this data collection. Since these codes provide the basis for possible future linkage of temperature stratification measurements of specific rooms and locations with the comfort and temperature ratings of the rooms and locations (see Occupant Questionnaires, section 5.12 below), some effort has been made to ensure uniform designations for a particular house. For the data that are in the computer disk files, such consistency can be reasonably assumed. For the data that are available only in hard copy, checking and editing is probably still required.

The inventory (table 17) shows the numbers of temperature stratification test data sets in the computer files, and those in hard-copy, only, in the "house" files. All of the computer files (along with associated programs) are on disk CSA1. The individual readings on individual houses have been edited together into "mass" files by site, with the file name CSA1:[CTC]1.TST. Within these files the readings are arranged in order 1) by house number, and 2) chronologically within house numbers. Thus, an analysis program (such as STTANAL2.FTN, a source listing of which is on disk volume CSA1 and also in [6]) can process these files, printing out the results of each temperature stratification "test" of a house, and writing single lines of results to summary data files in house number and chronological order. Both programs write a one-line summary data file CSA1:TSTRANAL.[CTC], which summarizes the physical measurements recorded. Program STTANAL3 also writes to another summary data file (TSTSTAT.[CTC]) the results of some statistical analysis of the data.

Both of these programs "look up" the dates of weatherization work on a house in the proper HSOPTDTS.[CTC] file (see Options Installed Data, section 5.9), and print at the top of the house/test output listing appropriate messages relating the date of the test to the status of weatherization work on the house.

EXHIBIT 10b
CODES FOR USE ON TEMPERATURE STRATIFICATION DATA SHEET

WIND: Use Beaufort number as shown on other side.

DIRECTION (of wind)
LOCATION (of measurements by walls):

North	1
Northeast	2
East	3
Southeast	4
South	5
Southwest	6
West	7
Northwest	8
Center	C

CLOUD COVER:

Clear	C
Partly cloudy	P
Overcast	O

FLOOR:

1st	1
2nd	2
3rd	3
Attic	A
Basement	B

ROOM:

Living room	LR
	L1
	L2
	L3
Dining room	DR
Kitchen	KT
Kitchen-Dining Rm.	KD
Hall	HL
Bedroom 1	B1
(up to)	↓
Bedroom 7	B7
Family room	FR
Sun room	SR
Bathroom 1	W1
Bathroom 2	W2
Living-Dining room	LD
Play room	PR
Utility room	UT
Store room	ST
unidentified	R1
	R2
	R3

By a:	Window:	Yes	Y
		No	N
		and Air Register	*
	Register:		R

Adjacent to unheated space (e.g., garage, storage shed) U

5.8 MIN/MAX TEMPERATURES DATA (ATTIC BY-PASS TEST)

One finding from the earlier Twin Rivers, New Jersey, house energy-conservation research was that there often existed, in houses that had supposedly been thoroughly weatherized, leakage paths by which heated air in the house convected into unheated spaces--particularly the attic.

In the CSA Demonstration, a simple test was devised to identify the presence of such leakage paths after the houses had been weatherized (see project plan [1], page 36). This test required setting up three maximum/minimum recording thermometers at the house late in the day, and reading them the next morning--i.e., obtaining overnight maximum and minimum readings. The thermometers were to be located 1) near the ceiling of the uppermost occupied floor, 2) in the attic, and 3) near the house, outdoors. As can be seen in table 17, some sites conducted this test several times, others only once or not at all. These data have never been analyzed, due to unavailability of resources.

5.9 OPTIONS INSTALLED DATA

As the Selection of (Architectural, or Mechanical) Options sections of the project plan [1] make clear, the options specified to be installed varied from house to house, even in a given city. This was particularly true of mechanical options, which had to be tailored to the nature of the existing heating system (assuming it was not replaced in its entirety). However, even the specified architectural (building shell) options differed, depending on construction type and the fuel used for space heating (i.e., fuel price). Further differences were generated in the field installation of options (e.g., the house already had good storm windows; the house already had wall insulation; there were no broken windows, or loose glazing, to be repaired; the homeowner refused to permit drilling of the walls to blow in insulation; the arrangement of the attic limited the amount of insulation that could be installed, etc.).

Two different media existed for reporting the options actually installed in a house: 1) Cost data for each option installed in each house were to be reported. (These data went directly to the economists who were working on the analysis of the economic aspects of the study.) 2) The site agencies were requested to report, regularly, options installed, by house, and the dates of installation (needed so that results of periodic tests could be related to the status of various individual options or groups of options).

To organize these options/dates data, two forms were made up for each site, with house numbers across the top and all the options (architectural or mechanical, respectively) prescribed for any house at the site listed down the left margin. Where a particular option was not prescribed to be installed in a particular house, the appropriate box of the matrix was filled in with an "X". The rest of the boxes remained to be filled in with information (either a date, or some indication that the option was not, in fact, installed on that house).

As a check of (and solicitation for more of) these data, copies of the forms were reproduced and sent out to the site agencies, with a request to check the data against their records and fill in any remaining blanks.

In the spring of 1980, the Project Manager visited each site, and endeavored to inspect each of the houses to spot-check the quality of weatherization work, verify building dimensions and descriptions, and make note of any energy-affecting peculiarities about the house or household that might not have been picked up in response to the prescribed data-gathering requirements. Although there was not time to systematically check the options installed in the houses in their entirety, some changes in the "options installed" data sheets were made based on these site visits.

When assembling the final results of the demonstration, we endeavored to verify the correctness of the "options installed" and the dates data. This proved to be no easy task. In a number of cases, costs were reported for options which were reported "not installed" or for which no date was reported--or vice versa. There were also inconsistencies between a date reported and field trip observation of non-installation of the option. The researchers spent the better part of a week working to try to resolve these inconsistencies--without achieving complete satisfaction. The individual options-installed data (given in tables 14 through 25 of the final report [2] and the installation dates data (see below for physical location) represent our best judgment, and are probably better than 90 percent correct.

The dates of installation of individual options were never computer-recorded, and exist only on the hard-copy data sheets in the city files, under Miscellaneous Data.

To be able to readily compare the dates of periodic tests against the status of option installation work, a set of summary-data computer files was written--one for each site. These files are on disk volume CSA1, are named HSOPTDTS.[CTC], and contain the dates of: 1) first infiltration work, 2) last infiltration work, 3) first conduction work, 4) last conduction work, 5) first mechanical systems work, 6) last mechanical systems work, and 7) service hot water system work. (The latter was usually completed within 1 or 2 days. Where it was spread over a longer time period a "55" flag was entered for the month, and the reference to the hard copy records is necessary to find the actual dates involved.)

A CSS file on CSA1 will print any of these "option dates" files, together with a heading and footnotes (see exhibit 11). This is initiated by the command: CSA1:PR2OPDTS [CTC].

Essentially these files should contain only the experimental (weatherized) houses. However, it has been mentioned that weatherization or other energy use-affecting work was done to some of the control houses. Such houses do appear in these files with "(C)" following the house number.

It is clear that these files can be easily read by a computer program. Although they contain some summary and notational information at the end that does not conform to the main record format, the last house entry in each file is followed by "***" in the "city code" field. The program will be reading this field under an alphabetic format instruction, and the "***" can be interpreted as "end of file" and appropriate action taken.

EXHIBIT 11

```
* CSS file "PR2OPDTS"
*    To print HSOPTDTS files (with heading) on PR2:
*    Use first parameter (@1) to specify site/city.
*
XDELETE CSA1:TABLEDTE.
AL CSA1:TABLEDTE.,IN,20
D T ,CSA1:TABLEDTE.
XDELETE CSA1:PRDUMMY
AL CSA1:PRDUMMY,IN,80
CSA1:COPYA CSA1:TABLEDTE,CSA1:PRDUMMY,,10
CSA1:APPEND CSA1:HSOPTDTS.HDG,CSA1:PRDUMMY
CSA1:APPEND CSA1:HSOPTDTS.@1,CSA1:PRDUMMY
CSA1:APPEND CSA1:HSOPTDTS.FNT,CSA1:PRDUMMY
CSA1:COPYA CSA1:PRDUMMY,PR2:
DE CSA1:TABLEDTE;DE CSA1:PRDUMMY
```

5.10 THERMOGRAPHY

Efforts were made to inspect by thermographic camera all house walls that were supposedly insulated, to obtain some indication of the thoroughness and overall quality of insulation work. In 105 of the houses, an even more extensive thermographic inspection was carried out, sometimes in conjunction with depressurizing the house (see Air Infiltration Measurements and Fan Test Data, section 5.6) to look for points of leakage around sill plates, wall-ceiling joints, window and door frames, wall electrical outlets, switch plates, etc.

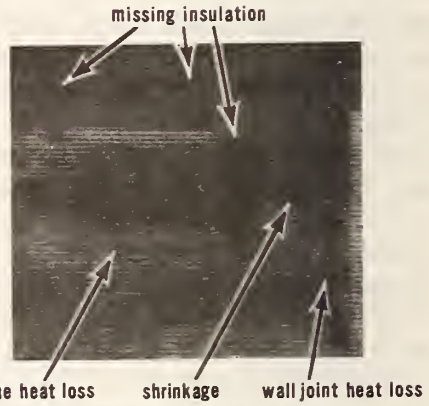
The raw thermographic data exist in the form of photographic prints (Polaroid or from negatives), 35-mm negatives, and video tape, and are all under the custody of Dr. Richard Grot, Physical Environment Division, Center for Building Technology, NBS. Some examples of raw thermographic data are shown in exhibit 12. The thermography records were analyzed to look for the following types of thermal defects in weatherized houses:

missing wall insulation
insulation shrinkage/fissures
defective ceiling insulation
air leakage at doors
frame heat loss at: doors
windows
joint heat loss: wall-wall
wall-ceiling
wall-floor
heat loss at soffits
heat loss at eaves
heat loss at basement/crawl space
cold air penetration: ceiling

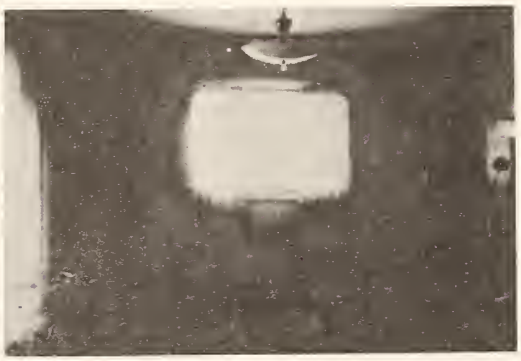
A table listing the incidences of these defects occuring in the first 65 houses surveyed (i.e., those completed in the winter of 1978/79) is included in the final report of the demonstration ([2], table 26). For further discussion of these data and their significance, see [5].

EXHIBIT 12
EXAMPLES OF RAW THERMOGRAPHY RECORDS

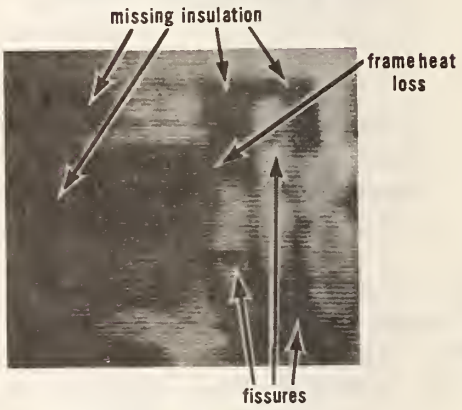
2a. LIVING ROOM WALL - VISUAL



2b. INTERIOR THERMOGRAM OF 2a.



2c. DINING ROOM WALL - VISUAL



2d. INTERIOR THERMOGRAM OF 2c.

5.11 OPTIONS COSTS DATA

Detailed data on the costs of weatherizing the houses in each city were collected. The weatherization work was separated into various retrofit techniques, called weatherization options. For each option done to a house, the cost data consisted of the total cost of the option, separated into labor, materials, and overhead costs; the labor type (contracted or in-house); the amount of work done, measured in lineal or square feet (job size); and physical aspects of the houses that could have some bearing on the value of energy savings, such as fuel type for water and space heating.

This information was numerically coded and put into formatted Data Files in the computer so that it could be analyzed. Index Files for the numerical codes were created to aid in accessing the information. The results of statistical analyses of the cost data were put into Summary Files for easy reference. The analyses concerned calculation of measures of central tendency and variation of unit costs. These measures were taken for groups of data categorized according to option, city, and labor type. For one study, the statistics were calculated for each option/city combination so that cost comparisons could be made among the different cities. For another study, the statistics were calculated for each option/city/labor type combination so that the comparisons could be extended to the labor types.* All of the resulting descriptive statistics are in the Summary Files described in this report.

These cost data can serve a number of research purposes. First, by comparing the cost information to the energy savings information described earlier in this report, it can be determined which combinations of options would pay for themselves over time. Second, the cost data could also be used to see whether economies of scale are present in installation costs of architectural options. Third, by applying a regression analysis to the attic insulation cost data, the marginal cost of increasing insulation could be measured. Fourth, the data could be used to develop a cost prediction model incorporating such factors as region, architecture of the house, and labor type.

This section describes the format of the three types of files (Index, Data, and Summary), the data contained in them, and the uses for the data. Subsection 1 describes the Index Files, subsection 2 the Data Files, and subsection 3 the Summary Files. All of the files discussed in this section are on disk volume "COS2."

5.11.1 Index Files

An Index File lists all possible values of a variable. There are four Index Files: ARCOPT lists architectural options, MECOPT lists mechanical options, CITIES lists the cities in the project, and FUELS lists the fuel types for water and space heating in the house studied.

---

* For a detailed description and the results of this second study, see reference [3].

Exhibit 13 is a listing of ARCOPT. The first 11 options are infiltration options and the rest are conduction options. Some options are listed twice to distinguish between cost data for an option installed by in-house labor and cost data for the same option installed in the same city by contracted labor. After each option name is an indication of the units in which the job size is measured. The second Index File, MECOPT, is listed in exhibit 14. The first 11 options are space heating options and the rest are water heating options. The third Index File, CITIES, is shown in exhibit 15. It is a listing of the 15 cities originally included in the project. Cost data for Miami and New Orleans were not submitted. In the Summary Files, the remaining cities are often referred to by three-letter codes. In CITIES, each city name is preceded by a code made up of the city's three-letter code followed by "II." The final Index File, FUELS, is presented in exhibit 16. It lists the six fuels used by furnaces, space heaters, and water heaters in the houses studied in this project.

In each of the four Index Files, the values of the variables in the file are listed sequentially according to variable number. For example, in ARCOPT the architectural options are listed according to option number. Thus, architectural option number 1 is "REPLACE BROKEN GLASS," option number 12 is "INSTALL STORM WINDOWS," and option number 13 is also "INSTALL STORM WINDOWS." Likewise, looking at the listings for the other index files, it is seen that mechanical option number 1 is "FLUE/VENT DAMPER," city number 1 is "ALBUQUERQUE, NM," and fuel number 1 is "GAS." In the Data Files, the variables are all referred to by these variable numbers, rather than by name.

5.11.2 Data Files

The second type of file is the Data File. This type of file lists the cost data in formated form, with much of the data given by numerical codes. Since it contains formatted numerical data with no headings, it is the best suited of the three types of files for use in conducting further computer analyses.

For each city, there are two classes of Data Files and two files of each class. Exhibit 17 shows the four Data Files for a city, the class of each, and what type of data is contained in each. The first class gives cost data for a city categorized by option, and the second gives data categorized by house. For Fargo, for example, the two files in the first class are FARARC and FARMEC and the two in the second class are FARHARC and FARHMEC (for any other city the file names are the same except that the particular city's three-leter code is substituted for "FAR").

FARARC and the equivalent files for the other cities contain architectural cost data grouped by option. For each option there is a line indicating the option number and labor type. The option line has a zero, the option number, and the labor type code (1 for in-house, 2 for contracted) with each value followed by one blank space. Each option line is immediately followed by lines containing the cost data for the houses in which the option was installed, one line for each house. For attic insulation options, each house line gives the house number, job size, R-value added, labor cost, materials cost, and total cost, each value followed by one blank space. For all other options, a house line

EXHIBIT 13
LISTING OF COST DATA INDEX FILE "ARCOPT"

```
"REPLACE BROKEN GLASS","SF"
"RESET GLAZING","LF"
"REPLACE THRESHOLDS","LF"
"SEAL STRUCTURAL CRACKS","LF"
"WEATHERSTRIP WINDOWS","LF"
"CAULK WINDOWS","LF"
"WEATHERSTRIP DOORS","LF"
"CAULK DOORS","LF"
"WEATHERSTRIP ATTIC HATCH","LF"
"CAULK WINDOWS AND DOORS","LF"
"WEATHERSTRIP WINDOWS AND DOORS","LF"
"INSTALL STORM WINDOWS","SF"
"INSTALL STORM WINDOWS","SF"
"INSTALL STORM DOORS","SF"
"INSTALL TRIPLE GLAZING","SF"
"INSTALL TRIPLE GLAZING","SF"
"INSULATE BASEMENT WALLS WITH CELLULOSE","SF"
"INSULATE BASEMENT WALLS WITH FIBERGLASS BATTS","SF"
"BASEMENT HIGH R SHEATHING & FIBERGLASS BATTS","SF"
"INSULATE BASEMENT WALLS WITH UF FOAM","SF"
"INSULATE CRAWL SPACE WITH STYROFOAM","SF"
"INSULATE CRAWL SPACE WITH UF FOAM","SF"
"INSULATE FLOOR JOISTS WITH FIBERGLASS BATTS","SF"
"INSULATE RIM JOISTS WITH FIBERGLASS BATTS","LF"
"INSULATE RIM JOISTS WITH UF FOAM","LF"
"INSULATE RIM JOISTS WITH CELLULOSE","LF"
"INSTALL FOUNDATION VAPOR BARRIER","SF"
"INSTALL FOUNDATION VENTS","SF"
"INSULATE WALLS WITH CELLULOSE","SF"
"INSULATE WALLS WITH CELLULOSE","SF"
"INSULATE WALLS WITH UF FOAM","SF"
"INSULATE WALLS WITH FIBERGLASS","SF"
"INSULATE ATTIC WITH ROCK WOOL","SF*R-VAL"
"INSULATE ATTIC WITH CELLULOSE","SF*R-VAL"
"INSULATE ATTIC WITH CELLULOSE","SF*R-VAL"
"INSULATE ATTIC WITH FIBERGLASS","SF"
"INSTALL ATTIC VENTS","SF"
"MISCELLANEOUS CONDUCTION OPTIONS","**"
```

EXHIBIT 14
LISTING OF COST DATA INDEX FILE "MECOPT"

"FLUE/VENT DAMPER"
"FLUE/VENT RESTRICTOR"
"ELECTRONIC IGNITION"
"TWO-STAGE GAS VALVE"
"DERATE FURNACE"
"REPLACE BURNER"
"REPLACE FURNACE"
"INSULATE DUCTS/PIPES"
"RADIATOR REFLECTOR"
"SET-BACK THERMOSTAT"
"INSTALL AQUA BOOSTER"
"NO OPTION"
"INSULATE WATER HEATER"
"REPLACE WATER HEATER"
"REDUCE TEMPERATURE OF WATER HEATER"
"SHOWER FLOW RESTRICTOR"
"TIMER ON WATER HEATER"
"OVERFLOW PIPE FOR RELIEF VALVE"
"REPAIR WATER HEATER"
"HOT WATER HEATER THERMOSTAT"
"FLUE DAMPER WATER HEATER"

EXHIBIT 15
LISTING OF COST DATA INDEX FILE "CITIES"

ALBII, Albuquerque NM
ATLII, Atlanta GA
CHAII, Charleston SC
CHIII, Chicago IL
CSPII, Colorado Springs CO
EASII, Easton PA
FARII, Fargo ND
MIAII, Miami FL
MSPII, Minneapolis/St. Paul MN
NORII, New Orleans LA
OAKII, Oakland CA
PORII, Portland ME
STLII, St. Louis MO
TACII, Tacoma WA
WASII, Washington DC

EXHIBIT 16
LISTING OF COST DATA INDEX FILE "FUELS"

```
"GAS"
"ELEC."
"OIL"
"BOTL.GAS"
"KERO."
"WOOD"
```

EXHIBIT 17
FORMATS OF "CITY" DATA FILE NAMES

Classes	DATA TYPE	
	Architectural Options	Mechanical Options
1: Data Organized by Option Type	[CTC]ARC	[CTC]MEC
2: Data Organized by House	[CTC]HARC	[CTC]HMEC

gives the house number, job size, labor cost, materials cost, and total cost, each value followed by one blank space. If the labor or materials cost was not reported for a house, the unknown cost was entered as zero as a flag value. If the job size was not reported, it was coded as 1. Exhibit 18 shows a section of FARARC giving cost data for architectural option number 15, "INSTALL TRIPLE GLAZING." There were 13 houses in Fargo to which this option was applied.

The second Data File for Fargo in the first class is FARMEC. It contains cost data for mechanical options. For each option there is a line indicating option type. It is made up of a zero, one blank space, and the option number. Immediately following the option line are lines giving cost data for the house in which the option was installed, one line for each house. Each house line has the house number, the fuel type code, the labor type code, and the total cost, each value followed by blank space. Exhibit 19 shows a section of FARMEC, giving cost data for one mechanical option number 10, "SET BACK THERMOSTAT." There were nine houses in Fargo to which this option was applied.

The first Data File for Fargo in the second class is FARHARC. It contains architectural cost data categorized by house. In FARHARC, there is one line for each option installed in each house. Each line gives the house number, option number, cost per job size, job size, and total cost. If the job size was not reported, it was coded as 1, which has the effect of making unit cost equal to the total cost. Each value in the line is left-justified in a field of 15 spaces. All lines for the same house are grouped together, and there is a blank line separating sets of lines for different houses. Exhibit 20 shows a section of FARHARC, giving cost data for houses 6 and 10 in Fargo.

The other Data File categorizing cost data for Fargo by house is FARHMEC, which stores mechanical cost data. Each line contains a house number, option number, total cost, and fuel type number. Each value is left-justified in a field of 15 spaces. All lines for the same house are grouped together, followed by a blank line to set one house off from the next. Exhibit 21 shows a section of FARHMEC, giving cost data for houses 6 and 10 in Fargo.

Note that some cities had no mechanical work done, and thus have neither a [CTC]MEC file nor a [CTC]HMEC file.

EXHIBIT 18
SAMPLE LISTING FROM "FARARC"

```
0 15 2
5 93 50.00 48.64 151.82
32 153 114.00 80.27 273.56
27 96 30.00 52.73 182.15
25 168 58.00 87.88 269.91
15 113 34 59.68 186.04
30 133 57.6 76.37 230.62
35 60 21.53 31.75 100.86
10 91 41.59 12.31 92.4
11 190 89.58 99.44 352.14
36 69 33.61 39.41 118.65
17 86 58 49.53 198
2 95 58 52.53 216
6 139 65.51 72.87 234.13
```

EXHIBIT 19
SAMPLE LISTING FROM "FARMEC"

```
0 10
5 1 1 54.17
30 1 1 54.17
32 1 1 54.17
2 1 1 54.17
17 1 1 54.17
10 3 1 54.17
11 3 1 54.17
25 3 1 54.17
6 3 1 54.17
```

EXHIBIT 20
SAMPLE LISTING FROM "FARHARC"

6	5	.4	198	80.87
6	15	1.68	139	234.13
6	31	.58	848	495
6	34	.24	690	170
6	6	.22	198	43.20
6	8	.13	34	4.50
6	9	.84	8	6.77
6	7	.69	32	22.18
6	21	1.56	288	449.92
10	5	.92	119	109.6
10	7	.59	37.3	22.18
10	15	1.01	91	92.4
10	31	.54	864	470.77
10	34	.25	729	184.23
10	6	.27	119	32.4
10	8	.13	34	4.50
10	9	.84	8	6.77
10	38	1.05	268	282.00

EXHIBIT 21
SAMPLE LISTING FROM "FARHMEC"

6	7	1265	3
6	10	54.17	3
6	13	19.5	3
6	17	65.07	3
10	7	1170	3
10	10	54.17	3
10	13	19.5	3
10	17	65.07	3

5.11.3 Summary Files

The third type of file is the Summary File. The Summary Files are all derived from the data Files, with the exception of the House Summary Files, which incorporate some additional information about the data.

The House Files contain basically the same information as the Data Files, but all costs for a house, both for architectural and mechanical options, are in the same file, and some of the work done is more fully described. There is one file for each house in the project, and the cost data are grouped according to option class (i.e., infiltration; conduction; and mechanical systems, broken down into "furnace options" and water heating options). The unit and total costs are given for each option, subtotals are given for each option class, and a grand total is given for all work done on the house. Exhibit 22 is one of the House Files, FARIIF10.

In the House Files the option descriptions were expanded in several ways. When costs for two options were reported in such a way that they were inseparable between options, to avoid double counting, the data were recorded as a cost for only one of the two options in the Data Files. In the House Files, the option heading indicates that the cost is for both options. Also unlike the Data Files, when the job size is unknown, the unit cost is not set equal to total cost in the House Files. Instead, a row of asterisks appears in the unit cost column. A third difference between House Files and Data Files is that when it was known that the cost data received were estimated, an "E" was entered after the estimated cost in the house file. However, since the estimations were done by the project managers at the sites, they should be fairly accurate. A final difference is that when work was done that could not be fitted into any specific option type listed in the options Index Files, it was reported in the Data Files as miscellaneous work, but listed in the House File under its full description.

The House File names are composed of the city's three-letter code, followed by "IIF," followed by the house number. For example the House File in figure 10, FARIIF10, is the file for house number 10 in Fargo.

A second type of Summary File is the Option/City File, which gives summary statistics for the costs for each architectural option in each city. For most options, each file reports labor type, the number of houses in which the option was installed, and the minimum, maximum, mean, and median of: job sizes, unit labor costs, unit materials costs, unit overhead costs, and unit total costs reported for the houses in that city. It also gives the mean total cost and standard deviation, both weighted by job size. For attic insulation options, the information given in the Option/City File is slightly different. It includes the minimum, maximum, mean and median of the R-value added, and the mean total cost and standard deviation are weighted by both R-value and job size. Exhibit 23 shows an example of one of these files, this one called FARIIA5. This and all other Option/City File names were constructed by taking the city's three-letter code, and adding "IIA" and the option number. Thus, the name FARIIA5 indicates that the file gives summary statistics for the cost of weatherstripping windows in Fargo. When both types of labor were used to install an option in

EXHIBIT 22
SAMPLE "HOUSE" FILE OF COST DATA

FARGO ND HOUSE NUMBER 10

INFILTRATION OPTIONS	UNIT COST	OPTION COST
WEATHERSTRIP WINDOWS	$.92/LF	$109.60
CAULK WINDOWS	$.27/LF	$32.40
WEATHERSTRIP DOORS	$.59/LF	$22.18
CAULK DOORS	$.13/LF	$4.50
WEATHERSTRIP ATTIC HATCH	$.84/LF	$6.77
TOTAL INFILTRATION COST		$175.45

CONDUCTION OPTIONS	UNIT COST	OPTION COST
INSTALL TRIPLE GLAZING	$1.01/SF	$92.40
INSULATE WALLS WITH UF FOAM	$.54/SF	$470.77
INSULATE ATTIC WITH CELLULOSE	$.25/SF	$184.23
INSULATE BASEMENT WALLS WITH THERMAX BOARD	$1.05/SF	$282.00
TOTAL CONDUCTION COST		$1029.40

FURNACE OPTIONS	OPTION COST
REPLACE FURNACE	$1170.00
SET-BACK THERMOSTAT	$54.17
TOTAL FURNACE COST	$1224.17

HOT WATER HEATING OPTIONS	OPTION COST
INSULATE WATER HEATER	$19.50
TIMER ON WATER HEATER	$65.07
TOTAL HOT WATER COST	$84.57

TOTAL WEATHERIZATION COST $2513.59

EXHIBIT 23
SAMPLE OF OPTION/CITY SUMMARY COST DATA FILE

FARGO ND
WEATHERSTRIP WINDOWS
WORK DONE UNDER CONTRACT
11 JOBS REPORTED

SUMMARY STATISTICS

	MIN	MAX	MEAN	MEDIAN
JOB SIZE(LF)	75.0	261.0	163.9	187.0
LABOR($/LF)	0.053	0.159	0.121	0.124
MATERIAL($/LF)	0.038	0.399	0.128	0.111
OVERHEAD($/LF)	0.101	0.384	0.182	0.163
TOTAL($/LF)	0.200	0.921	0.430	0.408

TOTAL COST STATISTICS WEIGHTED BY JOB SIZE

MEAN($/LF) = 0.429 STD DEV($/LF) = 0.143

different houses in a city, there are separate files for the two labor types, the names of the files differing by option number. All options for which this could happen were given two option numbers.

It should be noted that reference [3] has in it a set of these files. However, the data base currently includes some data not available when the report was written, since some of the current cost data were collected after the report was written. Reference [3] used cost data collected up to January, 1980, in its data base, so some Option/City Files have changed since they were printed in that report.

Some of the Option/City Files report no statistics for labor, materials, and overhead costs, since some of the cost data have no such breakdowns. Also, unless job size (and R-value) was reported for every house in which an option was installed that Option/City File was not created.

The third and final type of Summary File is the Combined Options File. It presents summary statistics about the cost data collected for each option in the whole project. There is one such file for architectural options, SCAII, and one for mechanical options, MECDO.

In SCSAII, each architectural option name is listed, followed by summary information about costs in each city. For each city there is a line giving the number of houses worked on, the mean job size, the mean cost per job size, and the coefficient of variation. Exhibit 24 shows a section of SCSAII for architectural option number 1, "REPLACE BROKEN GLASS."

In MECDO, each mechanical option name is listed, followed by summary information about costs in each city, broken down further by fuels used by the space and water heaters in the houses in which the option was installed. For each fuel type represented in each city, there is a line giving fuel type, city code, number of houses worked on, mean cost, and standard deviation. After these fuel type lines, there is one line summarizing the costs for the option in the whole project. It gives the total number of houses worked on, the mean cost weighted by number of houses per city, and the standard deviation weighted by number of houses per city. Exhibit 25 shows a section of MECDO for mechanical option number 1, "FLUE/VENT DAMPER."

5.12 OCCUPANT QUESTIONNAIRES

Two types of data were sought by means of a questionnaire-guided interview of a responsible member of each household (generally the head of the household), which were conducted near the end of the measurement period in May/June 1980. These were: 1) information about occupant activities over the course of the demonstration that might affect energy consumption (e.g., numbers and ages of occupants, thermostat-setting practices and changes therein, periods of extended non-occupancy of the house), and 2) occupant impressions of comfort and temperatures in the house in wintertime.

The data concerning comfort and temperature impressions (in weatherized vs. control houses) have been extensively discussed and analyzed in another report of the demonstration [4]. The latter paper includes a reproduction of the questionnaire used, so it seemed unnecessary to include it in this report.

Questionnaires (for most of the houses at a site) were received from all of the final (12) sites except Portland. However, review of the questionnaires from two sites (Chicago and Minneapolis/St. Paul) revealed inconsistencies and inadequacies in the data that appeared to necessitate considerable editing and "cleaning up" before the data could be used. Time was never available to do this job. Consequently, the questionnaire data have been computer-entered, and checked, for only nine sites: Atlanta, Charleston, Colorado Springs, Easton, Fargo, Oakland, St. Louis, Tacoma and Washington (Hughesville).

The data were coded in SPSS (Statistical Package for the Social Sciences)-compatible format, with each case occupying seven 80-column card records. The data are recorded in a single mass file on disk volume CSA1, with file name QUESTDTA. (It had been hoped to study the correlation of the subjective questionnaire-reported comfort and temperature responses with the objective physical measurements in the temperature stratification test data, which are also located on disk volume CSA1.)

EXHIBIT 24

SAMPLE LISTING FROM SUMMARY ARCHITECTURAL OPTIONS COST FILE

REPLACE BROKEN GLASS

CITY CODE	NUMBER OF HOUSES	AVERAGE JOB SIZE SF	MEAN CTS PER SF	C OF V IN %
ALBII	4	15.02	322.62	118
ATLII	2	3.06	1147.96	38
CHAII	12	5.87	439.1	27
CHIII	5	*****	12492.49	71
CSPII	15	9.84	335.95	86
EASII	14	12.9	357.7	66
MSPII	6	16	800	0
OAKII	7	26.73	520.84	55
PORII	9	*****	543.69	251
TACII	3	11.32	486.78	12

EXHIBIT 25

SAMPLE LISTING FROM SUMMARY MECHANICAL OPTIONS COST FILE

FLUE/VENT DAMPER

FUEL CODE	CITY CODE	NUMBER OF HOUSES	MEAN COST $	STD.DEV.
GAS	CHI	11	109.08	50.98
GAS	CSP	11	167.45	26.92
OIL	EAS	6	95.36	9.25
GAS	FAR	5	59.5	1.99
ELEC.	POR	12	135	0
OIL	WAS	4	260	0
		SUM OF HOUSES	WEIGHTED MEAN	WEIGHTED STD.DEV.
		49	134.11	4.93

Considering, for a moment, card one of each case, the entry in column 80 shows the status of the house vis-a-vis the demonstration sample: S, experimental (weatherized) house; C, control (not weatherized during the demonstration); and -, house dropped for one reason or another from the sample. In addition to the houses so indicated as missing from the sample at the end of the demonstration, certain other houses had to be disregarded in analyzing the comfort/temperature-impression data because: 1) insufficient data were provided, or 2) there had occurred a change of household, thus valid pre/post comparisons were unavailable. These houses are indicated by a blank in column 79 of card one. Those cases marked with an asterisk (*) in column 79 were considered to have valid, useful data for the comfort study. This is not to say, obviously, that the other cases may not have data useful for other purposes (i.e., when a household change took place, thermostat-setting practices, times of non-occupancy of the house, comfort and/or temperature ratings for the "after" winter but not the earlier one). Availability of a completed Occupant Questionnaire for a house is indicated in table 17.

5.13 INVENTORY OF MISCELLANEOUS DATA

The following table inventories the data that have been discussed in sections 5.4 through 5.12. Much of this information is available only in "hard copies" in the "house" files. Exceptions have been discussed in the appropriate sections, and are reviewed here: 1) the numbers of air infiltration measurements shown are taken from the files of "good" air bag tests maintained in "floppy disk" files by Dr. R. Grot; 2) temperature stratification tests data for some cities have been recorded in hard disk files located on disk volume CSA1--for others they have not; the distinction is shown in the table ("HC" = hard copy, only); 3) occupant questionnaire data from Chicago and from Minneapolis/St. Paul have not been computer-recorded; all others are in file QUESTDTA on volume CSA1; 4) for the options costs data, "Options Costs Summary" means there is a hard copy printout of the one-page house/options summary in the "house" file; the complete (raw and summarized) options costs data is on disk volume COS2, and is not inventoried in this paper.

TABLE 17

File CSA1:MISCINVY.

INVENTORY OF MISCELLANEOUS DATA

X = present (no.) = number present (C) = CONTROL house (no weatherization work done).
* = no infiltration work done on this house.
@ = Questionnaire received, but data not checked or edited. (BB) = baseboard (electric) heat.

CTC	No.	Bldg. Dimens./ Descr.	Mech. Systs. Tests Bef.	Mech. Systs. Tests Aft.	Fan Tests Bef.	Fan Tests Aft.	Fan Tests No.	Air infil. Meas. Bef.	Air infil. Meas. Dur.	Air infil. Meas. Aft.	Temp. Stratif. .TST	Temp. Stratif. HC	Attic By-pass	Ther-mography	Occup. Quest-tionaires	Options Costs Summary
ABE	03	X	X	X	-	X	1	2	1	6	7	-	1	X	-	-
ABE	04	X	X	X	-	-	-	3	-	4	7	-	1	-	X	X
ABE	11	X	X	X	X	X	2	1	-	7	8	-	1	X	-	X
ABE	12	X	X	X	X	X	2	3	-	5	7	-	1	X	X	X
ABE	20	X	-	-	-	X	1	2	-	5	7	-	1	X	X	X
ABE	22	X	X	X	-	X	1	3	-	5	7	-	1	X	X	X
ABE	23	X	X	X	-	X	1	1	1	3	8	-	1	X	X	X
ABE	25	X	X	X	X	X	2	1	2	3	7	-	1	-	X	X
ABE	27	X	X	X	?	?	1	2	2	4	8	-	1	X	X	X
ABE	28	X	X	X	X	X	2	1	2	5	8	-	-	X	-	X
ABE	31	X	X	X	-	X	1	4	-	4	6	-	1	X	X	X
ABE	32	X	X	X	X	X	2	6(C)			8	-	1	-	X	-(C)
ABE	33	X	X	X	X	X	2	4	-	4	8	-	1	X	X	X
ABE	38	X	X	X	X	X	2	6(C)			7	-	1	-	X	-(C)
ABE	39	X	X	X	X	X	2	2	2	4	8	-	-	-	X	X
ABE	40	?	-	-	-	-	-	-	-	-	-	-	1	-	-	-
ABE	41	X	-	-	?		1	-	3	1	-	-	-	-	-	X
ABE	42	X	-	-	X	X	2	2	-	5	7	-	2	X	X	X
ABE	44	X	X	-	X	-	1	1	-	4	6	-	-	-	-	X
ABE	46	X	X	X	X	X	2	8(C)			8	-	1	-	X	-(C)
ATL	01	X	X	-	X	X	2	1	2	1	4	-	-	-	-	X
ATL	02	X	X	X	?		1	7*			8	-	-	-	X	X
ATL	05	X	X	X	?		2	7(C)			7	-	-	-	X	-(C)

TABLE 17 (cont.)

ATL 11	X	X	X	?		2	8(C)			5	-	-	-	X	-(C)
ATL 12	X	X	X	?		2	9(C)			9	-	2	-	X	-(C)
ATL 16	-	X	-	?		2	1	-	-	-	-	-	-	-	-
ATL 17	-	X	X	?		1	-	-	4	3	-	-	-	-	X
ATL 19	-	X	X	?		1	6*			6	-	-	-	X	X
ATL 20	X	X	X	?		2	1	-	8	7	-	2	-	-	X
ATL 21	-	X	X	-	-	-	1(C)			-	-	-	-	X	-(C)
ATL 22	X	X	X	?		2	1	-	7	7	-	2	-	X	X
ATL 23	X	X	X	?		2	5*			4	-	-	-	X	X
ATL 25	X	-	X	?		1	10(C)			8	-	2	-	X	-(C)
ATL 29	X	-	X	?		1	4*			4	-	-	-	-	X
ATL 30	X	X	X	?		1	-	-	9	8	-	-	-	X	X
ATL 31	X	X	X	?		1	-	2	6	8	-	2	X	X	X
ATL 32	X	X	X	?		2	-	2	5	8	-	1	X	X	X
CHA 01	X	X	X	X	X	3	4	1	7	15	-	-	-	X	X
CHA 02	X	X	?	?		3	2	1	8	14	-	1	-	X	X
CHA 03	X	X	X	?		4	1	1	9	15	-	1	-	X	X
CHA 04	X	X	X	X	X	2	8(C)			11	-	-	-	-	-(C)
CHA 08	X	X	X	?		4	-	2	7	16	-	1	-	X	X
CHA 09	X	X	X	?		4	2	1	5	16	-	1	-	-	X
CHA 16	X	X	X	?		4	2	-	5	14	-	1	-	-	X
CHA 18	X	X	X	?		4	2	-	11	15	-	1	-	X	X
CHA 19	X	X	X	X	X	2	7(C)			13	-	-	-	X	-(C)
CHA 20	X	X	X	?		4	4	-	6	14	-	2	-	X	X
CHA 21	X	X	X	X	X	2	8(C)			13	-	-	-	X	-(C)
CHA 22	X	X	X	?		4	4	-	10	15	-	1	-	X	X
CHA 23	-	X	X	X	X	2	4	-	8	14	-	-	-	X	X
CHA 24	X	X	X	X	X	2	9(C)			14	-	-	-	X	-(C)
CHA 25	X	X	X	?		4	4	-	6	13	-	1	-	X	X
CHA 27	X	X	X	?		4	2	1	11	14	-	2	-	X	X
CHA 28	X	X	X	X	X	2	13(C)			15	-	-	-	X	-(C)
CHA 33	X	X	X	?		4	1	-	10	15	-	2	-	X	X
CHA 39	X	X	X	?		4	2	1	6	14	-	1	-	X	X
CHA 42	X	X	X+1	?		4	3	-	6	15	-	2	-	X	X
CHA 44	X	X	X+1	?		4	3	-	9	17	-	1	-	X	X

TABLE 17 (cont.)

CHA 47	X	X	X	?		8	3	-	6	16	-	1	X	X	X
CHA 49	X	X	X	?		4	3	1	8	15	-	1	-	X	X
CHI 03	-	X	-	X	-	1	-	-	-	-	1	-	-	-	-
CHI 05	-	X	X	X	X	2	-	-	-	-	1	-	-	-	X
CHI 07	-	X	X	-	-	-	1(C)			-	1	-	-	@	-(C)
CHI 08	-	X	X	X	X	2	-	3	3	-	3	-	X	@	X
CHI 09	-	X	X	X	X	2	-	1	3	-	3	-	-	@	X
CHI 11	-	X	-	X	-	1	-	-	4	-	3	-	-	@	X
CHI 12	-	X	X	-	X	1	3	-	1	-	1	-	X	@	X
CHI 14	-	X	X	X	X	2	-	-	2	-	1	-	-	@	X
CHI 15	-	X	X	X	X	2	-	-	1	-	2	-	X	@	X
CHI 16	-	X	X	X	X	2	-	3	3	-	3	-	X	@	X
CHI 17	-	X	X	-	-	-	2(C)			-	1	-	-	@	-(C)
CHI 18	-	X	X	X	X	2	3	-	3	-	2	-	-	@	X
CHI 19	-	X	X	X	-	1	2	-	3	-	3	-	X	@	X
CHI 22	-	X	-	-	-	-	-	-	2	-	1	-	-	-	-
CHI 23	-	X	-	X	-	1	-	1	2	-	1	-	-	-	-
CHI 24	-	X	X	X	X	2	7(C)			-	2	-	-	@	-(C)
CHI 25	-	X	X	-	X	1	-	-	2	-	3	-	-	@	X
CHI 26	-	X	-	X	-	1	-	-	2	-	1	-	-	-	-
CHI 29	-	X	X	X	X	2	-	2	2	-	3	-	X	@	X
CHI 30	-	X	-	-	-	-	-	-	2	-	1	-	-	-	-
CHI 31	-	X	-	X	-	1	1	-	-	-	1	-	-	-	-
CHI 32	-	X	X	-	X	1	3	-	3	-	3	-	X	@	X
CHI 33	-	X	-	-	-	-	-	-	2	-	1	-	-	-	-
CHI 35	-	X	-	X	-	1	4	-	-	-	2	-	-	-	-
CHI 37	-	X	X	X	X	2	1	-	2	-	2	-	-	@	X
CHI 38	-	X	X	X	X	2	1	-	3	-	3	-	-	@	X
CSP 01	X	X	X	?		3	15(C)			12	-	3	-	X	-(C)
CSP 05	X	X	X	?		3	15(C)			14	-	4	-	X	-(C)
CSP 06	X	X	X	?		3	12(C)			13	-	3	-	X	-(C)
CSP 07	X	X	X	?		3	4	-	9	12	-	5	X	X	X
CSP 08	X	X	X	?		3	10(C)			11	-	4	-	X	-(C)
CSP 10	X	X	X	?		3	15(C)			13	-	4	-	X	-(C)

TABLE 17 (cont.)

CSP 11	X	X	X	?		4	3	2	8	13	–	4	X	X	X
CSP 13	X	X	X	?		3	3	4	8	14	–	4	X	X	X
CSP 14	X	X	X	?		4	3	1	8	14	–	4	X	X	X
CSP 17	X	X	X	?		2	2	–	8	9	–	2	X	X	X
CSP 20	X	X	X	?		3	1	1	7	12	–	4	X	X	X
CSP 23	X	X	X	?		4	–	1	2	11	–	4	X	X	X
CSP 24	X	X	X	?		3	3	1	10	12	–	4	–	X	X
CSP 26	X	X	X	?		3	2	2	9	13	–	3	X	X	X
CSP 28	X	X	–	?		2	2	2	2	9	–	2	–	–	X
CSP 31	X	X	X	?		4	1	2	6	11	–	5	X	X	X
CSP 34	X	X	X	?		4	3	2	10	12	–	4	X	–	X
CSP 37	X	X	X	?		4	3	–	7	13	–	4	X	X	X
CSP 41	X	X	X	?		4	3	–	8	14	–	4	X	X	X
CSP 43	X	X	X	?		3	3	–	6	13	–	3	X	X	X
CSP 44	X	X	X	?		4	4	–	6	11	–	4	–	X	X
CSP 47	X	X	X	?		3	2	–	12	12	–	4	–	X	X
CSP 49	X	X	X	?		4	3	–	7	13	–	4	X	–	X
FAR 02	X	X	X	–	–	–	–	4	4	6	–	2	X	X	X
FAR 05	X	X	X	?		5	1	5	4	9	–	6	X	–	X
FAR 06	X	X	X	?		2	–	5	3	8	–	5	–	X	X
FAR 10	X	X	X	–	X	1	2	4	6	8	–	5	X	X	X
FAR 11	X	X	X	X	–	1	1	6	–	3	–	1	X	–	X
FAR 13	X	X	X	X	X	2	10(C)			8	–	6	–	X	–(C)
FAR 15	X	X	X	?		4	–	2	7	8	–	5	X	X	X
FAR 17	X	X	X	?		2	1	5	4	8	–	5	X	X	X
FAR 22	X	X	X	?		2	6(C)			8	–	5	–	X	–(C)
FAR 23	X	X	X	?		3	9(C)			8	–	5	–	X	–(C)
FAR 25	X	X	X	?		3	1	5	4	9	–	5	X	X	X
FAR 26	X	X	X	?		3	11(C)			8	–	6	–	X	–(C)
FAR 27	X	X	X	?		2	1	7	3	8	–	5	X	X	X
FAR 30	X	X	X	–	X?	1	2	5	4	8	–	5	X	X	X
FAR 32	X	X	X	?		2	–	1	10	8	–	–	X	X	X
FAR 34	X	X	X	X	X	2	10(C)			8	–	–	–	X	–(C)
FAR 35	X	X	X	–	X	1	–	5	4	8	–	5	–	X	X
FAR 36	X	X	X	–	X	1	–	5	5	9	–	6	X	X	X

TABLE 17 (cont.)

MSP 01	X	X	-	?		3	3	4	8	-	-	1	-	@	X
MSP 02	X	X	-	?		2	2	6	6	-	-	1	X	@	X
MSP 03	X	X	-	?		2	3	5	4	-	-	1	X	@	X
MSP 04	X	X	-	?		2	1	8	8	-	-	1	X	@	X
MSP 06	X	X	-	?		1	3(C)			-	-	-	-	@	-(C)
MSP 08	X	X	-	?		1	-	6	-	-	-	1	X	@	X
MSP 13	X	X	-	?		2	2	3	4	-	-	1	X	@	X
MSP 20	X	X	-	?		2	7	-	4	-	-	1	X	@	X
MSP 21	X	X	-	?		1	1	6	8	-	-	1	X	@	-
MSP 23	X	X	-	?		1	4	2	10	-	-	1	X	@	X
MSP 25	X	X	-	?		1	2(C)			-	-	-	-	@	-(C)
MSP 26	X	X	-	?		2	1	2	7	-	-	1	X	@	-
MSP 27	X	-	-	?		1	5(C)			-	-	-	-	@	-(C)
MSP 28	X	X	-	?		1	7(C)			-	-	-	-	@	-(C)
MSP 31	X	X	-	-	-	-	5(C)			-	-	-	-	@	-(C)
MSP 33	X	X	-	?		1	4	2	5	-	-	1	X	@	X
MSP 34	X	X	-	?		2	5	2	5	-	-	1	X	@	X
MSP 36	X	X	-	?		1	3(C)			-	-	-	-	@	-(C)
MSP 37	X	X	-	-	-	-	1(C)			-	-	-	-	@	-(C)
MSP 38	X	X	-	?		1	-	4	1	-	-	1	-	@	X
MSP 39	X	-	-	?		2	1	5	5	-	-	1	X	@	X
MSP 40	X	X	-	?		2	7	-	3	-	-	1	X	@	X
MSP 42	X	X	-	?		2	7	-	8	-	-	1	X	@	X
MSP 44	X	X	-	?		2	6	-	1	-	-	1	X	@	X
MSP 45	X	X	-	?		2	8	-	8	-	-	1	X	@	X
MSP 46	X	-	-	?		2	4	1	9	-	-	1	X	@	X
OAK 05	X	-	-	X	X?	2	6(C)			8	-	-	-	X	-(C)
OAK 06	X	-	-	?		4	6(C)			8	-	-	-	X	-(C)
OAK 09	X	-	-	X	-	1	4(C)			6	-	-	-	X	-(C)
OAK 17	-	-	-	X	-	1	-	3	-	4	-	-	-	X	X
OAK 19	X	-	-	X	-	1	-	3	-	4	-	-	-	-	X
OAK 26	X	-	-	X	-	1	3	-	3	7	-	-	-	X	X
OAK 28	X	-	-	X	-	1	2	-	-	1	-	-	-	-	X
OAK 31	X	-	-	X	-	1	6	-	-	6	-	-	-	X	X

TABLE 17 (cont.)

OAK 33	X	–	–	X	–	1	3	–	2	7	–	–	–	X	X
OAK 34	X	–	–	X	–	1	4	–	–	6	–	–	–	X	X
OAK 35	X	–	–	X	?	2	2	–	2	7	–	–	–	X	X
OAK 36	X	–	–	X	–	1	4	–	–	5	–	–	–	X	X
OAK 37	–	–	–	X	–	1	3(C)			1	–	–	–	–	–
OAK 38	X	–	–	X	?	2	1	–	–	6	–	–	–	X	X
POR 02	–	–	–	–	–	–				–	–	–	X	–	–
POR 03	–	–	X	–	–	–				–	–	–	X	–	–
POR 04	–	–	X	–	–	–				–	–	1	X	–	X
POR 07	–	–	–	?		1				–	–	–	X	–	X
POR 09	–	–	X	?		1				–	–	–	X	–	X
POR 10	–	–	–	?		1				–	–	1	X	–	X
POR 11	–	–	X	?		1				–	–	–	X	–	X
POR 12	–	–	–	?		1				–	–	1	X	–	X
POR 15	–	–	X	–	–	–				–	–	–	X	–	X
POR 16	–	–	X	?		1				–	–	1	X	–	X
POR 17	–	–	–	?		1				–	–	1	X	–	X
POR 18	–	–	X	–	–	–				–	–	–	X	–	X
POR 19	–	–	–	–	–	–				–	–	–	X	–	X
POR 20	–	–	X	–	–	–				–	–	1	X	–	X
POR 21	–	–	X	–	–	–				–	–	–	–	–	X
POR 23	–	–	–	?		1				–	–	1	X	–	X
POR 25	–	–	X	?		1				–	–	–	X	–	X
POR 26	–	–	X	?		1				–	–	–	X	–	X
POR 28	–	–	X	–	–	–				–	–	–	X	–	X
POR 29	–	?	–	–	–	–				–	–	–	–	–	-(C)
POR 30	–	?	–	–	–	–				–	–	–	–	–	-(C)
POR 31	–	?	–	–	–	–				–	–	–	–	–	-(C)
POR 32	–	?	–	–	–	–				–	–	–	–	–	-(C)
POR 33	–	?	–	–	–	–				–	–	–	–	–	-(C)
STL 04	–	X	X	–	–	–	1(C)			–	–	–	–	X	-(C)
STL 05	X	X	X	?		1	–	–	–	–	–	–	X	X	X
STL 06	–	X	X	?		1	–	–	–	–	–	–	–	X	X
STL 07	–	X	X	?		1	–	–	1	–	–	–	X	X	X

TABLE 17 (cont.)

STL 10	–	X	X	–	–	–	1(C)			–	–	–	–	X	–(C)
STL 11	–	X	X	?		1	–	–	2	–	–	–	–	X	X
STL 14	–	X	X	–	–	–	–	–	2	–	–	–	X	X	X
STL 15	–	X	X	–	–	–	–	–	1	–	–	–	–	X	X
STL 17	–	X	X	?		1	3	–	–	–	–	–	–	X	X
STL 18	–	X	X	–	–	–	–	–	3	–	–	–	–	X	X
STL 23	–	X	X	–	–	–	2(C)			–	–	–	–	X	–(C)
STL 28	–	X	X	–	–	–	1	–	3	–	–	–	–	X	X
STL 29	–	X	X	–	–	–	2	–	2	–	–	–	–	X	X
STL 34	–	X	X+	?		1	–	–	2	–	–	–	X	X	X
STL 38	–	X	–	?		1	1	–	6	–	–	–	X	X	X
STL 40	X	X	X	–	–	–	1	–	1	–	–	–	–	X	X
STL 41	X	X	X	?		1	2	–	2	–	–	–	–	X	X
STL 42	X	X	X	–	–	–	–	–	5	–	–	–	X	X	X
STL 44	–	X	–	–	–	–	1	–	–	–	–	–	–	–	–
STL 46	–	X	X	–	–	–	1	–	2	–	–	–	–	X	X
STL 49	X	X	X	?		1	–	–	3	–	–	–	X	X	X
STL 55	–	X	X	?		1	2	–	4	–	–	–	X	X	X
STL 56	–	X	X	?		1	–	–	2	–	–	–	–	X	X
STL 70	–	X	X	–	–	–	1	–	4	–	–	–	–	X	X
STL 77	–	X	X	?		1	2	–	3	–	–	–	–	X	X
STL 92	–	X	X	?		1	1	–	4	–	–	–	–	X	X
STL 93	–	X	X	?		1	2	–	5	–	–	–	X	X	X
TAC 04	X	X	X			3	2	7	5	15	–	2	–	X	X
TAC 21	X	X	X	?	X	2	3	1	3	7	–	–	X	X	X
TAC 37	X	–	–(BB)	X	X	2	6(C)			7	–	–	–	X	–(C)
TAC 39	X	–	–(BB)	?	X	2	3	6	5	15	–	1	–	X	X
TAC 45	X	X	X			4	8	4	4	16	–	–	X	X	X
TAC 49	X	X	X			3	8	–	8	16	–	–	–	X	X
TAC 55	X	X	X			4	5	3	5	15	–	–	X	X	X
TAC 57	X	X	X			4	2	–	14	16	–	1	X	X	X
TAC 58	X	X?	–			1	5(C)			6	–	–	–	–	–(C)
TAC 75	X	X	X	X	X	2	6(C)			7	–	–	–	X	–(C)
TAC 76	X	–	–(BB)			2	7(C)			7	–	–	–	X	–(C)
TAC 81	X	X	–(BB)			4	2	5	7	16	–	1	–	X	X

TABLE 17 (cont.)

TAC 83	X	X	X			3	3	-	12	16	-	1	-	X	X
TAC 87	X	X	X			2	10	-	5	16	-	-	X	X	X
TAC 98	X	X	X			2	13(C)			16	-	-	-	X	-(C)
WAS 02	X	-	X	X	X	2	3	3	6	-	10	-	X	X	X
WAS 05	X	-	X			3	2	7	6	-	14	-	-	X	X
WAS 06	X	X	X			2	12(C)			-	10	-	-	X	-(C)
WAS 07	X	X	-			3	1	3	10	-	13	-	-	X	X
WAS 08	X	-	-			1	4	3	7	-	10	-	X	X	X
WAS 24	X	X	X			2	5	2	6	-	11	-	X	X	X
WAS 27	X	-	X			3	3	4	7	-	10	-	-	X	X
WAS 40	X	-	-			2	12(C)			-	11	-	-	X	-(C)
WAS 41	X	X	-			1	5	-	6	-	10	-	-	X	X
WAS 44	X	X	X			2	6	-	7	-	9	-	X	X	X
WAS 47	X	X?	-			2	4	-	7	-	11	-	X	X	X
WAS 53	X	X	X			1	5	-	7	-	10	-	-	X	X
WAS 57	X	-	X			1	12(C)			-	11	-	-	X	-(C)
WAS 58	X	X	X			2	11(C)			-	11	-	-	X	-(C)
WAS 63	X	X	X			4	11(C)			-	11	-	-	X	-(C)

5.14 WEATHER (DAILY TEMPERATURES) DATA AND DERIVED DEGREE DAYS

To be able to run the "floating balance point" analysis program (see section 6.0), we had to have the capability of calculating cumulative degree days for any balance point (i.e., base temperature). Since degree days represent a measure of the extent to which the temperature, on a daily basis, lies below the "balance point" reference temperature, it is necessary to deriving degree days for the balance point temperature to operate as a cut-off value on the daily temperature range. In other words, degree days can only be calculated on a day-by-day basis, with reference to the specified reference temperature, from the recorded high and low temperatures for the day.

Tables (files) of daily high and low temperatures for each site (plus several other weather stations, for comparison) were generated from raw weather data tapes supplied by the National Climatic Data Center (NCDC). It should be noted that the temperatures listed in these files are not necessarily identical to the "maximums" and "minimums" reported on the monthly Local Climatological Data sheets supplied by NCDC. This is because: 1) the NCDC tapes do not report the highest and lowest temperatures recorded on a day, and 2) our "high" and "low" temperatures had to be obtained as follows: The raw data tapes contain "3-hourly" readings--the readings of many meteorological parameters taken at 3-hour intervals. We employed one program to decode (from their special, modified EBCDIC coding) the eight temperature readings for a day, and then another program to look through that list and find the highest and lowest temperatures. Since the maximum for a day is unlikely to occur right at a 3-hourly reading, it may well be somewhat higher than the "high" found by the program, and the minimum may well be somewhat lower than the "low." Since the errors will be in opposite directions, they presumably tend to cancel each other out, and should not cause any consistent bias in the daily temperature ranges. (Both of the computer programs used are listed in [6].)

For most of the weather stations, these files extend from January 1973 through June 1980. Midway Airport (Chicago) ceased reporting weather data at the end of December 1979, so we obtained data from O'Hare Airport for 1975 through June 1980, to cover the 1979/80 heating season for Chicago. (When "pre" fuel data records for the Chicago houses were rerun against O'Hare temperature data, most of the balance points obtained differed from the original ones obtained with Midway data by no more than 0.5 or 1.0 F degrees. The year-total data in table YTDDYTBL (see below) also demonstrate that the difference between temperatures at Midway and at O'Hare is virtually insignificant.)

Although these files have a record length of only 40 characters, their size and the frequency of use of any particular file made it inappropriate to maintain them on a disk volume. They are recorded on a tape, using the Interdata COPY32 utility, with a blocking factor of 100 records (so the COPY32 parameter for reading the tape is "40/100").

The files are named [CTC]N.WEA. For the weather stations that were not site cities, the "CTC" codes are as follows: CHO--(Chicago) O'Hare airport; (CHI contains the data from Midway airport); WNA--Washington National Airport (which

is geographically nearest to Hughesville); WDU--Dulles International Airport (Washington); and BWI--Baltimore Washington International Airport.

The format of the files is as follows:

CTC MO DY YR HIG LOW

where HIG and LOW represent, respectively, the high and low temperatures for the day, recorded in FORTRAN 13 format.

The discussion above has described how the daily "high" and "low" temperatures were obtained, and why they are slightly different from the "maximum" and "minimum" temperatures reported on the monthly NCDC data sheets. The algorithm we used for calculating degree days from the daily high and low also differed from the customary one, and produced somewhat different--and probably more accurate--results.

The "standard" method for determining degree days for a day is simply to take the difference between the mean of the high and low temperatures and the (balance point) reference temperature as the (heating) degree day figure. If the difference is zero or negative, no degree days are recorded for that day. Example: if the high is 70° and the low is 30°, the mean for the day is 50°; if the reference temperature is 65°, 15 degree days would be recorded for this particular day. The daily figures are then summed to obtain the figure for the period in question (month, year, fuel consumption period).

All of our calculations involving degree days employed a "modified" degree day, obtained by dividing the day into 24 hour intervals, fitting a sine curve to the high and low temperatures for the day, calculating "degree hours" as the differences between the sine curve and the reference temperature, and summing the 24 hourly figures to obtain the degree day figure for the day. Obviously, the sine wave is likely to be a somewhat better model for the actual fluctuation of temperature over a 24-hour period than the simple mean of the high and low.

Two types of tables of "modified" degree days were generated from the daily high/low temperatures file, and retained in disk files for reference: 1) A set of tables named TDDYTBL.[CTC] gives, for the year July 1976-June 1977 and the year June 1979-May 1980 (as they were generated before the June 1980 weather data tape had been received), monthly total degree days for all balance points from 45°F to 85°F (in one degree intervals). (These were generated for use in the thermal load calculations part of the analysis, which was done on a monthly basis.) 2) A single file, named YTDDYTBL., contains three tables showing, for all sites plus the extra weather stations, year total degree days for all balance points from 45°F to 85°F for: a) 1973-1980 (7-year mean, except where less data were available, e.g., CHI and CHO)*; b) 1975-1977 (2-year mean for the period over which most of the "pre" fuel consumption data were analyzed); c) and 1979/80 (in fact, July 1979-June 1980). These files are on disk volume CSA1. It

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* This table is printed as appendix C in the final report of the demonstration [2].

should be noted that, at present, the 1979/80 and the 7-year mean data for Chicago-O'Hare (CHO) are in error, due to a problem encountered in decoding the raw weather data tapes from that site.

6. THE "BALANCE POINT" ANALYSIS AND ITS RESULTS

In order to compare the consumption of fuel for space heating of a house during one period (say, before weatherization) with that at another time (say, after weatherization), one must employ some means to factor out the effect of the actual weather that prevailed during the two measurement periods. If the first winter happened to be abnormally warm and the second abnormally cold, more fuel might be used during the winter after the house had been weatherized--but, obviously, this would not truly reflect the effect of the weatherization.

What must be done in order to compare space heating fuel consumption of a house in different years is to "normalize" the actual measured consumption--to somehow convert it to a rate (e.g., "per year") for a "normal year", somehow defined.

The measure of "amount of coldness" in a heating season, against which one compares the fuel consumption in order to derive the rate of "normal" consumption, is the number of degree days (as discussed above) in the year. What we actually determine is the "consumption per degree day", and then by multiplying by the number of degree days in a specific year, or the average number of degree days over several years for a "normal year", we can "predict" or estimate the actual consumption for that particular year or a "normal" year. This estimate we use as the "measure" of fuel consumption--particularly for a "normal" year, since we cannot wait around for a "normal" winter during which to make field measurements. Ideally we would use 30-year averages for the "normal" year, but 30-year average degree days are not available for balance points other than 65°F.

The analysis method used to determine "consumption per degree day" in the demonstration was based on a mathematical model that assumes that the energy actually used for space heating is directly proportional to the amount of coldness in the measurement period, measured in degree days. The implication of this assumption is that, if we plot measured fuel consumption against measured degree days, the points should lie roughly on a straight line.

The mathematical term for this type of problem is a regression analysis: One regresses fuel consumption on degree days, finds that line that constitutes a "best fit" to the data points, and obtains three parameters: 1) the slope of the line, referred to as the B_1; 2) the Y-intercept (the Y value at the point where the line crosses the Y-axis), referred to as the B_0; and 3) a regression coefficient--a measure of how "good the fit" of the data to the straight line is (maximum = 1.0), referred to as the R^2 (usually expressed as r^2--the squared coefficient of correlation).

In our "balance point" analysis procedure, the B_1 has the meaning "consumption (in whatever units we have entered the data) per degree day", and the B_0 the meaning "consumption (per day, by the way we entered the data) at zero degree days"--i.e., whenever there is no demand for space heating. To be a bit more precise, one should insert "average" before "consumption" in each of the above expressions. Thus, the B_0 may be referred to as the "average daily base load consumption." If we have analyzed whole-house gas consumption, and gas is also used for cooking and service water heating in the house, the B_0 would be expected to have some positive value. On the other hand, if we have analyzed the

consumption of oil which is used only to fire a space heating furnace, under the assumption that some of the space heating load is provided for by solar gains through windows and internal heat gains from operation of appliances and from the occupants themselves, the B_0 would reasonably be expected to be negative.

The analysis of fuel consumption that was used in the demonstration was, in fact, one step more complex than described above. It has been mentioned that degree days are calculated with reference to some base temperature, that 65°F is the customarily-assumed base temperature, but that other base temperatures can be used, and may in fact be more correct for a particular house. Our "balance point" analysis program let the base temperature, or balance point, "float" from 45°F to 84.5°F (in steps of 0.5 F degrees), and looked for the balance point (T_0) that gave the best fit of the data to the straight line (as measured by the R^2).

We had hoped that this analysis would, in fact, give us a statistically-determined unique balance point for a house for a measurement period. From this, we came to refer to it as a "balance point" analysis. However, while this seemed to work out for some houses, for others the analysis proved to be too unstable as far as the balance point temperature was concerned: some went off one or the other end of the balance point range (45°F or 84.5°F--either of which is hard to explain in terms of the real world), while with others the R^2 shifted so little as the balance point changed that the "best fit" temperature could not be said to be well defined.

Nevertheless, as long as the fit of the data points to the straight line was good enough (as measured by the R^2), we could validly use the B_1, B_0 and T_0 obtained to project or "measure" fuel consumption.

The "balance point" fuel consumption analysis was accomplished using program BALPOINT.FTN, a symbolic listing of which will be found on disk volume CSA1, and also in [6]. The required input to the "balance point" analysis program consists of a set of consumption records in the format shown on page 27 (under "Utility Data"). Note that, since each record, having a beginning and an ending date, constitutes a complete consumption measurement, it is not essential for the records to be continuous over the entire analysis period. The absence of measurements for some time periods obviously reduces the amount of data on which the analysis result is based, but causes no problem to the operation of the program.

In the demonstration the analysis of space heating fuel consumption was conducted as follows. The main output of a balance point analysis run consisted of 1) a plot showing the data points and the fitted straight line, using degree days as calculated from the "best fit" solution; 2) a table showing the data analyzed (the beginning and ending dates of each consumption period and the associated fuel consumption), the total degree days for each consumption period at the standard 65°F base, and the consumption and degree days <u>per day</u> for each data entry. (The actual plotting and analysis were carried out on the per day figures, since for delivered fuels such as oil, kerosene and propane, the <u>total</u> degree days for each consumption period would tend to be about the same, giving

no useable basis for analysis of fuel consumption against them--all of the data points would lie close together, rather than spread out to form a line.); 3) a table containing a similar listing of the data, but with degree days calculated from the "best fit" balance point-i.e., the data that corresponds to the previously described plot--and also listing the residuals (differences--vertical, on the plot--in the fuel units being used) between the measured data points and the "best fit" line (the latter representing the projected consumption for that number of degree days); 4) a table that lists, for all balance points from 45°F to 84.5°F, the B_1, B_0, and R^2, so that we can observe the effect of changing T_0 on the other parameters and the stability of the "best fit" solution. (See exhibit 26 for an example balance point analysis printout.)

The program then went through an edit routine that discarded any data points with residuals larger than a specified criterion--usually two standard errors (S.E.) were used--and reran the regression. (This was done on the rationale that one or two misreported, mispunched, or otherwise erroneous data points, should not be allowed to contaminate the analysis result.) If any points were edited out, the program would print a second plot immediately following the first one (and labeled "EDITED"), and a second set of tables 3) and 4).

A one-line summary of each analysis run was also written (by later versions of the analysis program) to the appropriate one of the site summary data files--which are discussed below.

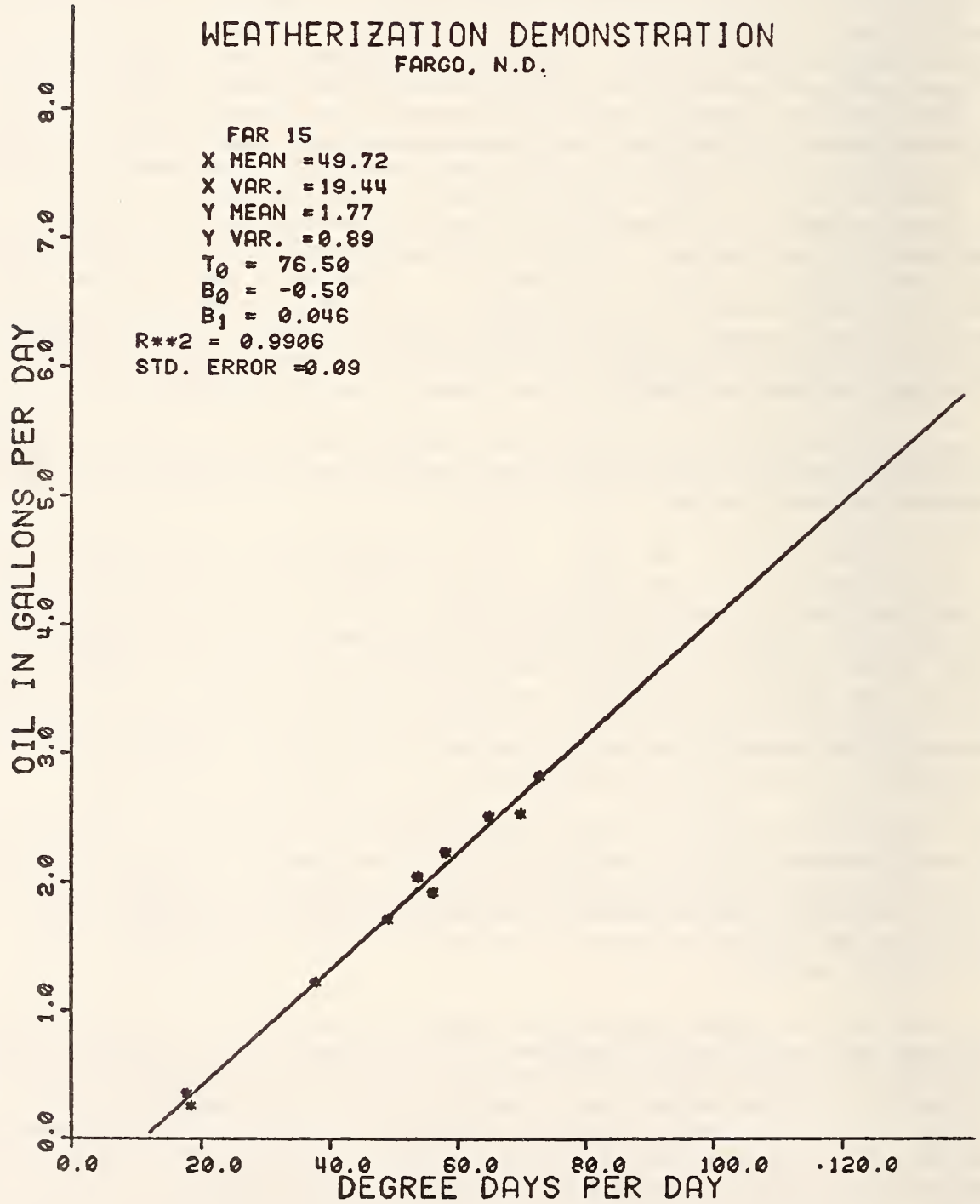
For all proposed houses for which 2 (or more) years (i.e., mid-1975-mid-1977) of space heating fuel consumption data were submitted to NBS, we ran the data through the "balance point" analysis program. As a selection criterion for houses to be eligible for the program, we required an R^2 of at least 0.9. (This value signifies that 90 percent of the variation in fuel consumption over various time periods is explained by the variations in degree days.) As can be seen by examination of the summary data files (discussed below), a remarkable number of the analysis runs on archival data sets (i.e., ordinary utility meter readings or fuel delivery records) produced R^2's of 0.97 or higher.

The results of the analysis runs (on both "before" and "after" data) are shown by one-line summaries in a set of summary files. These are present on disk volume CSA1, and are labeled HSBPTDTA.[CTC]. A CSS file, invoked by CSA1:PR2BPD [CTC]" (see exhibit 27) will cause the specified site summary data file to be printed on the high-speed printer attached to the Interdata system, with appropriate headings.

A record in these files displays the following data: city code; house number; fuel code for space heating fuel (see table 18, page 122) (if two are listed, the first is the one analyzed by that run); fuel code for water heating (for identification of co-use of fuel--this had to be entered manually, and is missing from some records); a selection flag (discussed below); the beginning and the ending dates of the period over which consumption is analyzed (in the form MOYR MOYR, each in FORTRAN I2I2 format); a one-letter code for the type of data analyzed (see table 18); then: the B_0, B_1, T_0 and R^2 for the 'best fit" solution; the B_0, B_1 and R^2 obtained using degree days calculated from the standard 65°F base; and, <u>if</u> the B_0's change sign between balance points 45°F

EXHIBIT 26

EXAMPLE OUTPUT OF "BALANCE POINT" ANALYSIS RUN



*** DATA ANALYZED ***

BASE TEMPERATURE: 65.0
FUEL: OIL IN GALLONS

	DATE		TOTALS		PER DAY			NO. OF
	INITIAL	FINAL	FUEL	DG. DAYS	FUEL	KBTU	DG. DAYS	DAYS
FAR 15	10/30/79	11/20/79	36.1	786.5	1.72	238.43	37.45	21
FAR 15	11/20/79	12/10/79	41.0	841.5	2.05	284.33	42.07	20
FAR 15	12/10/79	1/ 2/80	44.3	1021.5	1.93	267.15	44.41	23
FAR 15	1/ 2/80	1/22/80	50.3	1065.0	2.51	348.83	53.25	20
FAR 15	1/22/80	2/12/80	59.5	1281.0	2.83	392.98	61.00	21
FAR 15	2/12/80	3/ 3/80	50.7	1161.0	2.53	351.60	58.05	20
FAR 15	3/ 3/80	3/25/80	49.3	1021.5	2.24	310.81	46.43	22
FAR 15	3/25/80	4/15/80	25.9	551.0	1.23	171.06	26.24	21
FAR 15	4/15/80	5/ 6/80	5.6	197.4	0.27	36.99	9.40	21
FAR 15	5/ 6/80	5/28/80	7.9	211.6	0.36	49.81	9.62	22

NUMBER OF POINTS= 10
***

FAR 15
THE FOLLOWING DATA WAS USED IN INTERPRETING WEEKLY READINGS
METERS CODE: 15
NOZZLE CHANGE DATE: / / NOZZLE RATES: 0.63/ 0.
MTR. 6 CHG. DATE: / / MTR. 6 FACTORS: 1.00/ 0.
MTR. 1/4/5/9 FACTORS: 1.00/ 1.00/ 1.00/ 1.00

*** DATA ANALYZED ***

BASE TEMPERATURE: 76.5
EDIT STANDARD: 2.0 S.E.'S
FUEL: OIL IN GALLONS

	DATE		TOTALS		PER DAY			RESIDUAL
	INITIAL	FINAL	FUEL	DG. DAYS	FUEL	KBTU	DG. DAYS	
FAR 15	10/30/79	11/20/79	36.1	1028.0	1.72	238.43	48.95	-0.01
FAR 15	11/20/79	12/10/79	41.0	1071.5	2.05	284.33	53.57	0.11
FAR 15	12/10/79	1/ 2/80	44.3	1286.0	1.93	267.15	55.91	-0.12
FAR 15	1/ 2/80	1/22/80	50.3	1295.0	2.51	348.83	64.75	0.06
FAR 15	1/22/80	2/12/80	59.5	1522.5	2.83	392.98	72.50	0.03
FAR 15	2/12/80	3/ 3/80	50.7	1391.0	2.53	351.60	69.55	-0.14
FAR 15	3/ 3/80	3/25/80	49.3	1274.5	2.24	310.81	57.93	0.10
FAR 15	3/25/80	4/15/80	25.9	792.5	1.23	171.06	37.74	0.01
FAR 15	4/15/80	5/ 6/80	5.6	385.4	0.27	36.99	18.35	-0.07
FAR 15	5/ 6/80	5/28/80	7.9	393.6	0.36	49.81	17.89	0.04

NUMBER OF POINTS=

EXHIBIT 26 (cont)

	FUEL UNITS				KBTU	
TO	BO	B1	R**2	SS	BO	B1
45.0	0.46	0.061	0.9446	0.2097	66.1	8.40
45.5	0.46	0.060	0.9472	0.2046	64.2	8.33
46.0	0.45	0.060	0.9497	0.1997	62.3	8.26
46.5	0.44	0.059	0.9521	0.1948	60.4	8.19
47.0	0.42	0.059	0.9544	0.1901	58.6	8.13
47.5	0.41	0.058	0.9566	0.1855	56.7	8.07
48.0	0.40	0.058	0.9587	0.1810	54.8	8.00
48.5	0.38	0.057	0.9607	0.1765	52.9	7.94
49.0	0.37	0.057	0.9626	0.1722	51.0	7.89
49.5	0.35	0.056	0.9644	0.1679	49.1	7.83
50.0	0.34	0.056	0.9662	0.1637	47.2	7.78
50.5	0.33	0.056	0.9679	0.1596	45.3	7.72
51.0	0.31	0.055	0.9695	0.1556	43.4	7.67
51.5	0.30	0.055	0.9710	0.1517	41.4	7.62
52.0	0.28	0.055	0.9724	0.1480	39.5	7.57
52.5	0.27	0.054	0.9737	0.1445	37.5	7.52
53.0	0.26	0.054	0.9749	0.1412	35.6	7.48
53.5	0.24	0.054	0.9760	0.1380	33.6	7.43
54.0	0.23	0.053	0.9770	0.1349	31.7	7.39
54.5	0.21	0.053	0.9780	0.1320	29.7	7.35
55.0	0.20	0.053	0.9789	0.1292	27.7	7.30
55.5	0.19	0.052	0.9796	0.1265	25.8	7.26
56.0	0.17	0.052	0.9806	0.1239	23.8	7.22
56.5	0.16	0.052	0.9814	0.1214	21.8	7.19
57.0	0.14	0.052	0.9821	0.1191	19.8	7.15
57.5	0.13	0.051	0.9828	0.1168	17.8	7.11
58.0	0.11	0.051	0.9834	0.1147	15.8	7.08
58.5	0.10	0.051	0.9840	0.1127	13.7	7.04
59.0	0.08	0.051	0.9845	0.1107	11.7	7.01
59.5	0.07	0.050	0.9850	0.1089	9.7	6.98
60.0	0.05	0.050	0.9855	0.1071	7.6	6.94
60.5	0.04	0.050	0.9860	0.1054	5.6	6.91
61.0	0.03	0.050	0.9864	0.1038	3.5	6.88
61.5	0.01	0.049	0.9868	0.1023	1.4	6.85
62.0	-0.00	0.049	0.9871	0.1009	-0.7	6.82
62.5	-0.02	0.049	0.9875	0.0996	-2.8	6.80
63.0	-0.04	0.049	0.9878	0.0984	-4.9	6.77
63.5	-0.05	0.049	0.9881	0.0972	-7.1	6.74
64.0	-0.07	0.048	0.9883	0.0962	-9.3	6.72
64.5	-0.08	0.048	0.9886	0.0952	-11.5	6.70
65.0	-0.10	0.048	0.9888	0.0942	-13.7	6.67
65.5	-0.11	0.048	0.9890	0.0934	-15.9	6.65
66.0	-0.13	0.048	0.9892	0.0925	-18.1	6.63
66.5	-0.15	0.048	0.9894	0.0918	-20.4	6.61
67.0	-0.16	0.048	0.9895	0.0912	-22.7	6.59
67.5	-0.18	0.047	0.9896	0.0906	-25.0	6.57
68.0	-0.20	0.047	0.9898	0.0901	-27.3	6.55
68.5	-0.21	0.047	0.9899	0.0896	-29.6	6.53
69.0	-0.23	0.047	0.9899	0.0892	-32.0	6.52
69.5	-0.25	0.047	0.9900	0.0888	-34.3	6.50

EXHIBIT 26 (cont)

	FUEL UNITS				KBTJ	
TO	B0	B1	R**2	SS	B0	B1
70.0	-0.26	0.047	0.9901	0.0884	-36.7	6.48
70.5	-0.28	0.047	0.9902	0.0881	-39.1	6.47
71.0	-0.30	0.047	0.9903	0.0878	-41.6	6.45
71.5	-0.32	0.046	0.9903	0.0875	-44.0	6.44
72.0	-0.33	0.046	0.9904	0.0872	-46.4	6.43
72.5	-0.35	0.046	0.9904	0.0870	-48.9	6.41
73.0	-0.37	0.046	0.9905	0.0869	-51.4	6.40
73.5	-0.39	0.046	0.9905	0.0867	-53.9	6.39
74.0	-0.41	0.046	0.9905	0.0865	-56.4	6.38
74.5	-0.43	0.046	0.9905	0.0864	-59.0	6.37
75.0	-0.44	0.046	0.9906	0.0864	-61.5	6.35
75.5	-0.46	0.046	0.9906	0.0863	-64.1	6.34
76.0	-0.48	0.046	0.9906	0.0863	-66.6	6.33
76.5	-0.50	0.046	0.9906	0.0862	-69.2	6.32
77.0	-0.52	0.046	0.9906	0.0862	-71.8	6.32
77.5	-0.54	0.045	0.9906	0.0862	-74.4	6.31
78.0	-0.56	0.045	0.9906	0.0862	-77.1	6.30
78.5	-0.57	0.045	0.9906	0.0863	-79.7	6.29
79.0	-0.59	0.045	0.9906	0.0863	-82.4	6.28
79.5	-0.61	0.045	0.9906	0.0864	-85.0	6.27
80.0	-0.63	0.045	0.9906	0.0864	-87.7	6.27
80.5	-0.65	0.045	0.9905	0.0865	-90.4	6.26
81.0	-0.67	0.045	0.9905	0.0865	-93.1	6.25
81.5	-0.69	0.045	0.9905	0.0866	-95.8	6.25
82.0	-0.71	0.045	0.9905	0.0867	-98.6	6.24
82.5	-0.73	0.045	0.9905	0.0867	-101.4	6.24
83.0	-0.75	0.045	0.9905	0.0868	-104.1	6.23
83.5	-0.77	0.045	0.9905	0.0869	-106.9	6.23
84.0	-0.79	0.045	0.9904	0.0869	-109.8	6.22
84.5	-0.81	0.045	0.9904	0.0870	-112.6	6.22

LEAST SQUARE FIT: FAR HOUSE 15
X = DEGREE DAYS—BASE 76.5 F
Y = FUEL
B0(NBAL) = -0.50 (+/- 0.27)
B1(NBAL) = 0.046 (+/- 0.005)
STANDARD ERROR = 0.09 R**2 = 0.9906

EXHIBIT 27

```
* CSS file "PR2BPD"
*    To print HSBPTDTA files (with heading) on PR2:
*    Use first parameter (@1) to specify site/city.
*
XDELETE CSA1:TABLEDTE.
AL CSA1:TABLEDTE.,IN,20
D T ,CSA1:TABLEDTE.
XDELETE CSA1:PRDUMMY
AL CSA1:PRDUMMY,IN,100
CSA1:COPYA CSA1:TABLEDTE,CSA1:PRDUMMY,,10
APPEND CSA1:HSBPTDTA.HDG,CSA1:PRDUMMY.,,100
APPEND CSA1:HSBPTDTA.@1,CSA1:PRDUMMY.,,100
COPYA CSA1:PRDUMMY.,PR2:,,100
* COPYA CSA1:PRDUMMY.,PR2:,,100
* COPYA CSA1:PRDUMMY.,PR2:,,100
DE CSA1:TABLEDTE;DE CSA1:PRDUMMY
$EXIT
```

TABLE 18

CODES USED IN "HSBPTDTA" FILES

Code	Fuel type	Units
B	bottled gas (propane or LPG)	gallons
E	electricity	kWh
F	(for service water heating: same as furnace--i.e., heated in furnace)	
G	natural gas	therms
K	kerosene	gallons
M	natural gas	100 ft^3 (i.e., direct meter readings)
O	oil	gallons
P	propane	1 ft^3 (direct meter readings)

Code	Type of data analyzed
U	utility or fuel delivery
W	weekly readings

and 84.5°F, the B_1, T_0 and R^2 for the B_0 closest to 0.0 (i.e., the slope at zero base load, or assuming all fuel used goes to space heating); finally, a set of codes (listed in the heading of the HSBPTDTA printout) showing what weatherization options, by group, had been completed by the beginning date of the particular analysis run. Note that an option group code enclosed in parentheses indicates that options of that type were installed on the house, but were not completed until after the beginning date of the analysis run; thus their effect may contaminate the analysis result.

If it is desired to have a print-out of the HSBPTDTA file with all consumption data (i.e., B_0's and B_1's) converted to kBtu, to enable direct comparisons between houses using different types of fuel, CSS file CSA1:PR2BPBTU [CTC] (see Exhibit 28) will produce such a table on the high-speed printer with appropriate headings. The fuel-type code in column 8 of each record tells the program what conversion factor to use to get from fuel units to KBtu. (Note that this CSS file/program is presently set up to operate only on records "flagged" with a "#" in column 12--see discussion below, on page 126. If it is desired to obtain kBtu data on all records in a HSBPTDTA file, the HSBPDTA file can be edited into a "dummy" file with the "#" in column 12 of each record, and PR2BPBTU run on this file.)

The results of virtually all "pre" (i.e., 1975-1977) data analysis runs are listed in the HSBPTDTA files. The only ones omitted from these files were runs resulting in extremely low R^2's (<ca. 0.20)--indicating either very bad data, inconsistent occupant-use patterns, or that the fuel was simply not used for space heating, thus did not correlate with degree days. Most of these "pre" data were manually written into the computer, rather than automatically recorded by the analysis program, as is true of later runs. These data were proofread, but 100 percent accuracy is not assured, especially for houses that were not selected for the demonstration sample.

As to the location of the original computer printouts from "balance point" analysis runs: all printouts for houses in the sample should be in the appropriate "house" files; the printouts for "pre" runs on houses that were not selected for participation in the demonstration should be in the "city" files, in the section labeled "Balance Points."

Multiple analysis runs of either "pre" or "post" data were conducted for such reasons as: 1) the initial submission of "pre" data was insufficient, so it was rerun with added data (we sought to have a minimum of 8-10 data points, over two heating seasons); 2) a relatively low R^2 combined with a pattern of negative residuals for one heating season and positive ones for the other suggested some change in heating energy use patterns had occurred between the seasons, and we split the data and ran the 2 years separately to try to ascertain the nature of the change; 3) original runs on Oakland data using an edit criterion of 2 S.E.'s gave generally low R^2's, so most of these data sets were rerun with the criterion tightened to 1 S.E.; 4) some mid-demonstration runs were made on data from Portland and Fargo; 5) with "post" data analysis, a run on weekly readings did not result in a good enough fit, so the utility data was entered and analyzed.

EXHIBIT 28

```
* CSS file "PR2BPBTU"
*   To convert BALPOINT analysis results to KBTU, and
*   print (with headings) on PR2:
*
*   Use first parameter (@1) to specify site/city.
*   Use second parameter (@2 NONNULL) to evoke PR: copy, also.
*
*        This version converts only (!) HSBPTDTA.[CTC] entries flagged with
*        a '#' in column 8, and sorts the output by 1) house number and
*        2) beginning date of analysis period.  (It requires the use
*        of the SORT utility.)
*
$IFNULL @1
$COPY
***  CITY/SITE NOT SPECIFIED  ***
$NOC
$EXIT
$ENDC
XDELETE CSA1:BPTDTA.TMP
AL CSA1:BPTDTA.TMP,IN,100
LO CSA1:BPTCONV
AS1,CSA1:HSBPTDTA.@1,SRO
AS2,CSA1:BPTDTA.TMP,EWO
ST
$IFNE 0;$CLEAR;$EXIT;$ENDC
XDELETE RSORT.TMP;AL RSORT.TMP,IN,100
$BUILD CSA1:RSORT.CMD
RECL 100
KEY
5/2/A
15/2/A
EKEY
SCRATCH
SORT BPTDTA.TMP,RSORT.TMP
END
END
$ENDB
LO CSA1:SORT
AS5,CSA1:RSORT.CMD
ST
$IFNE 0
$W ** SORT ERROR **
$CLEAR;$EXIT
$ENDC
XDELETE CSA1:TABLEDTE.
AL CSA1:TABLEDTE.,IN,20
D T ,CSA1:TABLEDTE.
XDELETE CSA1:PRDUMMY
AL CSA1:PRDUMMY,IN,100
```

EXHIBIT 28 (cont.)

```
CSA1:COPYA/P CSA1:TABLEDTE,CSA1:PRDUMMY,,10
CSA1:APPEND CSA1:HSBPTDTA.HD2,CSA1:PRDUMMY.,,100
CSA1:APPEND CSA1:RSORT.TMP,CSA1:PRDUMMY.,,100
COPYA CSA1:PRDUMMY.,PR2:,,100
* COPYA CSA1:PRDUMMY.,PR2:,,100
* COPYA CSA1:PRDUMMY.,PR2:,,100
$IFNNULL @2
CSA1:UPPR
COPYA CSA1:PRDUMMY.,PR:,,100
CSA1:UPPR
$ENDC
DE CSA1:TABLEDTE;DE CSA1:BPTDTA.TMP
DE CSA1:PRDUMMY.
$EXIT
```

When we came to making final comparisons of "before" and "after" fuel consumption, selection had to be made, among multiple runs, of the "before" and the "after" run which represented our best judgment of the measured fuel consumption. The runs selected in this process were flagged with a number sign ("#") in column 12 (immediately following the water heating fuel code), so that subsequent analysis programs could operate on just these records.

6.1 NOTE ON CONVERTING WEEKLY READINGS TO CONSUMPTION DATA

In order to analyze consumption, one must, of course, have consumption data. Meter readings are not themselves consumption data. They must be converted into consumption measurements, i.e., the differences between successive readings determined.

In order to carry out "balance point" analysis of weekly readings data, a program called RWRITDTA.FTN was written to translate weekly meter readings into consumption figures, and write them out in records of precisely the format shown in section 5.2, "Utility Data". (A source-listing of RWRITDTA.FTN is located on disk volume CSA3 and can also be found in [6].)

In order to carry out this calculation, the program needed to "know" some things about the desired interpretation: Since, as has been described in section 5.3, "Weekly Readings Data", there were a number of (possible) meters recorded in a weekly readings record, the program needed to know which one--i.e., which field (or fields, in the case of multiple space heaters or multiple-circuit electric heating) to "look at." For oil or kerosene furnaces, where consumption was to be calculated as the product of run-time and nozzle flow rate, it needed to know the nozzle "size." If the furnace was replaced or de-rated, the program needed to know when, and the new nozzle size. For some other meters, a scale factor had to be provided (e.g., Fargo at first reported water heater gas consumption from standard 100 ft^3 meters, then replaced those with the requested 1 ft^3 meters. Again, the program needed to know the two scaling factors and the date of the change.

All of these necessary interpretation parameters were provided through a set of site files named METRCAR.[CTC], which are present on disk volume CSA3 (along with the weekly readings data files). The data in and format of these files are as shown in table 19, with each pair of fields separated by one space.

We anticipated having field-calibrated furnace nozzle sizes (flow-rates) available for use in calculating "measured" consumption from run-time. However, due to a slip-up in instructions to the field, these data were not collected. The nozzle size information we had (as reported on the Mechanical Systems Tests Data Sheets, see section 5.4) was, for the most part, obtained by field personnel by merely observing the rating stamped on the nozzle.

To check the accuracy of these reported nozzle sizes, for those houses for which we had the backup delivery data, we compared the delivery-to-delivery consumption measurements with consumption measurements for the same time intervals generated from weekly readings by RWRITDTA (using the reported nozzle sizes). For some houses, the ratios of the two sets of consumption measures

TABLE 19

DATA LIST FOR METRCAR.[CTC] FILES

Datum	(FORTRAN) Format Code
city code	A3
house number	I2
space heating fuel	A1
water heating fuel	A1
"meters" (i.e., field(s)) code	I2
(initial) nozzle size (gal/hr)*	F4.2
change date (MODYYR)	3I2
(new) nozzle size	F4.2
meter "6" scale factor**	F5.2
change date (as above)	3I2
new meter "6" scale factor	F5.2
meter "1" scale factor	F5.2
meter "4" scale factor	F5.2
meter "5" scale factor†	F5.2
meter "9" scale factor†	F5.2

* In effect, meter field "2" scale factor--see exhibit 3, page 57.

** Meter field "6" contains water heater fuel readings.

† Meter fields "5" and "9" were available, optionally, for special uses--see exhibit 3.

intervals generated from weekly readings by RWRITDTA (using the reported nozzle sizes). For some houses, the ratios of the two sets of consumption measures were consistently 1.0. We took these nozzle sizes to correctly reflect the flow rates of the nozzles, labeled them "OK" in the METRCAR file, and used them for the final calculations of "after" consumption. (We endeavored to use the weekly readings rather than the delivery records for "post" analysis, wherever possible, since this gave us more data points, thus a more reliable analysis. Fuel deliveries tended to be infrequent after houses had been weatherized, and for some cases we had less than the whole 1979/80 heating season in which to obtain "after" measurements.)

For other oil-burning houses, the two sets of consumption measurements displayed a consistent ratio--but one other than 1.0. We "adjusted" these nozzle sizes (in the METRCAR file) by an appropriate factor so that consumption as calculated from run-time would consistently match consumption as measured by deliveries, considered them "calibrated", and labeled them "MOD" in the reference data file. For houses for which the two sets of measurements displayed no consistent ratio, or for which we had too little (or no) delivery data with which to compare the weekly readings data, we labeled the house "UNC" (for uncalibrated), and had no choice but to use the reported nozzle size for calculating consumption. Obviously, this necessity may introduce a scaling error into the "after" consumption figures for some houses. It will be observed that, for oil (and some kerosene) burning houses, the entries for "after" weekly readings analysis runs in the HSBPTDTA files show whether the calculation was made with a calibrated (or verified) nozzle size, or with a merely reported one. This is indicated by, respectively, the symbols + or - immediately following the "0" for space heating fuel type (i.e., in column 9).

The meanings of the "meter (field) codes" that have been used are as follows:

"10" Use whole house gas meter reading (field "8"). Write "M" as fuel code.

"13" Use furnace fuel meter (field "1"). Write "P" as fuel code.

"14" Use run-time meter (field "2") and nozzle size. Write "K" as fuel code.

"15" Use run-time meter (field "2") and nozzle size. Write "O" as fuel code.

"18" Use whole-house electric meter (field "16"). Write "E" as fuel code.

"19" (This constituted an attempt to use weekly tank contents, obtained by dip stick, to calculate weekly consumption for gravity-fed kerosene space heaters. Since the readings could only be recorded to the nearest 5 gallons, it did not produce usable weekly consumption data.)

Some additional "meter (field) codes" have already been written into RWRITDTA.FTN to obtain such measurements out of weekly readings as: furnace fuel meter (field "1") with different fuel codes written (i.e., "M" or "E"); whole-house gas meter (field "8") minus water heater gas meter (field "6"); combinations of space heaters or electric heating circuits (field "1" plus field "4"; field "1" plus field "4" plus field "3"; etc.) with appropriate

fuel code written. However, the five described in detail above were all that were needed to obtain "whole-house" consumption results for comparability with the "pre" measures that were derived from whole-house data, and they are the only ones that have actually been used.

When a "balance point" fuel consumption analysis was run on weekly readings, the reference data from the METRCAR file that was used to "interpret" the weekly readings was printed, as a check, at the bottom of the first data-listing table of the analysis output. (See the second page of exhibit 26 for an example.)

7. "PROJECTED" YEAR TOTAL FUEL CONSUMPTION DATA

To obtain "normal year" fuel consumption projections from "before" and "after balance point analysis results, a series of programs and operations can be executed by a CSS file on disk volume CSA1. This procedure is invoked by entering: "CSA1:FUELCALC [CTC], [Weather Station Code, if different from CTC]" (see exhibit 29). Starting from the data in the appropriate HSBPTDTA file, and processing only those records flagged with a "#" in column 12, this procedure:

1) runs program BPTCONV.FTN, to convert B_1's and B_0's to kBtu;

2) sorts the resulting output on a) house number, and b) beginning date of analysis period, so that the "before" and "after" results for a house are listed together, in that order; and

3) runs program FUELCALC.FTN, which, using the B_1's, B_0's, and T_0's, and looking up year-total (or average) degree day numbers for appropriate balance points in the three tables of file YTDDYTBL, calculates year-total (or "normal") consumption figures in MBtu. The formula for this calculation is:

$$Q = (B_0 \times 365) + (B_1 \times DD_{T_0})$$

The output of the program is printed with appropriate headings, and corresponds to the sets of data in the HSBPTDTA file: i.e., totals are given for the "best fit" results, the 65°F balance point data, and the "zero intercept" results, if present.

EXHIBIT 29

```
** CSS file "FUELCALC"
*    To: 1) convert (flagged) BALPOINT results to Btu;
*        2) sort the results by a) house number and b) "begin" date of analysis,
and
*        3) calculate and print "projected" year total fuel consumption, using
*           degree days from table YTDDYTBL.
*
*  PARAMETERS:
*    @1 -- CITY CODE
*    @2 -- WEATHER STATION (IF DIFFERENT FROM CITY CODE)
*    @3 -- "PR:" FOR VERSATEC OUTPUT, ALSO
*
XDELETE CSA1:RSORT.TMP
LO CSA1:BPTCONV
AS1,CSA1:HSBPTDTA.@1
XDELETE CSA1:FUELCALC.TMP;AL CSA1:FUELCALC.TMP,IN,100
AS2,CSA1:FUELCALC.TMP
ST
$BUILD CSA1:REDIT.CMD
G CSA1:FUELCALC.TMP
CH/******/,/0000.0/,1-
S*
DONE
DONE
$ENDB
LO CSA1:EDIT32
ST ,C=CSA1:REDIT.CMD,L=C:
$BUILD CSA1:RSORT.CMD
RECL 100
KEY
5/2/A
15/2/A
13/2/A
19/2/A
17/2/A
EKEY
SCRATCH
SORT CSA1:FUELCALC.TMP,CSA1:RSORT.TMP
END
END
$ENDB
LO CSA1:SORT/S
AL CSA1:RSORT.TMP,IN,100
AS5,CSA1:RSORT.CMD
ST
$IFNE 0
$W ** SORT ERROR **
$CLEAR;$EXIT
```

EXHIBIT 29 (cont.)

```
$ENDC
XDELETE CSA1:FUELCALC.OUT;AL CSA1:FUELCALC.OUT,IN,120
$IFNNUL @2
$BUILD CSA1:FUELCALC.SCR
 @2
$ENDB
$ENDC
$IFNULL @2
$BUILD CSA1:FUELCALC.SCR
 @1
$ENDB
$ENDC
LO CSA1:FUELCALC
AS2,CSA1:RSORT.TMP
AS3,C:
* AS4,PR2:
AS4,CSA1:FUELCALC.OUT
AS5,CSA1:YTDDYTBL,SRO
AS6,C:
AS7,CSA1:FUELCALC.SCR
ST
XDELETE CSA1:FUELCALC.TMP
XDELETE CSA1:FUELCALC.SCR
* XDELETE CSA1:RSORT.TMP
COPYA CSA1:FUELCALC.OUT,PR2:,,120
* COPYA CSA1:FUELCALC.OUT,PR2:,,120
* COPYA CSA1:FUELCALC.OUT,PR2:,,120
$IFNNULL @3
CSA1:UPPR
COPYA CSA1:FUELCALC.OUT,PR:,,120
CSA1:UPPR
$ENDC
$EXIT
```

8. "STATUS" OF FINAL ANALYSES

As an aid to managing the final analyses of "post" consumption data, a computer file was developed to record some key information about analysis results. Data for all of the sites, in alphabetical order (by "CTC"), are recorded in this one file, named STATTBLE., and present on disk volume CSA1. Some of the data in the table (which is reprinted in this section as a set of site tables) are of interest in evaluating the final results based on the "balance point" analysis that are presented in the final report of the demonstration [2].

The first several columns in the table repeat information from the HSKEYDTA files: house number; "status" of the house vis-a-vis the demonstration (see discussion on page 7); fuel used for space heating; and fuel used for water heating. The next three columns present data about the latest, or "best" balance point analysis of "post" weekly readings data: the R^2 (squared correlation coefficient), number of data points and, for some cases with limited "after" data, the number of months covered by the analysis. (Ideally such analysis should cover an entire heating season and have a minimum of 8 to 10 data points.)

The next several columns relate to analysis of "post" utility data. "Needed?" would be filled in "YES" if: 1) weekly readings were not available, were insufficient, or produced an inadequate analysis (i.e., R^2 of less than 0.90); 2) if the fuel was oil, so that the nozzle rate was a factor in calculating consumption and analysis of the utility (i.e., delivery) data was needed as backup (see discussion in section 6.1); or 3) the fuel was propane (since we wanted to cross-check consumption from in-line gas meters on propane heaters with consumption from delivery quantities). Succeeding columns showed: that the needed utility data (had been received and) were in the computer; and the R^2 and the number of data points (months, also, in some cases) obtained from analysis of "post" utility data.

The next column lists the percentage savings calculated from the "before" and the best "after" balance point runs. Note that water heater fuel consumption is not factored out of this figure, so for those houses that use the same fuel for space heating and for water heating, these figures should be somewhat smaller than those reported in the final report of the demonstration [2].

The next four columns indicate what categories of options had been installed by the beginning of the analysis period, and thus are reflected in the "BAL.PT.ANAL." savings figure shown.

Once a "best" (and adequate--in terms of R^2 and length of time period analyzed) "post" analysis had been obtained (or selected among several different runs), that result was flagged in the HSBPTDTA table by a "#" in column 12 (see discussion at end of section 6). (In some cases it was a matter of having to choose between a run after all options were completed but which had insufficient data points, and a run with sufficient data points and time coverage but which overlapped the installation of mechanical options, say, or of insulation of a flat roof or some other "problem" option that was completed very late.)

For comparison, the last two columns show the savings as measured by two other methods. (These data are reported and discussed in the final report [2], and the numbers here may not be up to date.)

TABLE 20
"STATUS" OF RESULTS: ATLANTA

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

					WKLY.RDGS.ANAL.		---UTIL.DATA ANAL.----					----------INDICATED SAVINGS----------				
SITE	HSE. NO.	CATEG.	FUEL		R**2	NO. OF PTS.(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.(MO.)		BAL.PT. ANAL.	OPTIONS	INST.	TRACK. PROG.	LOAD CALCS.
ATL	1	S	G	E	94	18	NO					13	I	C		-17
	2	S	G	E	99	13	NO					5		C		-14
	5	C+														
	11	C	G	G	98	26	NO					6				
	12	C+	G/W		(G:100/31 11/17)		?									
	16	-X	G													
	17	S	E	E	97	21	NO					7	I	C		
	19	S	G	G	81	18	YES	YES	99	4		-6	I	C		
	20	S*	G													-9
	21	C	G	G			YES	YES	99	7	(10)	30				
	22	S	G	G	95	28	NO					-17	I	C		-12
	23	S	G	G	93	21	NO					-2		C		-11
	25	CX	P	P	96@	13	YES	YES	73	5						
	29	-	G	G	19	6	YES	YES	100	5	(7)	45		C		33
	30	S	G	G	96	30	NO					-53	I	C		-18
	31	S	P	E	98@	23 (13)	YES	YES	100	3	(12)	40				-6
	32	S	E	E	98	27	NO					4	I	C		41

@ Weekly Readings from furnace (only) gas meter could not be satisfactorily related to whole house consumption in gallons.

TABLE 21
"STATUS" OF RESULTS: CHARLESTON

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

				WKLY.RDGS.ANAL.		---UTIL.DATA ANAL.----				----------INDICATED SAVINGS----------					
SITE	HSE. NO.	CATEG.	FUEL	R**2	NO. OF PTS.(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.(MO.)	BAL.PT. ANAL.	OPTIONS		INST.	TRACK. PROG.	LOAD CALCS.
CHA	1	SX	K			YES	NENUF							30	37
	2	S	P P	98@	26	YES	YES	100	4	19	I	C	W	21	29
	3	S	P E	82@	27	YES	YES	94	4	33	I	C	(M)(W)		5
	5	C	P E	93@	26	YES	YES	76	5	(12)				18	
	8	S	P E	97@	26	YES	YES	100	5	36	I	C	(M)(W)	34	5
	9	S	P E	84@	25	YES	NENUF							33	36
	16	C	P E	97@	23	YES	YES	91	6	32	I	C	(W)	38	22
	18	S	P -	94@	28	YES	YES	99	6	19	I	C		19	18
	19	C	P -	97@	26	YES	YES	96	5	14				4	
	20	S	P E	93@	24	YES	YES	93	4	22	I	C	(W)	23	14
	21	C	P P	92@	26	YES	YES	85	8	(18)				18	
	22	SX	P/W								I	C			23
	23	S	P E	96@	19	YES	YES	90	6	24	I	C	(W)	18	29
	24	C	P P	97@	27	YES	YES	100	8	25				23	
	25	S	P -	98@	24	YES	YES	99	4	30	I	C		30	16
	27	SX	P E	97@	27	YES	YES	68	5					13	21
	28	C	P P	02@	28	YES	YES	81	7	(-11)				-7	
	33	S	KP/P P	94@	26	YES	YES	93	4	54	I	C	W		-4
	39	S	P -	99@	23	YES	YES	100	3	65	I	C		64	12
	42	SX	P E			YES	YES	18	4						17
	44	S	PO?E	94@	28	YES	YES	67	4	(23)	I	C	(W)	34	-2
	47	S	E/W	74@	26	YES	YES	95	9	25				14	
	49	S	P E	98@	25	YES	YES	99	3	30	I	C	(M) W	35	49

@ Weekly Readings from furnace (only) gas meter could not be satisfactorily related to whole house consumption in gallons.

TABLE 22
"STATUS" OF RESULTS: CHICAGO

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

				WKLY.RDGS.ANAL.			---UTIL.DATA ANAL.----				----------INDICATED SAVINGS----------						
SITE	HSE. NO.	CATEG.	FUEL	R**2	NO. OF PTS.(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.(MO.)	BAL.PT. ANAL.	OPTIONS			INST.		TRACK. PROG.	LOAD CALCS.
CHI	3	-X	G														
	4	-X	G														
	5	S	G	G	99	3		YES	96	3	33			M	W	19	
	7	CX	G													22	
	8	SX	G	G	49	4		YES	100	2						11	
	9	S	G	G				YES	95	4	60	I	C	M	W	18	
	10	SX	G														
	11	S	G	G	99	3					21	I	C	M	W	18	
	12	S	G	G	100	4		YES	08	4	69	I	C	M	W	50	
	13	-	G														
	14	S	G	G				YES	97	4	41	I	C	M	W	14	
	15	SX	G	G				YES	93	4	(-133!)	I	C	M	W	27	
	16	SX	G													32	
	17	CX	G													-6	
	18	S	G	G	100	4		YES	100	3	31	I	C	M	W	9	
	19	S	G	G	99	4		YES	79	4	40	I	C	M	W	27	
	20	-X	G														
	22	-X	G														
	23	SX	G														
	24	C	G	G				YES	92	8	74					0	
	25	S	G	G	100	4		YES	89	4	30	I	C	M	W	1	
	26	SX	G														
	29	S	G	G				YES	93	4	59	I	C	M	W	21	
	30	-X	G														
	31	-X	G														
	32	S	G	G	100	2		YES	82	4	(-14)	I	C	M	(W)	18	
	33	-X	G														
	34	-X	G														
	35	CX	G	G	20/18	4/3											
	37	S	G	G				YES	72	4	(62)	I	C	M	W	18	
	38	S	G	G	98	5		YES	98	3	28	I	C	M	W	28	
	39	-X	G														

TABLE 23
"STATUS" OF RESULTS: COLORADO SPRINGS

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

					WKLY.RDGS.ANAL.			---UTIL.DATA ANAL.----			----------INDICATED SAVINGS----------						
SITE	HSE. NO.	CATEG.	FUEL		R**2	NO. OF PTS.(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.(MO.)	BAL.PT. ANAL.	OPTIONS				TRACK. PROG.	LOAD CALCS.
CSP	1	C	G	G	99	14	NO				2					2	
	5	C	G	G	99	15	NO				-14					-19	
	6	C+	G	G	100	14	NO									0.4	
	7	S	G	G	95/97	5/6 (3/4)	NO				35	I	C	M	W	24	41
	8	C	G	G	99	14	NO				13					12	
	10	C	G	G	99	14	NO				16					11	
	11	S	G	G	100	6 (5)	NO				50	I	C	M	W	46	53
	13	S	G	G	98	10 (7)	NO				11	I	C		(W)	0	36
	14	S	G	G	98/96	9/7 (7/5)	NO				21	I	C	M	(W)	30	47
	17	S	G	G	97/99	11/5(8/3)	NO				37	I	C	M		29	62
	20	S	G	G	100/89	11/6(8/4)	NO				15	I	C	(M)		13	43
	23	S	G	G	90/99	10/7(7/6)	NO				30	I	C	M	W	30	53
	24	S	G	G	99/100	14/5(10/3)	NO				23	I	C	M	W	30	31
	26	S	G	G	95/99	11/6(7/4)	NO				38	I	C	M	W	18	51
	28	S	G	G	99	9	NO				-22	I	C			9	-82
	31	S	G	G	86/99	8/6 (6/4)	NO				50	I	C	M		47	62
	34	S*	G	G								I	C	M	W		49
	37	S	G	G	96/98	8/6 (6/4)	NO				53	I	C	M		36	59
	41	S	G	G	98/97	10/6(7/4)	NO				42	I	C	M	(W)	35	48
	43	S	G	G	99/99	10/7(6/5)	NO				44	I	C	M	W	38	45
	44	S	G	G	93/97	9/6 (6/4)	NO				49	I	C	M	W	47	48
	47	S	G	G	97/99	4/6 (4/)	NO				55	I	C	M	W	40	65
	49	S	G	G	94/96	8/5 (7/4)	NO				55	I	C	M	W	57	45

TABLE 24
"STATUS" OF RESULTS: EASTON

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

					WKLY.RDGS.ANAL.			---UTIL.DATA ANAL.----					----------INDICATED SAVINGS----------						
SITE	HSE. NO.	CATEG.	FUEL		R**2	NO. OF PTS.	(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.	(MO.)	BAL.PT. ANAL.	OPTIONS				TRACK. PROG.	LOAD CALCS.
ABE	3	S*	O	P															
	4	S	O	G	100	7	(6)	YES	YES	84	4		12C	I	C	M	W	0	
	11	SX	O	F	86/96	8/4	(6/3)	YES					(88!)						
	12	S	G	G	99	8	(6)	NO					13	I	C	M	W	23	
	20	S	E	?	99	8	(6)	NO					12	I	C		W	8	
	22	S	O	F	99/100	8/5	(6/4)	YES	YES	71/100	4/2		28C	I	C	M	W	12	
	23	S	G	G	97	6	(4)	NO					37	I	C		W	18	
	25	S	O	G	99	6	(4)	YES					38N	I	C	M	W	18	
	27	S	G	G	91	7	(5)	NO	YES				40	I	C	M	W	42	
	28	S	O	G	99	4	(3)	YES	YES				11N	I	C	(M)	W	19	
	31	S	O	F				YES	YES				14N	I	C	M	W	7	
	32	C	O	F				YES	YES	84	5	(9)	(7)						
	33	S	O	F	88/95	7/4	(5/3)	YES	NENUF				0C	I	C	M	W	14	
	38	C	G	G	100	11	(7)	NO					2					12	
	39	S	O	F				YES	YES	97/99	5/3	(5/3)	3	I		M	W	18	
	42	S	E	?	88#	11	(7)	YES	YES	34	6	(7)	11	I			(W)	10	
	44	S	G	G	100/97	4/6	(3/3)	?					33	I	C	M	W		
	46	C	O	F	100/94	12/11	(9/4)	YES	YES	100	8	(7)	13C						

M.F.P. = 13 DAYS

TABLE 25
"STATUS" OF RESULTS: FARGO

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

					WKLY.RDGS.ANAL.			---UTIL.DATA ANAL.----				----------INDICATED SAVINGS----------						
SITE	HSE. NO.	CATEG.	FUEL		R**2	NO. OF PTS.	(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.	(MO.)	BAL.PT. ANAL.	OPTIONS				TRACK. PROG.	LOAD CALCS.
FAR	2	S	G	G	96	9		NO					44	I	C	M	W	36	38
	5	S*	G	G										I	C	M	(W)		41
	6	S	O	E	97	9	(6)	YES	YES	100	2		60C	I	C	M	W	35	23
	10	S	O	E	98	11	(8)	YES	NENUF				52C	I	C	M	W	14?	51
	11	S	O	G	100	5	(5)	YES	YES	97	3		35C	I	C	M	W	18	46
	13	C	G	G	99	15		NO					6					6.5	
	15	S	O	G	99	10	(7)	YES	YES	100	3		25C	I	C	M	W	43	26
	17	S	G	E	98	9	(6)	NO					51	I	C	M	W	42	-13
	22	C	G	G	100	15		NO					-1					2	
	23	C	O	-	99	15		YES	YES	90	6		19N					14	
	25	S	O	G	98	10		YES	YES	100	2		28N	I	C	M	W	12	49
	26	C	G	E	97	14		NO					7					12	
	27	S	O	E	93	9		YES	NENUF				35C	I	C		W	34	-10
	30	S	G	G	97	9		NO					41	I	C	M	W	40	67
	32	S	G	G	99/100	20/9		NO					26	I	C	M	W	20	20
	34	C	O	E	100	16		YES	YES	54	3		-3					0.3	
	35	S	G	G	97	9	(6)	NO					25	I	C	M	W	24	52
	36	S	G	G	98	10		NO					22	I	C	M	W	24	73

TABLE 26
"STATUS" OF RESULTS: MINNEAPOLIS/ST. PAUL

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

					WKLY.RDGS.ANAL.			---UTIL.DATA ANAL.----				----------INDICATED SAVINGS----------			
SITE	HSE. NO.	CATEG.	FUEL		R**2	NO. OF PTS.	(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.	(MO.)	BAL.PT. ANAL.	OPTIONS	TRACK. PROG.	LOAD CALCS.
MSP	1	S	G	G					YES	100	8		-12	I C		
	2	S	G	G					YES	99	11		12	I C		
	3	S	G	G					YES	99	6		11	I C		
	4	S	G	G					YES	94	8		15	I C		
	5	-X	G	G					NONE							
	6	C+	O/G	G	97	12	(9)									
	7	-X	G	G					NONE							
	8	S	O/GF	G	96	4	(3)	YES					22	I C		
	12	-X	G	G					NONE							
	13	S	G	G					YES	100	6		36	I C		
	19	-X	O	E				YES								
	20	S	GW	G					YES	100	7		26	I C		
	21	S	G	G					YES	100	10		33	I C		
	23	S	G	G	96/99	10/5			YES	37	3		11	I C		
	25	C	G	G					YES	100	-2		-2			
	26	S	G	E					YES	100	8		45	I C		
	27	CX	O	G				YES								
	28	C	G	G					YES	99	5		16			
	31	C	G	G					YES	100	3		15			
	33	S	G	G	99	10			YES	70	8		34	I C		
	34	S	G	G					YES	96	6		6	I C		
	36	C	G	G					YES	100	9		16			
	37	C	G	G					YES	89	9		-8			
	38	SX	G	G												
	39	SX	O	G				YES								
	40	S	G	G					YES	98	10		27	I C		
	42	S	G	G					YES	99	8		5	I C		
	44	S	G	G					YES	98/98	10/4		33	I C		
	45	S	G	G					YES	99/100	8/3		11	I C		
	46	S	G	G	90	5	(3)		YES	100	2		3	I C		

TABLE 27
"STATUS" OF RESULTS: OAKLAND

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

				WKLY.RDGS.ANAL.		---UTIL.DATA ANAL.----				----------INDICATED SAVINGS----------			
SITE	HSE. NO.	CATEG.	FUEL	R**2	NO. OF PTS.(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.(MO.)	BAL.PT. ANAL.	OPTIONS	INST.	TRACK. PROG.	LOAD CALCS.
OAK	5	C	G G?			YES	YES	80	8	(-23)				
	6	C	G G?			YES	YES	99	8	12				
	9	C	G G?			YES	YES	100	8	(-28)				
	17	S	G G?			YES	YES	98	9	10		I	C	
	19	S	G G?			YES	YES	100	5	4		I	C	
	26	S	G G?			YES	YES	95	8	(-17)		I	C	
	28	SX	G G?			YES	YES	83	7	(13)				
	31	S	G G?			YES	YES	96/96	4/3	(-7)		(I)	C	
	33	S	G G?			YES	YES	92	7	3		I	C	
	34	S	G G?			YES	YES	96	9	10		I	C	
	35	S	G G?			YES	YES	97	4	1		I	C	
	36	S	G G?			YES	YES	93	10	15		I	C	
	37	C	G G?			YES	YES	99	7	1				
	38	S	G G?			YES	YES	92	8	24			C	

TABLE 28
"STATUS" OF RESULTS: PORTLAND

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

				WKLY.RDGS.ANAL.			---UTIL.DATA ANAL.---				----------INDICATED SAVINGS----------						
SITE	HSE. NO.	CATEG.	FUEL	R**2	NO. OF PTS.	(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.	(MO.)	BAL.PT. ANAL.	OPTIONS				TRACK. PROG.	LOAD CALCS.
POR	2	SX	O F?				YES											
	3	-	OW F?	11	4		YES											
	4	SX	O F?	50	14		YES						1	C	M	W	38	
	7	S	O E?	99	13		YES					55N	I	C	M		43	
	9	S	O E?	97	14	(10)	YES					52N	I	C	M			
	10	S	G G?	99	14							7	I	C			30	
	11	S	OW E?	99	15		YES					55N	I	C	M		53	
	12	S	O F?	98	14		YES					63N	I	C	M	W	25	
	15	S	O E?	100	14		YES					-20N	I	C	M			
	16	S	O E?	99	15		YES					29N	I	C	M			
	17	S	O ?				YES					42N						
	18	SX	OW E?	44	13		YES										71	
	19	SX	O/OW F?				YES										37	
	20	S	O F?	98	13		YES					43N	I	C	M	W	51	
	21	S	OW E?	99	14		YES					46N	I	C	M		35	
	23	S	O E?	100	14		YES					36N	I	C	M	W	30	
	25	S	O F?	98	12		YES					54N	I	C	M	W	59	
	26	S	O F?	99	14		YES					50N	I	C	M	W	47	
	28	S	O E?				YES					47N	I	C	M			
	29	C	O E?				YES					3N						
	30	C	O F?				YES					43N						
	31	C	O F?				YES					-8N						
	32	CX	O F?				YES											
	33	C	O E?				YES					16N						

TABLE 29
"STATUS" OF RESULTS: ST. LOUIS

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

					WKLY.RDGS.ANAL.			---UTIL.DATA ANAL.----				BAL.PT.	----------INDICATED SAVINGS----------		
SITE	HSE. NO.	CATEG.	FUEL		R**2	NO. OF PTS.(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.(MO.)		ANAL.	OPTIONS	INST.	TRACK. PROG.	LOAD CALCS.
STL	4	C+	G	G	96	11	NO							M	26	
	5	S	G	G	99	10	NO					-13	I C			
	6	S	G	G	99	12	NO					-10	I C		-13	12
	7	S	G	G	99/100	11/2	NO					38	I (C)		35	
	10	C	G	G	98	13	NO					-12			-12	
	11	SX	G	G			YES									51
	14	S*	G										I C			
	15	SX	G	G			YES									15
	17	S	G	G	99	15	NO					-18	C		0.4	28
	18	SX	G	G	97	3	YES									28
	23	C	G	G	98	17	NO					-28			-32	
	28	S	G	G			YES	YES	98/	8/2	(8)	-6	I (C)			25
	29	S	G	G			YES	YES	96	8	(8)	-20	I C			5
	34	S	G	G	96/100	6/2	NO					36	I (C)	M	0	
	38	S	G	G	99	13	NO					16	I C		16	44
	40	S	G	G	90/100	7/3	NO					-74	I (C)			29
	41	S	G	G	96/95	12/3	NO					-6	I (C)		20	
	42	S	G	G	98/100	15/4	NO					32	I C		38	
	44	-X	G	G												
	46	S	G	G	87/83	7/4	YES					(-20)	I (C)			68
	49	S	G	G	99/99	8/4	NO					32	I (C)		26	57
	55	S	G	G	92/100	9/2	NO					32	I (C)		25	49
	56	S	G	G	98/98	9/3	NO					21	I (C)		13	33
	70	SX	G	?			YES	YES	50	4					22	12
	77	S	G	G	98/100	9/2	NO					24	I (C)		40	
	92	S	G	G	98/98	11/4	NO					16	I (C)		19	29
	93	S	G	G	99/100	11/4	NO					45	I C		45	67

TABLE 30
"STATUS" OF RESULTS: TACOMA

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

				WKLY.RDGS.ANAL.			---UTIL.DATA ANAL.----				----------INDICATED SAVINGS----------						
SITE	HSE. NO.	CATEG.	FUEL	R**2	NO. OF PTS.(MO.)		NEE-DED?	DATA IN	R**2	NO. OF PTS.(MO.)	BAL.PT. ANAL.	OPTIONS				TRACK. PROG.	LOAD CALCS.
TAC	4	S	E E	98	8		NO				23	I	C	M	W	18	70
	21	S	G G	96	6		NO				48	I	C	M	W	23	62
	37	C	E E	75	8		YES	YES	96	4	-4					-4	
	39	S	E E	96	8		NO				48	I	C		W	40	69
	45	S	G G	99	6		NO				53	I	C			40	67
	49	S	G E	98	7		NO				36	I	C		(W)	34	52
	55	S	G E	91	5			YES	99	4	50	I	C	M	W	49	49
	57	S*	G									I	C	M	W		74
	58	C	G E	99	7		NO				38					0.8	
	75	C	G G	80	7		YES	YES	100	8	-3						
	76	C	E E					YES	98	4	6					11	
	81	S	E E	97	9	(6)		YES	100	2	31	I	C	M	W	22	67
	83	S	G E	98	6		NO				54	I	C	M	W	41	39
	87	S	G G	99	7		NO				30	I	C	M	W	27	67
	98	C	GW E					YES	97	10	21		C			29	

TABLE 31
"STATUS" OF RESULTS: WASHINGTON

09/25/81

RESULTS OF "POST" FUEL CONSUMPTION ANALYSIS
* * * * * * * * * * * * * * * *

X = NO, OR INSUFFICIENT, "AFTER" FUEL DATA FOR "BALPNT" ANALYSIS.
* = "BEFORE/AFTER" COMPARISON CONTAMINATED BY OCCUPANT CHANGE.
+ = "BEFORE/AFTER" COMPARISON CONTAMINATED BY BUILDING CHANGE (E.G., CONTROL HOUSE).

NOTE: IN "BAL.PT.ANAL." RESULTS, FUEL USED FOR SERVICE WATER HEATING, IF THE SAME AS THAT USED FOR SPACE HEATING, IS NOT (!) FACTORED OUT.

					WKLY.RDGS.ANAL.		---UTIL.DATA ANAL.----				----------INDICATED SAVINGS----------					
SITE	HSE. NO.	CATEG.	FUEL		R**2	NO. OF PTS.(MO.)	NEE-DED?	DATA IN	R**2	NO. OF PTS.(MO.)	BAL.PT. ANAL.	OPTIONS			INST.	TRACK. PROG.	LOAD CALCS.
WAS	2	S	P	E			YES	YES	96	6 (7)	55	I	C	M	W	41	
	5	SX	K	E			YES	YES	100	3 (5)						36	
	6	C	O	F			YES	YES	99	3 (7)	-11					-6	
	7	S	O	E			YES	YES	100/	4/2 (6/)	31	I	C	(M)	W		
	8	SX	K	E			YES	YES		2 (5)						39	
	24	SX	O	F			YES	YES		2 (5)						68	
	27	SX	K	P			YES	YES		2 (5)						53	
	40	CX	P/W	P?			YES	YES	24	5 (5)						49	
	41	S	K/P	P			YES	YES	91/98	7/4 (7/4)	31	I	C	M	W	(-16)	
	44	SX	O	E			YES	YES		2 (6)						65	
	47	SX	K	P			YES	YES		2 (3)						12	
	53	S	O	F			YES	YES	85/93	6/3 (5/3)	(49)	I	C	(M)	W	45	
	57	C	K	E			YES	YES	100	5 (3)	-71					(-67)	
	58	CX	O	F			YES	YES		2 (3)						26	
	63	CX	O	E			YES	YES								39	

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Roy E. Clark

6. PERFORMING ORGANIZATION (If joint or other than NBS, see instructions)

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1000 Independence Ave., S W , Washington, DC 20545

10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

The Community Services Administration (CSA) National Optimal Weatherization Demonstration was conducted over a 3 1/2 year period (1977-1981) by the National Bureau of Standards and Community Action agencies in 12 areas around the Nation, principally to determine what reductions in residence space heating energy consumption could be achieved by extensive, economically cost-effective weatherization of dwellings. Because the project was funded by the CSA, it was conducted using houses occupied by low-income households. In addition to recording overall energy consumption (for the 1975-1980 period), the demonstration collected considerable additional energy-related measurements from approximately 240 houses (including some 40 unweatherized control houses) at the 12 sites. These measurements probably constitute the most extensive and comprehensive data base on real energy usage of real houses extant. The report describes the various measurements that were obtained and how they were obtained. It contains house-by-house inventories of the data actually present in the data base and, as an access aid for further study of the data, it describes the media in which the data exist.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

Community Services Administration Weatherization Demonstration; costs of weatherization;energy conservation; energy consumption data; energy related data; field measurement of building energy use; Optimal Weatherization Demonstration; residential energy consumption; space heating consumption; weatherization.

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