NBSIR 79-1957

Analysis of Code Related Responses From the Solar Demonstration Program

Joseph Greenberg

Building Economics and Regulatory Technology Division
Center for Building Technology
National Engineering Laboratory
National Bureau of Standards
Washington, D.C. 20234

January 1980

Prepared for:
Department of Energy
Office of Conservation and Solar Applications
Washington, D.C. 20234

and

Department of Housing and Urban Development
Division of Energy, Building Technology and Standards
Washington, D.C. 20410

NBSIR 79-1957

ANALYSIS OF CODE RELATED RESPONSES FROM THE SOLAR DEMONSTRATION PROGRAM

Joseph Greenberg

Building Economics and Regulatory Technology Division
Center for Building Technology
National Engineering Laboratory
National Bureau of Standards
Washington, D.C. 20234

January 1980

Prepared for:
Department of Energy
Office of Conservation and Solar Applications
Washington, D.C. 20234

and

Department of Housing and Urban Development
Division of Energy, Building Technology and Standards
Washington, D.C. 20410

U.S. DEPARTMENT OF COMMERCE, Philip M. Klutznick, *Secretary*

Luther H. Hodges, Jr., *Deputy Secretary*
Jordan J. Baruch, *Assistant Secretary for Science and Technology*

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

FOREWORD

The objective of this project is the analysis of data collected for the HUD Solar Residential Demonstration Program to provide an insight into those aspects of the building regulatory process that inhibit, impede, or otherwise adversely affect the installation and use of solar hot water and space heating and/or cooling systems. The regulatory data used for this report were collected by HUD contractor personnel as part of an overall effort in documenting a broad base of technical and institutional information. The HUD contractor-designed questionnaires were used as basic data and pertinent regulatory responses were identified and analyzed by NBS in preparing this report. Information is compiled which should provide useful input to appropriate standards generating committees, building code promulgating organizations, regulatory jurisdictions, and the building community in general in stimulating the acceptance of the use of solar hot water systems and space heating and/or cooling systems.

This project was designed to provide:

(a) An analysis of the response by the participants in the demonstration program as to real or perceived regulatory problems encountered during the conduct of the program.

(b) An analysis of the adverse impacts, if any, resulting from differences in various regulatory statutes.

(c) A recommended course of action, as articulated by the participants in the demonstration program, regarding current and future regulatory needs.

(d) An assessment of the documentation and training needed to assure an orderly and efficient system for the evaluation and acceptance of solar systems.

This report is limited to data from the HUD Solar Residential Demonstration Program. Although an attempt was made to also include data from the DoE Commercial Demonstration Program, a search of the available information indicates that very little regulatory data have been collected.

The HUD Demonstration Program is structured in cycles; each takes place sequentially in a different time frame with various projects awarded for each cycle. Although the HUD Solar Residential Demonstration Program is expected to have a total of five cycles, this report is limited to data gathered during the first three cycles and includes data collected from late 1975 to September 30, 1978--the cutoff date of this report.

The information is generally presented on a cycle-by-cycle basis, using site specific regulatory and other related data collected during the conduct of the HUD Solar Residential Program. Where appropriate, the effects of the varying cyclical time frames are considered in analyzing and determining any regulatory impacts and trends.

ACKNOWLEDGEMENTS

The author wishes to express his gratitude to Ms. Sandra A. Berry for her efforts in reviewing, editing, and organizing this report and to Ms. Laurie Watkins for preparing and typing the text and various tables presented herein.

TABLE OF CONTENTS

ABSTRACT

This report was prepared jointly for the Department of Housing and Urban Development (HUD) and the Department of Energy (DoE) under activities carried out by the National Bureau of Standards (NBS) relative to the Solar Heating and Cooling Demonstration Program. Regulatory information is abstracted from HUD contractor developed questionnaires and analyzed to determine perceived regulatory constraints which might inhibit, impede, or otherwise adversely affect the installation and use of solar hot water and space and/or cooling systems. The report documents and analyzes building regulatory information gathered by HUD Contractor personnel during the course of the Solar Residential Demonstration Program--from inception of the program (late 1975) through September 30, 1978.

Although not all builders and local code officials participating in the demonstration program were interviewed for this study, the total number of participants interviewed was of sufficient size to postulate trends and draw reasonable conclusions regarding the building regulatory aspects of the program. The report concludes that existing codes do not present a barrier to the installation and acceptance of solar systems; however, code officials need additional training and better back-up material to properly evaluate solar systems.

EXECUTIVE SUMMARY

This report is prepared jointly for the Department of Housing and Urban Development (HUD) and the Department of Energy (DoE). It documents and analyzes the building regulatory information gathered during the course of the Solar Residential Demonstration Program. The report is based on data collected by HUD contractor personnel and includes data collected from late 1975 through September 30, 1978.

The major findings documented in this report are discussed below.

A. Constraints/Technical Issues

1. Approximately eighty percent (80%) of the local building code officials indicated that there are no major barriers in building codes at present which would impede the installation of solar energy systems in their jurisdictions, while a smaller percentage (approximately 64%) foresaw no future problems. Those officials identifying current problems specified administrative difficulties as the most frequent reason for these problems. Anticipated new code requirements and structural concerns were identified by those officials who expected future problems.

2. Some local building code officials reported that the codes used in their jurisdictions contain provisions for solar systems. There was no indication that the processing and acceptance of solar energy installations was either affected adversely or advantageously by a jurisdiction's adoption or lack of adoption of solar energy provisions.

3. Approximately one-quarter of the local building code officials indicated that their departments had studied the question of potential impact of solar energy systems on building codes and of these, one-third indicated a need for standards for solar systems and components.

B. Approval and Inspection of Solar Systems

1. The solar demonstration builder/developer faces no greater or lesser difficulty than that routinely faced by non-solar builders in obtaining approval from building inspectors during the planning and construction phases of their projects. From the builder/developer perspective, it appears that regulatory issues have not impeded the acceptance of solar systems on the Solar Residential Demonstration Program.

2. Approximately one-quarter of the local building code officials indicated that solar applications presently require additional processing time and approximately one-half of these local building code officials expect that the need for this increased processing time will continue.

3. The number of waivers requested for solar installation is low. However, if a waiver is requested, the chance of having the waiver granted is excellent. In addition, approximately one-quarter of the local building code officials required design changes to be made on solar systems installed in their jurisdictions.

4. System approvals and site inspections normally were handled in a routine manner; however, approximately one-quarter of the local building code officials reported that additional site inspections were required for them to become familiar with the solar installations or to run plumbing or other physical tests.

5. The greatest concern of the local building code officials identifying problems with solar systems meeting code requirements are the toxic fluids used in these systems.

6. Approximately two-thirds of the local building code officials indicated building code problems in the installation of a solar system in an older structure; citing an overwhelming concern with structural adequacy of the buildings. In addition, approximately one-quarter of the local building code officials indicated that multi-family solar installations would entail unique considerations from an approval point of view because of the inherent complexity of these larger installations.

7. Certification of solar equipment, with approved testing conducted by any qualified testing institution, was desired by one-third of the local building code officials prior to their issuing a building permit.

C. Code Official Training and Technical Support

1. Generally, the knowledge and educational background of the local building code official and the sources of solar energy information available to him varied greatly from jurisdiction to jurisdiction. If the processing of solar applications is to be accomplished more effectively, the code official's knowledge of solar energy systems must be upgraded by education, training and actual experience.

2. Areas of assistance identified by the local building code official include: the training of evaluators and inspectors; the development of manuals of accepted practice and inspection guidelines; development of feasibility data; development of efficiency data for different solar systems; certification of equipment and systems; and, need for standards.

3. The sources most often used by the local building code official for information related to solar energy are trade publications, manufacturer's data, national and local associations, and government agencies. Other important sources are universities and independent agencies. Developers and financial institutions were rated low as sources for solar information.

PART I - DESCRIPTION OF DATA SOURCES AND INFORMATION USED AS THE BASIS FOR THE STUDY

1. DATA SOURCES

1.0 General

To assure an orderly and systematic method of identifying and collecting the pertinent data associated with the regulatory aspects of the HUD Solar Residential Demonstration Program, each organization having responsibility for the collection of data was identified. The data collection instruments (questionnaires and reports) were collected and a review made of each document to assess its value as a data source for regulatory information. Those valuable to this project were then singled out for study and the appropriate mechanisms established to collect the data; either through the NBS Solar Data Base or through direct contact with the custodial organization. To facilitate the handling and analysis of the information, special computer print-outs were developed using the information stored in the NBS Solar Data Base.

A presentation of organizations collecting data for the Solar Residential Demonstration Program, the data collection instruments, and the applicable building requlatory questions are shown in Figure 1. In addition, a reference code has been assigned to each selected questionnaire (data collection instrument) and this reference code is used to identify these data sources throughout this report. (The selected building regulatory data collection instruments are included in Appendix II.) A description of each data source is given below.

1.1 Real Estate Research Corporation (RERC)

The upper portion of Figure 1 indicates the three volume data instruments prepared by the Real Estate Research Corporation (RERC) for use in the Solar Residential Demonstration Program. These volumes, dated January 1977, are non-technical in scope and are intended to document responses to questions oriented toward the marketing, consumer, and institutional sectors.

As part of RERC's approach, some questionnaires were supplemented with visits to other construction sites to obtain the views of organizations that are not directly involved in the Solar Residential Demonstration Program. For example, a solar demonstration builder may be asked if he has had any trouble in processing his plans and specifications through a particular code approval process. The reactions of other builders regarding their experiences with the same code officials on non-solar related activities are also obtained, and comparisons of this nature are included in this report. This provides the mechanism to analyze the perceived differences in reactions by the different organizations to a similar situation. Although not all sites were visted, the questionnaires were generally answered in sets and data are

HEATING & COOLING DEMONSTRATION PROGRAM
RESIDENTIAL BUILDING REGULATORY DATA

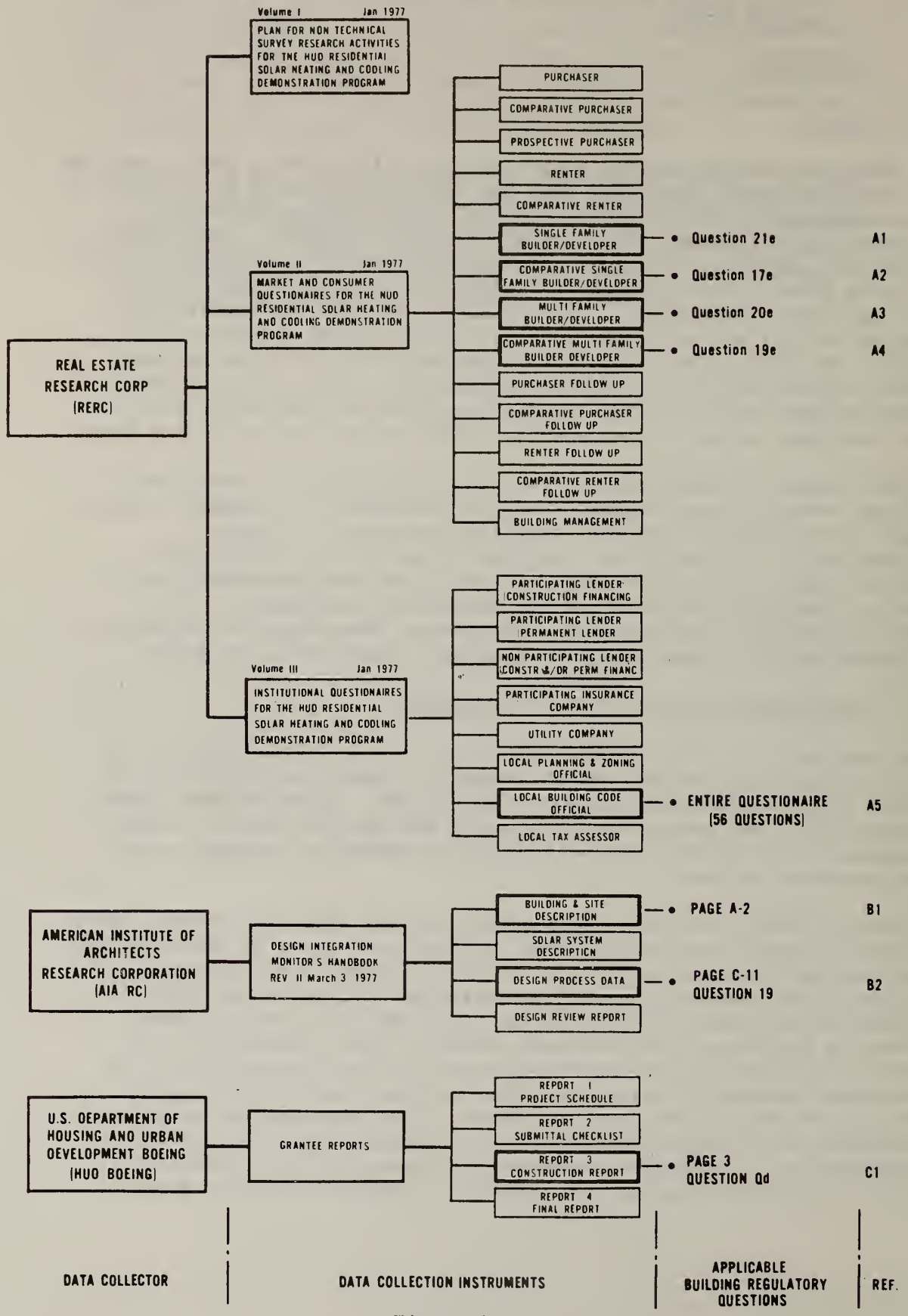


Figure 1

gathered for all information pertinent to a site. To illustrate, if a particular site is to be visited at all, the builder, comparative builder, code official, tax assessor, etc., generally all are contacted and the respective questionnaires completed.

Figure 1 illustrates not only the three volumes to be used but also the questionnaires in each volume. Volume I is a plan and contains no questions. There are separate questionnaires (in Volume II) containing numerous questions oriented toward "The Purchaser," "The Comparative Purchaser," "The Prospective Purchaser," etc. Four of the 14 questionnaires in Volume II are directly relevant to codes and standards. Furthermore, only one question within each of those four questionnaires relates to regulatory concerns. In Volume III, only one of eight questionnaires is of interest. However, this 56-part questionnaire, "Local Building Code Official," is of interest in its entirety. Section A of Appendix II consists of the pages of the RERC interview guide which contain all the questions applicable to this study.

The RERC data are by far the most pertinent to this study and are used to generate most of the conclusions and trends presented. The broad scope of the questions asked and the variety of respondents (demonstration builders, non-demonstration comparative builders, and local building code officials) allow for cross-correlations to be included in this report.

The data collected by RERC were coded and included in the NBS Solar Data Base. The bulk of the data used for this report came directly from this source. Where possible, unclear responses, anomalies, and ambiguities identified during the course of this study were investigated for possible resolution using the original source data maintained by RERC.

1.2 American Institute of Architects Research Corporation (AIA/RC)

Another organization collecting data for the Solar Residential Demonstration Program is the American Institute of Architects Research Corporation (AIA/RC). This organization developed a Design Integration Monitor's Handbook, dated March 3, 1977. The handbook is divided into four sections (see Figure 1) and is oriented toward collecting a major portion of the technical data for the Solar Residential Demonstration Program. Information collected by AIA/RC using these forms is limited to those sites which have been fully instrumented; hence, the data is mostly technical in nature. Much of the data collected were coded by AIA/RC and the coded sheets sent for input into the NBS Solar Data Base.

As noted in Figure 1, only two sections of the four in the Design Integration Monitor's Handbook are applicable to this study and each of the questionnaires contains only one pertinent question. Section B of Appendix II shows these questions.

Of these two questions, the second (Reference B2) was of greater interest to this study. However, responses to these questions were neven entered into the NBS Solar Data Base and a search of the AIA/RC files revealed only a small number of responses available. For completeness, these responses are included in Section 11. These responses had little impact on this study.

1.3 U.S. Department of Housing and Urban Development/Boeing (HUD/Boeing)

The Grantee Reports (see Figure 1) which were administered by Boeing for the U.S. Department of Housing and Urban Development (HUD) contain only one question (in Report No. 3 - Construction Report) of interest to this study.

Although some of the information contained in these reports appear in other questionnaires, the regulatory data extracted represent nearly a 100% response, since each grantee must provide this data. The other related reports which contain regulatory data have this data only for those sites which were visited on a selected basis for the purpose of obtaining broader information. For example, the AIA/RC questionnaires included this data only for the relatively few sites which were instrumented, while RERC collected regulatory data on the larger number of sites selected for the collection of marketing, consumer and institutional information.

2. SITE IDENTIFICATION AND STATUS OF DATA AVAILABILITY

2.0 General

Efforts were made to collect and organize all available data as of the cutoff point of this report--September 30, 1978. The availability of these data are shown in Appendix I, which also contains information that chacterizes the housing units and solar systems installed. Sample sizes are presented individually in the sections of this report that analyze specific areas of response.

To organize the data in a mode which maintains time as a variable, the information in Appendix I is presented on a cycle-by-cycle basis. The division of data in this cyclical manner is maintained throughout this report and, where appropriate, time dependent observations are presented.

2.1 Site Identification and Data Availability

The site information pertinent to the Solar Residential Demonstration Program is presented in Appendix I. The tables are organized by State, and city within the State, and highlight some of the characteristics of the site and the solar units. The site information pertains to active sites (as of September 30, 1978) and is derived from the NBS Solar Data Base. The information is tabulated by data source and the applicable reference number (see Figure 1) indicated. As discussed previously, the information collected by RERC is the primary resource for this report. The AIA/RC regulatory data are limited and no conclusions are drawn. These data are included herein for completeness. The HUD/Boeing regulatory data from the Grantee Reports represents the most complete group of data available; although the data is not 100% complete.

In a few cases, data inconsistencies exist. For example, multi-family questionnaires are shown to have been completed at sites where single family units are the housing type indicated. No attempt has been made to resolve these differences, since the major thrust of this report is the identification and analysis of overall regulatory issues, concerns, and trends and the relatively minor problems with data concerning specific sites do not affect the conclusions presented.

PART II - AN ANALYSIS OF THE BUILDER'S REACTION TO THE REGULATORY ASPECTS OF THE DEMONSTRATION PROGRAM AND THE RESPONSES OF COMPARATIVE BUILDERS

3. RESPONSES BY BUILDERS/DEVELOPERS AND COMPARATIVE BUILDERS/ DEVELOPERS

3.0 General

This section addresses the reactions of the solar builder/developer toward the local regulatory environment existing during the demonstration program. It also probes at determining if the solar builder was treated differently, from other builders in the area, by asking similar questions to non-demonstration, non-solar (comparative) builders. An analysis is made to determine if there are differences and the extent of these differences. Comments presented by each builder responding negatively were recorded and tabulated. This section addresses the responses to the RERC questionnaire for:

(a)	Single Family Builder/Developer	(Reference A1)
(b)	Comparative Single Family Builder/Developer	(Reference A2)
(c)	Multi-Family Builder/Developer	(Reference A3)
(d)	Comparative Multi-Family Builder/Developer	(Reference A4)

When appropriate, the builder's views toward the regulatory environment are compared with the local building code official's comments in Part III of this report.

3.1 The Question

In effect, only a single question of a regulatory nature in the RERC package of questionnaires was addressed to both the solar demonstration builder and the non-solar, non-demonstration (comparative) builder (see Figure 1). The question was:

> "Did you have any problems obtaining approval from building inspectors during the planning and construction phase of the project?
>
> For Development?
> For Solar Houses/Apts.?
>
> If yes, please explain."
>
> (See Appendix II for sample questionnaire form.)

This question was posed to: (1) the single family solar builder/ developer, to respond both for the development and for the solar houses; (2) the comparative single family builder/developer, to respond only to problems for the development since no solar units were involved; (3) the multi-family builder developer, also to respond

both to the development and the solar apartments; and, (4) the comparative multi-family builder, to respond only to problems with the development.

Although a single regulatory question was asked of these builders, it is an important question. It is broad in scope, covering the period "during the planning and construction phase," and gives the opportunity for any perceived problems to be aired.

3.2 Sample Size

The detailed information in Appendix 1 are summarized in Figure 2. to indicate the baseline data for this study. As can be seen, the regulatory question detailed in section 3.1 was asked by RERC of approximately fifty percent (50%) of the single family builder/developers engaged in constructing solar equipped demonstration houses, but only of 9.7 percent of the multi-family builders/developers. In addition, RERC interviewed non-demonstration, non-solar comparative single family builders at approximately fifty percent (50%) of the locational areas where solar demonstration programs are being conducted and comparative multi-family builders at 6.5 percent of these locational areas. The demonstration builder data, both single family and multi-family, approximately reflects the number of site locations visited; the usual scheme is to generally interview only a single demonstration builder/developer per location. However, the number of comparative builders varied from one to four.

3.3 Analysis of the Data

To gain an overview of the information analyzed, the builder/developer responses are summarized in Figure 3. The number of overall responses are a good proportion of the population studied, although, as noted in section 3.2, the number of responses from multi-family builders is somewhat lacking.

Figure 3 illustrates that for the three cycles studied, demonstration builder/developer responses were received from 115 of the 272 possible sites (approximately 42%). This includes both single family and multi-family builders/developers. In addition, 221 responses were obtained from comparative non-demonstration, non-solar builders/developers; also both single family and multi-family.

Thirteen (13), or approximately twelve percent (12%) of the builders/developers interviewed, expressed difficulty in obtaining approval from their building inspectors for solar houses/apartments. One solar demonstration builder/developer reported difficulty in obtaining approval for his development. As a comparison, sixteen (16) of the 221 comparative non-demonstration, non-solar builders (approximately 7%) reported difficulty with their local building inspectors in obtaining approval for their developments.

AVAILABILITY OF BUILDER/DEVELOPER DATA

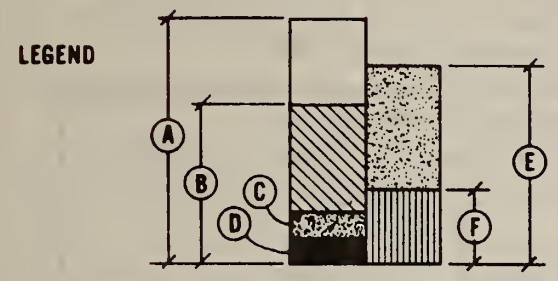
	SOLAR SINGLE FAMILY BUILDER/DEVELOPER (INCLUDES SINGLE FAMILY DETACHED AND ATTACHED)		NON-SOLAR (COMPARATIVE) SINGLE FAMILY BUILDER/DEVELOPER		SOLAR MULTI-FAMILY BUILDER/DEVELOPER		NON-SOLAR (COMPARATIVE) MULTI-FAMILY BUILDER/DEVELOPER	
	REFERENCE A1		REFERENCE A2		REFERENCE A3		REFERENCE A4	
	BUILDER DATA AVAILABLE	BUILDER DATA NOT AVAILABLE	BUILDER DATA AVAILABLE	BUILDER DATA NOT AVAILABLE	BUILDER DATA AVAILABLE	BUILDER DATA NOT AVAILABLE	BUILDER DATA AVAILABLE	BUILDER DATA NOT AVAILABLE
CYCLE 1	27[1]	17	27	17	1[1]	5	0	6
CYCLE 2	31	28	32	27	2	14	2	14
CYCLE 3	48	60	47	61	3	37	2	38
TOTAL	106[1]	105	106	105	6[1]	56	4	58

TOTAL RESPONSES POSSIBLE (ALL CYCLES)	211	211	62	62
PERCENT RESPONSES AVAILABLE (ALL CYCLES)	50.2	50.2	9.7	6.5

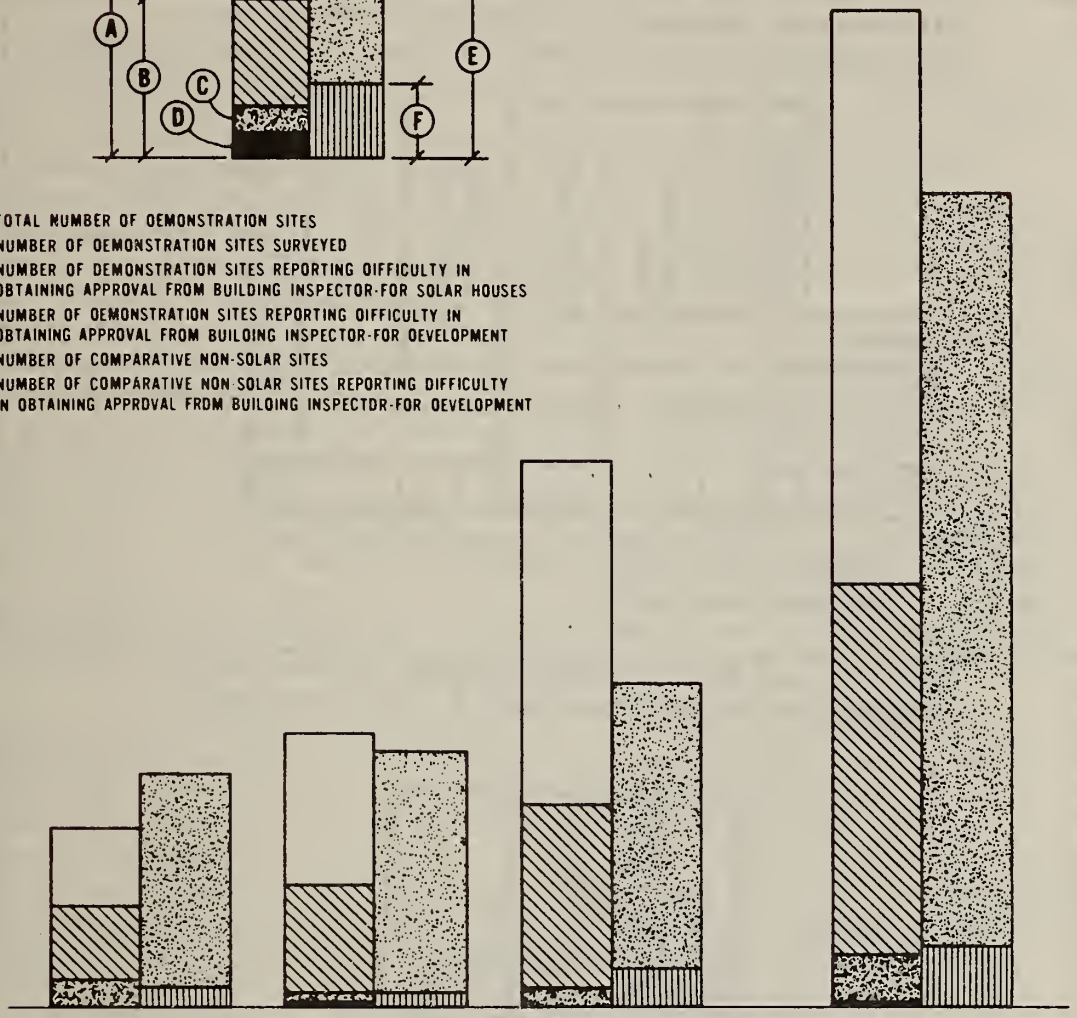
[1]A solar demonstration builder at one site responded to both the single family and multi-family questionnaire.

Figure 2

SUMMARY OF BUILDER/DEVELOPER RESPONSES



(A) TOTAL NUMBER OF DEMONSTRATION SITES
(B) NUMBER OF DEMONSTRATION SITES SURVEYED
(C) NUMBER OF DEMONSTRATION SITES REPORTING DIFFICULTY IN OBTAINING APPROVAL FROM BUILDING INSPECTOR-FOR SOLAR HOUSES
(D) NUMBER OF DEMONSTRATION SITES REPORTING DIFFICULTY IN OBTAINING APPROVAL FROM BUILDING INSPECTOR-FOR DEVELOPMENT
(E) NUMBER OF COMPARATIVE NON-SOLAR SITES
(F) NUMBER OF COMPARATIVE NON SOLAR SITES REPORTING DIFFICULTY IN OBTAINING APPRDVAL FRDM BUILDING INSPECTDR-FOR DEVELOPMENT



	CYCLE 1		CYCLE 2		CYCLE 3		TOTAL-CYCLE 1,2,3	
(A)	49		75		148		272	
(B)	27		34		54		115	
(B)/(A)	.55		.45		.36		.42	
(Bs)	27		30		50		107	
(BD)	27		33		50		110	
(C)	7		2		4		13	
(D)	0		1		0		1	
(C)/(Bs)	.26		.07		.08		.12	
(D)/(BD)	.00		.03		.00		.01	
(E)		64		70		87		221
(F)		5		3		8		16
(F)/(E)		.08		.04		.09		.07

Figure 3

The reported reasons for having difficulty obtaining approvals are tabulated in Figure 4. The difficulties reported--"Inspector Not Knowledgeable of Solar," "Need Better Wiring," etc.--are in the short summary form provided by RERC as coded input to the NBS Solar Data Base. A spot check of the completed questionnaires on file with RERC confirmed that the short summaries generally reflected the gist of the longer, narrative responses provided by the builder/developer.

Difficulties Reported in Obtaining Approval by Solar Demonstration Builder/Developer for Solar House/Apt.

	INSPECTOR NOT KNOWLEDGEABLE OF SOLAR	NEED BETTER WIRING	STRICT HEATING CODE	NEED SYSTEM DEVELOPMENT	NO REASON GIVEN	TOTAL
CYCLE 1	5	2				7
CYCLE 2	2[1]					2
CYCLE 3	1		1	1	1	4
TOTAL	8	2	1	1	1	13

[1]A single builder/developer reported difficulty in obtaining approval "for development" as well as "for solar house/apt."

Difficulties Reported in Obtaining Approval by Comparative Builder/Developer for His Development

	STRICT INSPECTOR	INSPECTOR VERY BUREAUCRATIC	SPECIAL MATERIAL APPROVAL	NO REASON GIVEN	TOTAL
TOTAL	10	3	1	2	16

Figure 4

The reason most cited occurs in eight (8) of the thirteen (13) cases (approximately 62%) where the solar demonstration builder felt that the inspector was "Not Knowledgeable of Solar." It also should be noted that the number of solar demonstration builders reporting that the inspector was "Not Knowledgeable of Solar," becomes smaller in each succeeding cycle. This could be interpreted, in a positive sense, that the building inspectors are becoming more knowledgeable of solar with the passage of time; or pessimistically, that the builder/developer-

building inspector interplay has not yet caused the builder to comment adversely about the inspector. No investigation was made to determine the construction phase of each site in relation to the time frame of the interview with the builder/developer. An analysis of the local building code official's assessment of his own knowledge about solar is included in Part III of this report.

Other difficulties in obtaining approval stated by solar demonstration builders/developers are small in number, scattered, and vary by cycle. Little meaning is attributed to these data in that they may reflect operational problems associated with any normal builder/inspector interface. However, in California, Colorado and Connecticut--States with very active solar programs--there are a greater number of builder/developers reporting difficulties with the local building code official.

Figure 4 also tabulates the difficulties reported by the comparative non-demonstration, non-solar builder/developers. Thirteen (13) of the sixteen (16) comparative builder/developers (approximately 81%) reported that the difficulties experienced were due to a "Strict or Very Bureaucratic" inspector. At two sites, the solar demonstration builder/developer and the comparative non-demonstration, non-solar builder/developer both reported difficulty in obtaining approval from the building inspector. At another site, the two comparative non-demonstration, non-solar builder/developers indicated problems with a "Strict Inspector," yet the solar demonstration builder/developer at the same location reported no problem in obtaining approvals.

As a final observation, all thirteen (13) of the solar demonstration builder/developers reporting difficulty in obtaining approvals were constructing new units (as opposed to retrofitting existing units), although nine percent (9%) of the two hundred seventy-two (272) demonstration sites were retrofit sites. Additionally, only one multi-family solar demonstration builder-developer (of the thirteen) reported difficulty in obtaining approval. All of the solar demonstration builder/developers reporting difficulty are involved with active (vs. passive) systems with no particular type (heating/cooling, hot water) predominating.

3.4 Conclusions

The solar demonstration builder/developer faces no greater or lesser difficulty than that routinely faced by a non-solar builder in obtaining approval from building inspectors during the planning and construction phases of a project. A small percentage of all builders (solar and non-solar alike) face the occupational hazard of difficult dealings with building inspectors and this study indicates that the new technology--solar energy--is no exception. It appears, from the builders/developers perspective, that regulatory issues have not impeded the development of solar, at least on the demonstration program.

PART III - AN ANALYSIS OF THE LOCAL BUILDING CODE OFFICIAL'S RESPONSES TO THE REGULATORY ASPECTS OF THE SOLAR RESIDENTIAL DEMONSTRATION PROGRAM AND OTHER RELATED MATTERS

4. RESPONSES BY LOCAL BUILDING CODE OFFICIALS

4.0 General

Part III addresses the viewpoint of the local building code official--his attitudes, preferences, opinions, etc.--regarding the Solar Residential Demonstration Program and other aspects of the regulatory environment related to solar energy. It also gives a brief profile of the building inspector, characterizes his knowledge of solar systems, and touches slightly on his energy conservation attitudes in general.

Part III forms the bulk of this study, as it includes the responses to fifty-six (56) questions asked of the local building code official by the Real Estate Research Corporation (RERC). (See Reference A5; Figure 1.) Each question is analyzed and the results presented individually. Where appropriate, questions are cross-tabulated and the findings and conclusions resulting from these correlations presented.

4.1 The Questions

Responses to the fifty-six (56) questions comprising the Local Building Code Official's questionnaire would be difficult to manage unless broken down into smaller, easily handled groups. Fortunately, RERC has made such a manageable division in developing its questionnaire and this division is followed here. The groupings are as follows:

QUESTIONS	REPORT SECTION
1 through 8	5. Profile of Building Code Administration
9 through 20	6. Experience with Demonstration Program
21 through 30	7. Building Code and Solar Systems' Applications in General
31 through 44	8. Solar Energy Systems' Impact on Building Code
45 through 48	9. Building Code and Energy Conservation
49 through 56	10. Knowledge and Attitudes Re: Solar Energy Systems

The specific questions asked in the RERC document are included in the appropriate section of this report, along with a tabulation of the responses received. Observations and comments are presented with each question, as well as a summary of findings and conclusions at the end of each section. A sample of the questionnaire used by RERC is included in Appendix 2.

4.2 Sample Size

The data availability listings in Appendix 1 (under RERC, Reference A5) are summarized in Figure 5. Responses were received from eighty-seven (87) local building code officials, which represents responses from approximately thirty-two percent (32%) of the two hundred seventy-two (272) site locations. This percentage appears smaller than the sample available for the solar demonstration builder/developer and comparative builder/developer study in Part II. However, if duplicate sites are eliminated from the tabulation under the assumption that a single interview with the local building code official is sufficient at each site location, then the total number of interviews possible for all three (3) cycles reduces to two hundred four (204). The eighty-seven (87) responses then become approximately a forty-three percent (43%) sample, comparable to the forty-two percent (42%) sample achieved for the solar demonstration builder/developer.

Although responses to the RERC questionnaire were received from eighty-seven (87) local building code officials, not all questions were answered by each official. This is apparent when reviewing the responses to the individual questions as the total responses will generally be less than eighty-seven (87). In addition, responses which were unintellibable due to poor handwriting, errors in computer coding, or other reasons are also not tallied.

4.3 Presentation of Data

The format used to present the data in the following sections was chosen to provide maximum visibility toward understanding the questions asked and the responses received. The thrust of this report is not oriented toward the individual responses tabulated, but rather on the conclusions drawn from the aggregation of responses.

The responses are grouped by cycle. This allows an analysis of time-dependent trends given the sequential nature of the cycles. Responses to certain questions are also cross-tabulated to reinforce conclusions or give another perspective to the perceived regulatory environment.

Where responses given by the responding local building code official were other than "yes" or "no," the responses shown in this report basically reflect the information stored in the NBS Solar Data Base. These responses were coded by RERC in a short summary form to reflect the gist of the thought articulated by the local building code official. No attempt was made by NBS to verify that RERC captured the essence of the thought expressed or that responses coded in the same abbreviated way generally reflected similar opinions or beliefs. However, where the short summary statement was considered unclear by NBS, contacts were established with RERC in an effort to clarify these statements.

There are some responses to questions contained herein that apparently lead to no conclusion in that the responses are scattered, varied, and present no significant pattern. This lack of order, in itself is valuable in concluding that perhaps there is no consensus on that subject by local building code officials.

SUMMARY OF LOCAL BUILDING CODE OFFICIAL RESPONSES

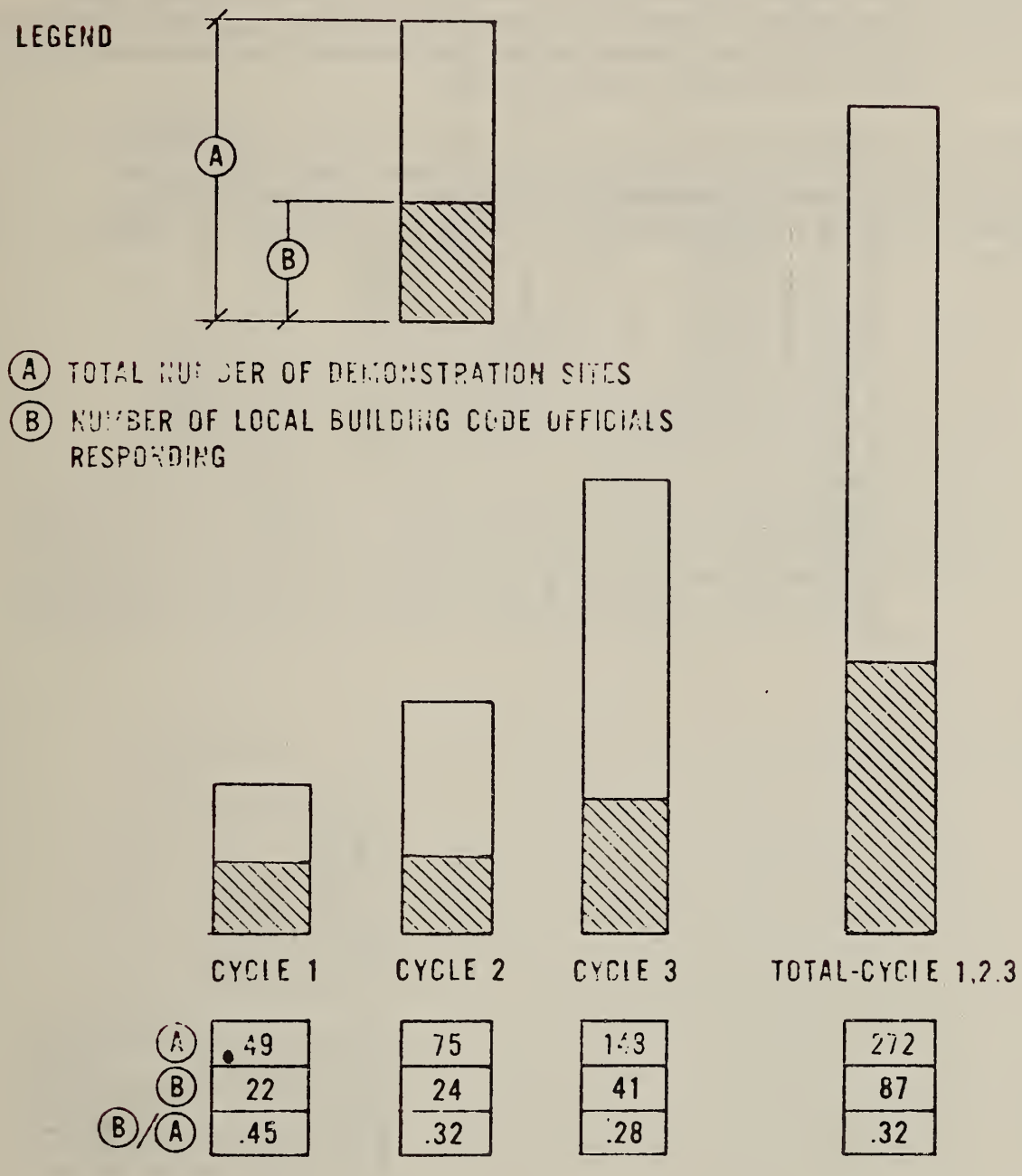


Figure 5

5. PROFILE OF BUILDING CODE ADMINISTRATION

This section deals with the first eight questions of the RERC report oriented toward the Local Building Code Official (Reference A5, Figure 1). These data are not solar specific and are general in nature but they provide broad information concerning the local building code official. These data are useful in characterizing the "typical" local building code official and demonstrating the diversity and autonomy associated with building code administration.

Responses are tabulated relative to the organizational location and reporting level of the building enforcement department within the structure of the local government, the number of inspectors in the department, and data concerning the building code used by the jurisdiction.

QUESTION 1: "Where is your department located within the government's organizational structure?"

QUESTION 2: "This department is part of what level of government?"

RESPONSES

Question 1

	INDEPENDENT DEPARTMENT	RESPONSIBLE TO CITY	TOWN BOARD	HOUSING AND URBAN REHAB/DEVELOPMENT	DEPARTMENT OF COMMUNITY DEVELOPMENT	PLANNING AND ZONING DEPARTMENT	PUBLIC WORKS	COUNTY EXECUTIVE BOARD	COUNTY BUILDING AND INSPECTION DEPARTMENT	STATE GOVERNMENT	PRIVATE COMPANY	
CYCLE 1	6	2	2	1	2	0	0	5	0	1	0	
CYCLE 2	6	5	5	1	3	1	1	2	0	0	0	
CYCLE 3	6	7	3	0	3	0	2	8	2	1	1	
	18	14	10	2	8	1	3	15	2	2	1	76

Question 2

	CITY	TOWN/VILLAGE	CITY/COUNTY	STATE GOVERNMENT	PRIVATE COMPANY	
CYCLE 1	10	2	9	0	0	
CYCLE 2	14	3	7	0	0	
CYCLE 3	21	0	12	1	1	
	45	5	28	1	1	80

Observations and Comment

The answers given by the local building code officials regarding the location of their departments within the governments' organizational structure and the supervising level of government are tabulated under "Responses." Unsurprisingly, the summary of responses highlight the autonomy such organizations have within the overall structure of government, the level rarely reaching above the county level. A cross-tabulation of the responses to Questions 1 and 2 is shown below.

CROSS TABULATION OF RESPONSES TO QUESTIONS 1 AND 2

Level of Govt. Supervising Department \ Where department is located within Govts organ. structure	INDEPENDENT DEPARTMENT	RESPONSIBLE TO CITY	TOWN BOARD	HOUSING AND URBAN REHAB/DEVEL.	DEPARTMENT OF COMMUNITY DEVEL.	PLANNING AND ZONING DEPT.	PUBLIC WORKS	COUNTY EXECUTIVE BOARD	COUNTY BLDG. AND INSPEC. DEPT.	STATE GOVERNMENT	PRIVATE COMPANY	UNSPECIFIED	
CITY	13	12	5	2	7	1	1	1				1	43
TOWN/VILLAGE			4							1			5
CITY/COUNTY	5	2	1		1		2	14	2			3	30
STATE GOVERNMENT										1			1
PRIVATE COMPANY											1		1
	18	14	10	2	8	1	3	15	2	2	1	4	80

The highest frequency of the correlated data shown above indicates that the departments of fourteen (14) local building code officials are within the county executive board and that the supervising department is the city/county. Although tabulated above, this information is of questionable value for any meaningful detailed analysis in defining the local building code official/level of government/organizational structure in that the answers provided are not precise. Definitions are not provided to differentiate between "Town/Village" and "City;" is "Responsible to City" the same as "Independent Department?"; etc., etc. Nevertheless, this lack of order could characterize, in an overall sense, the local governmental environment in which the building code official operates. Words like autonomous, fragmented, diversified and independent seem appropriate.

QUESTION 3. "How many inspectors do you have in the department?"

RESPONSES

	0 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 to 89	90 to 99	100
CYCLE 1	14	3	1	1		1		1			
CYCLE 2	14	5	2	2							1
CYCLE 3	24	6	1	5	2		1				
	52	14	4	8	2	1	1	1			1

Observations and Comment

The answers given by the local building code officials regarding the number of inspectors in their departments are summarized in the table under "Responses." These responses also are graphically represented in Figure 6. It should be noted that the highest frequency is one building inspector reported by seventeen (17) respondents. This represents approximately twenty percent (20%) of the jurisdictions covered by this survey. In addition, approximately sixty-two percent (62%) reported nine (9) or fewer inspectors. The median number of inspectors is between four (4) and five (5).

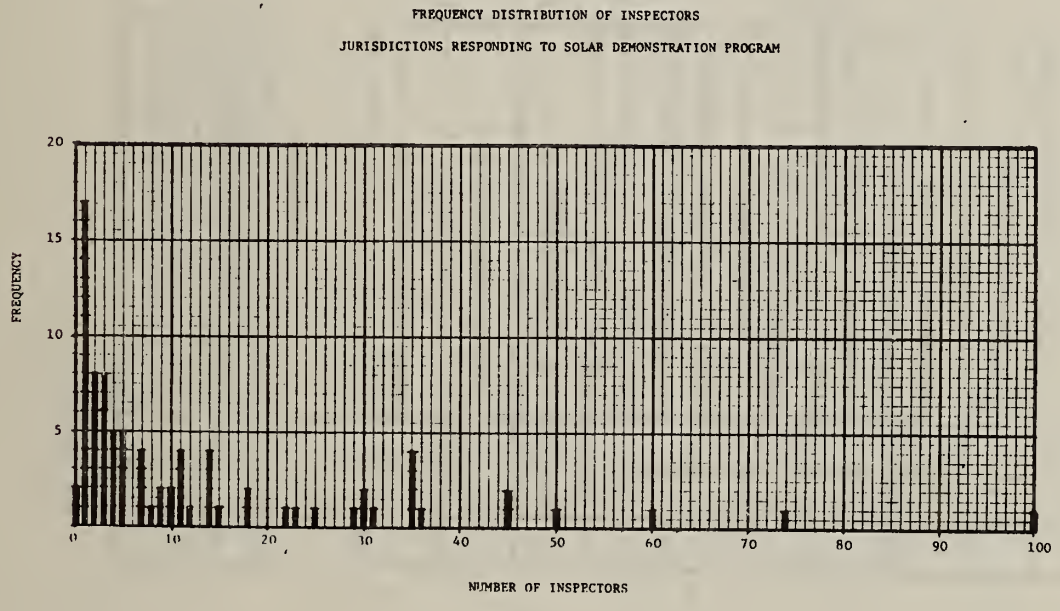


Figure 6

QUESTION 4. "Does your department have an established building code?"

QUESTION 5. "What is the name of the code?"

QUESTION 6. "On what code is it modeled?"

QUESTION 7. "How closely does your code conform to the model code?"

QUESTION 8. "If not, how are buildings and structures evaluated with regard to public health and safety?" (Note: This question relates to question 4.)

RESPONSES

Question 4

	YES	NO
CYCLE 1	17	1
CYCLE 2	22	2
CYCLE 3	40	0
	79	3

Question 5

	STANDARD BUILDING CODE	BASIC BUILDING CODE	UNIFORM BUILDING CODE	NATIONAL BUILDING CODE	BUILDING, PLUMBING, MECHANICAL	STATE CODE	UNIFORM SOLAR CODE	STATE AND LOCALITY CODE	TOWN ZONING ORDINANCE	
CYCLE 1	2	2	4	0	3	3	0	0	3	
CYCLE 2	2	2	9	1	1	6	1	0	0	
CYCLE 3	1	3	19	1	4	10	0	1	1	
	5	7	32	2	8	19	1	1	4	79

Question 8

	HEALTH DEPARTMENT AND ZONING	MINIMUM LOT SIZE/FLOOR AREA	
CYCLE 1	1	0	
CYCLE 2	1	1	
CYCLE 3	0	0	
	2	1	3

Responses to Questions 4 - 8 (cont'd.)

Question 6

	STANDARD BUILDING CODE	BASIC BUILDING CODE	UNIFORM BUILDING CODE	NATIONAL BUILDING CODE	IAPMO UNIFORM PLUMBING CODE	NFPA-NEC AND LIFE SAFETY CODE	FOLLOWS STATE CODE	COMBINATION OF ABOVE	
CYCLE 1	4	5	6	0	0	1	2	2	
CYCLE 2	2	3	12	1	2	0	2	1	
CYCLE 3	3	8	19	0	0	0	1	4	
	9	16	37	1	2	1	5	7	78

Question 7

	MODEL WITH SOME VARIATION	MANDATORY/MINIMUM	MANDATORY	DO NOT KNOW	RECOMMENDED MINIMUM	CONFORMS TOTALLY	SEISMIC REQUIREMENTS ADDED	ENERGY CODE	BASIC MECHANICAL AND PLUMBING	MORE STRINGENT	
CYCLE 1	13	0	6	1	0	0	0	0	0	0	
CYCLE 2	12	3	2	1	1	0	0	0	0	0	
CYCLE 3	16	6	9	0	0	2	1	1	1	1	
	41	9	17	2	1	2	1	1	1	1	76

Observations and Comment

Seventy-nine (79) of the eighty-two (82) local building code officials responding (approximately 96%) indicated that their departments had an established building code. Not surprising, is that two (2) of the three (3) jurisdictions which did not have an established building code also have no inspectors in their organization. One, of course, wonders who participated in the local building code official's interview if the jurisdictions have no codes or inspectors.

The names of the codes vary and are tabulated under "Responses" to Question 5. Thirty-seven (37) of the local building code officials (approximately 47%) indicated that their building codes were based on the Uniform Building Code. In addition, forty-one (41) of the seventy-six (76) local building code officials (approximately 54%) said that their codes were a variation of a model code; seventeen (17), approximately twenty-two percent (22%), indicated that the model code was mandatory in their jurisdictions, and nine (9), approximately twelve percent (12%), said that the model was a mandatory/minimum requirement. A cross-tabulation matrix of these parameters as shown below in "CODE BASIS AND CONFORMITY TO MODEL," indicates the most prevalent condition existing in the reporting jurisdictions to be the Uniform Building Code, modified by some variation (approximately 24%).

The responses to question seven, "How closely does your code conform to the model code?" require further examination. The responses in some cases such as, "Model with Some Variation," and, "More Stringent," rightly refer to a comparison of the code used in the jurisdiction as evaluated against the provisions found in the model code. Answers given, however, such as "Mandatory" and "Mandatory/Minimum" refer to the administration or enforcement of the code rather than to a comparison of provisions.

For example, the local building code officials in two jurisdictions reported that their codes are based after the "Basic Building Code" and that it is a "Mandatory/Minimum." It could be implied from this answer that the code used is the Basic Building Code with no variation and this code is enforced as a "Mandatory/Minimum." Or, in fact, the code used might be modeled after the Basic Building Code "with some variations" and that the modified code is enforced as a "Mandatory/Minimum" code. The responses give no clue as to the real answer to the question asked.

Questions 4-8 (cont'd.)

CODE BASIS AND CONFORMITY TO MODEL

Question 6

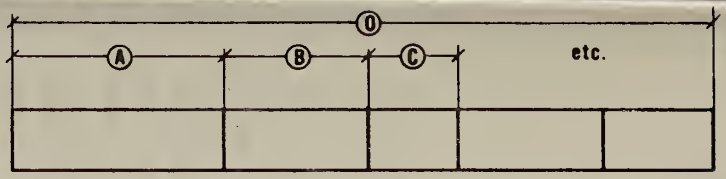
Question 7	STANDARD BUILDING CODE	BASIC BUILDING CODE	UNIFORM BUILDING CODE	NATIONAL BUILDING CODE	UNIFORM PLUMBING CODE	NFPA-NEC AND LIFE SAFETY CODE	FOLLOWS STATE CODE	COMBINATION OF ABOVE	NOT ANSWERED	
MODEL WITH SOME VARIATION	6	10	19	1			1	4		41
MANDATORY/MINIMUM		2	6		1					9
MANDATORY	3	3	8			1		1	1	17
DO NOT KNOW							2			2
RECOMMENDED MINIMUM			1							1
CONFORM TOTALLY			1		1					2
SEISMIC REQUIREMENTS ADDED			1							1
ENERGY CODE									1	1
BASIC MECHANICAL AND PLUMBING		1								1
MORE STRINGENT								1		1
NOT ANSWERED			1				2	1		4
	9	16	37	1	2	1	5	7	2	80

5.1 Conclusions

The individual results listed under each question are depicted in graphical form in Figure 5. In summary, the "Profile of Building Code Administration" can be characterized as follows:

The "typical" local building code official operates in a governmental environment that focuses around city or perhaps county government and is directly responsible to a higher echelon of that government. The group is not large, with perhaps four to five inspectors in the department. Most jurisdictions base their local codes after some nationally-recognized model code "with some variation" to meet the specific needs of the jurisdiction.

PROFILE OF BUILDING CODE ADMINISTRATION



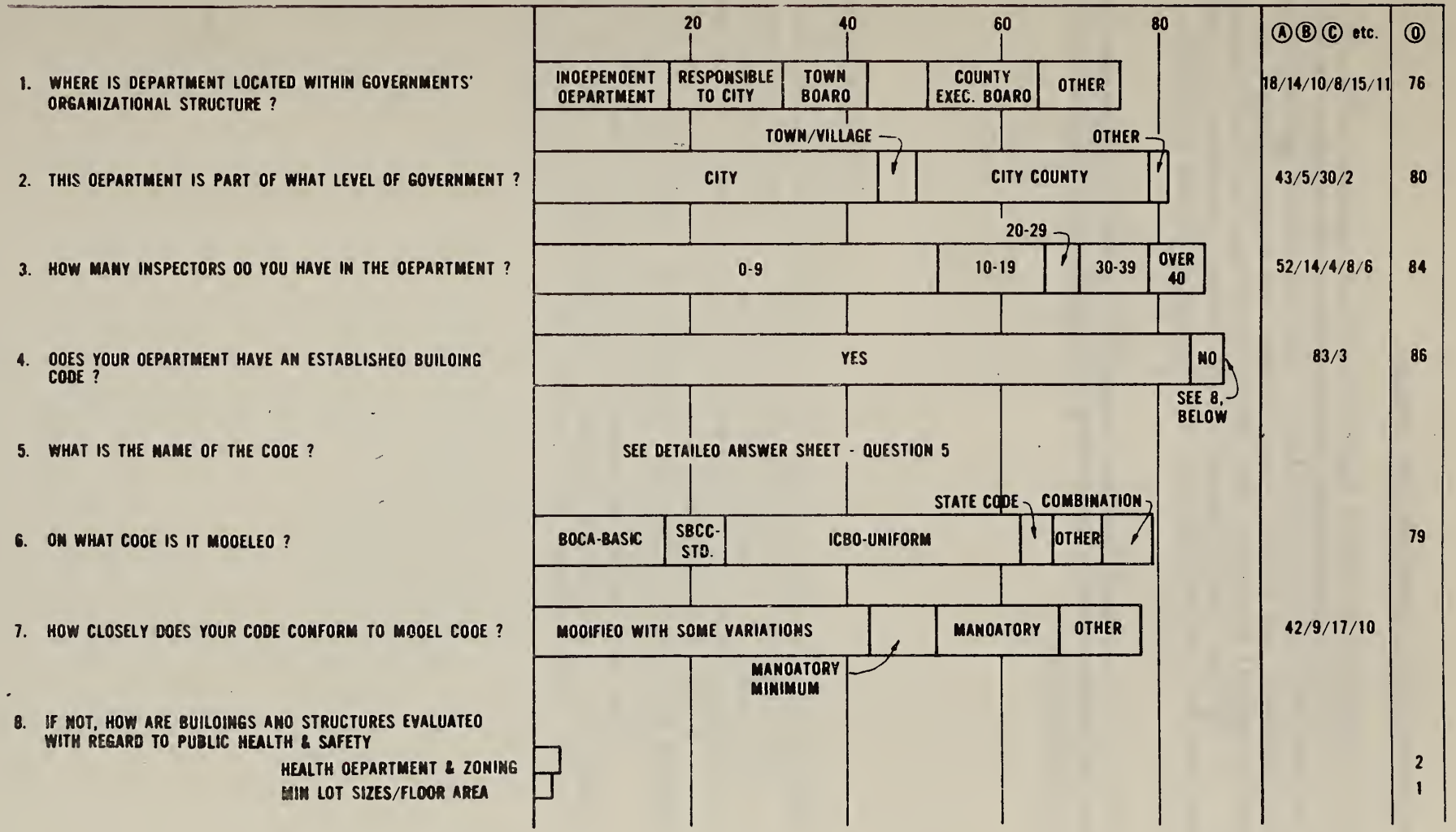


Figure 6

6. EXPERIENCE WITH DEMONSTRATION PROGRAM

Questions 9 through 20 relate to the local building code official's experience with the Residential Solar Demonstration Program. Questions are included regarding his familiarity with the demonstration program; waivers requested and granted; requirements for design changes and approvals; special training; site inspections; and, approval processing times. In addition, the influence of the Federal government on the process used for systems approval for the demonstration program is queried.

In Section 7, these questions are compared with similar questions concerning the system used in processing and approving non-demonstration solar applications.

QUESTION 9: "Are you familiar with the solar house(s)/apartment(s) that was (were) built with a Federal grant in your jurisdiction?"

RESPONSES

	YES	NO
CYCLE 1	21	1
CYCLE 2	24	0
CYCLE 3	37	4
	82	5

Observations and Comment

Five of the eighty-seven (87) local building code officials interviewed (approximately 6%) were not familiar with the solar units built in their jurisdictions under the demonstration program. At these five sites, none of the solar builders reported difficulty in obtaining approval from the building inspectors. This question, however, is unclear in its meaning and the responses, therefore, may not be answering the intended question. In effect, the respondents could have meant that they were not aware of the demonstration program being conducted in their jurisdiction; or, that they were aware of the demonstration program but were not familiar with the specific solar units that were built there.

QUESTION 10: "Were any waivers requested to accommodate the solar system?"

QUESTION 11: "Were these waivers granted?"

RESPONSES

Question 10

	NO	YES
CYCLE 1	20	0
CYCLE 2	23	0
CYCLE 3	34	4
	77	4

Question 11

WAIVER REQUEST	WERE WAIVERS GRANTED	REASON
For Wood Stove Back-up	No	System Considered Inadequate
Eliminate Roofing Undercoat	Yes	-
Conform to New Code	Yes	Used New Code
Windows Too Small	No	-

Observations and Comment

Four (4) of the eighty-one (81) local building code officials interviewed (approximately 5%) reported receiving waiver requests to accommodate the solar systems. Waivers were granted to two of the four builders requesting them. It is interesting to note that the builder/developer who was denied a waiver for a wood stove back-up reported difficulty in obtaining approval from the building inspector and indicated (in the builder/developer questionnaire) that the jurisdiction had a "Strict Heating Code."

QUESTION 12: "Were any design changes required prior to approval?"

RESPONSES

	NO	YES
CYCLE 1	13	7
CYCLE 2	19	3
CYCLE 3	32	6
	64	16

Observations and Comment

Sixteen (16) of the eighty (80) local building code officials interviewed (20%) required design changes prior to approval. These changes are grouped by frequency of response and by building element.

RESPONSES BY FREQUENCY

(1)	Additional Roof Support	4
(2)	Ventilation System	4
(3)	Wall Construction	3
(4)	Additional Windows	2
(5)	Wiring Changes for Safety	1
(6)	Valves Required	1
(7)	Separate Tanks for Potable Water	1
		16

RESPONSES BY BUILDING ELEMENT

Structural (1,3)	7
Ventilation (2,4)	6
Plumbing (6,7)	2
Electrical (5)	1
	16

The highest number of design changes (approximately 81%) concern themselves with structural and ventilation requirements; changes only peripherally associated with the functioning of solar systems. The smaller number of plumbing and electrical changes seem directly associated with the solar systems installed.

At three (3) of the sixteen (16) sites where design changes were required, the builder/developer indicated that he had difficulty with the local building code official.

QUESTION 13: "Were system approvals handled in the normal manner by regulatory personnel or did special considerations prevail? Please explain."

RESPONSES

	NORMAL MANNER	OTHER
CYCLE 1	17	2
CYCLE 2	21	2
CYCLE 3	33	5
	71	9

Observations and Comment

Nine (9) of the eighty (80) local building code officials interviewed (approximately 11%) indicated that system approvals were handled in a special manner. Approximately fifty-five percent (55%) of those responding that special handling occured identified the collector as receiving special attention. Nevertheless, none of the nine (9) solar builders/developers whose sites were handled in a special manner reported difficulty in obtaining approval from the local building code official.

QUESTION 14: "Was special training needed for regulatory staff or field inspectors?"

RESPONSES

	NO	YES
CYCLE 1	18	2
CYCLE 2	20	3
CYCLE 3	33	4
	71	9

Observations and Comment

Nine (9) of the eighty (80) local building code officials interviewed (approximately 11%) reported that special training was needed for regulatory staff or field inspectors

QUESTION 15: "Were job site inspections handled in a normal way or by special personnel? Please explain."

RESPONSES

	NORMAL	OTHER
CYCLE 1	19	1
CYCLE 2	24	0
CYCLE 3	36	2
	79	3

Observations and Comment

Three (3) of the eighty-two (82) local building code officials interviewed (approximately 4%) handled job site inspections in a special way. Two (2) reported that site inspections were handled in a more impersonal and thorough manner and the other reported that site inspections were handled by specially trained personnel.

QUESTION 16: "Were additional job site inspections necessary?"

RESPONSES

	NO	YES
CYCLE 1	12	6
CYCLE 2	17	5
CYCLE 3	26	9
	55	20

Observations and Comment

Twenty (2) of the seventy-five (75) local building code officials interviewed (approximately 27%) indicated that additional job site inspections were necessary. The reasons are tabulated by frequency.

To Understand System Operation	6
Water Test/Structural Inspection	4
Electrical and Plumbing	4
Unspecified	4
Storage and Structural	2

QUESTION 17: "Did it take longer to process the solar application than it would have for conventional property?"

QUESTION 18: "If the time factor was increased, would this hold true for future residential applications using solar energy systems?"

RESPONSES

	NO	YES
CYCLE 1	18	2
CYCLE 2	16	8
CYCLE 3	30	7
	64	17

Observations and Comment

Seventeen (17) of the eighty-one (81) local building code officials interviewed (approximately 21%) indicated that it took longer to process the solar demonstration applications than it would have for conventional property. The reasons cited by frequency are:

Formal Plan Check	5
To Understand System	4
Stringent Mechanical Review	4
Non-Conventional Plumbing	2
Non-Conventional Framing System	1
Check Structural Adequacy	1
	17

In response to Question 18 regarding the increased time factor for processing future applications for solar systems, sixteen (16) of the local building code officials responding "Yes" to Question 17 answered as follows:

Variety of Construction and Technology	4	7	EXPECT TIME DELAYS TO CONTINUE
Plumbing Inspection Necessary	2		
Yes - No Reason	1		
Okay After System Established	6	9	EXPECT TIME DELAYS TO DIMINISH
Not Caused by Solar	2		
Not that Significant	1		

In effect, seven (7) of the eighty-one (81) local building code officials interviewed (approximately 9%) believe that there will be delays encountered in the future for processing solar energy applications, while nine (9) local building code officials (approximately 11%) expect the time delays to diminish. It should be noted that three solar builders at sites currently taking longer to process solar applications indicated difficulty in obtaining approval from building inspectors and cited "Inspector Not Knowledgeable of Solar" as the reason.

QUESTION 19: "Did the fact that the solar unit(s) was (were) funded by a Federal grant impact the approval process?"

RESPONSES

	NO	YES
CYCLE 1	19	1
CYCLE 2	23	1
CYCLE 3	37	0
	79	2

Observations and Comment

Seventy-nine (79) of the eighty-one (81) local building code officials interviewed (approximately 98%) indicated that the Federal presence in the demonstration program did not impact the approval process. This is discussed in detail in Section 7 where the views of the local building code official are analyzed regarding his handling of solar systems submitted by non-demonstration solar builder/developers.

QUESTION 20: "Would the process have differed for a solar unit built outside of the demonstration project?"

RESPONSES

	NO	YES
CYCLE 1	19	1
CYCLE 2	23	1
CYCLE 3	36	1
	78	3

Observations and Comment

Seventy-eight (78) of the eighty-one (81) local building code officials interviewed (approximately 96%) indicated that the approval process would not have differed for solar units built outside of the demonstration project. Two (2) of the three (3) who indicated that the process would have been different cited that certified approval would have been required for non-demonstration solar units built in their jurisdictions. This is discussed in detail in Section 7 where the views of the local building code official are analyzed regarding his handling of solar systems submitted by non-demonstration solar builder/developers.

6.1 Conclusions

The individual results listed under each question are shown in graphical form in Figure 6. The local building code official's observations toward his "Experience with the Demonstration Program" can be summarized as follows.

1. During the demonstration program very few waivers were requested. However, if requested, the chance of approval was 50/50. This small number of waivers could be the result of a more thorough design effort required by the local building code official or because of the Federal government's role in the demonstration program.

2. Local building code officials required design changes to be made in approximately twenty percent (20%) of the systems. The majority of the design changes appear to be non-solar system related and not directly applicable to the operation of the solar system. The required design changes seem to originate because of structural and ventilation concerns--requirements which the local building code official addresses on a routine basis.

3. For the most part, the system approvals were handled normally. However, several local building code officials required a special review of the solar collectors.

4. A relatively large number of local building code officials reported the necessity of additional site inspections to review the solar equipment. Some of the inspections were necessary to understand the system operations, while others were necessary to inspect the adequacy of the installation regarding structural, plumbing, or electrical concerns. In addition, several inspectors required additional field training to perform these inspections and a small number handled inspections in a special way.

5. Approximately twenty-one percent (21%) indicated that it took longer to process the demonstration application and the opinion was almost split on whether the process time would continue to be longer than normal or would gradually diminish to a normal, routine time frame once a mechanism has been established to process these systems.

6. The vast majority of local building code officials reported that the approval process was not influenced by the Federal presence on the demonstration program and that the process would not differ for non-demonstration sites. This is discussed in greater detail in Section 7.

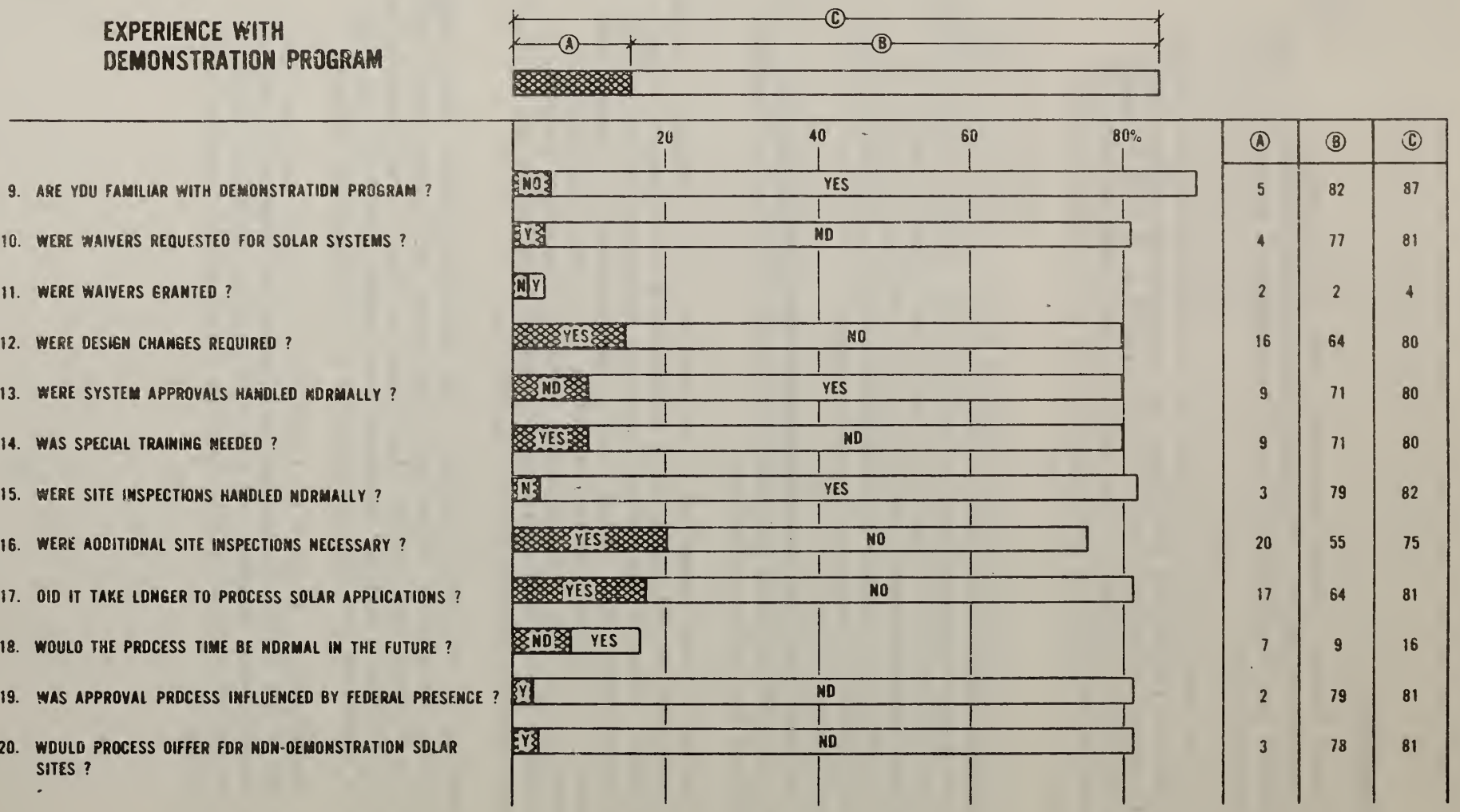

EXPERIENCE WITH
DEMONSTRATION PROGRAM
Ⓒ
Ⓐ
Ⓑ
20
40
60
80%
9. ARE YOU FAMILIAR WITH DEMONSTRATION PROGRAM ?
NO
YES
5
82
87
10. WERE WAIVERS REQUESTED FOR SOLAR SYSTEMS ?
Y
NO
4
77
81
11. WERE WAIVERS GRANTED ?
N
Y
2
2
4
12. WERE DESIGN CHANGES REQUIRED ?
YES
NO
16
64
80
13. WERE SYSTEM APPROVALS HANDLED NORMALLY ?
NO
YES
9
71
80
14. WAS SPECIAL TRAINING NEEDED ?
YES
NO
9
71
80
15. WERE SITE INSPECTIONS HANDLED NORMALLY ?
N
YES
3
79
82
16. WERE ADDITIONAL SITE INSPECTIONS NECESSARY ?
YES
NO
20
55
75
17. DID IT TAKE LONGER TO PROCESS SOLAR APPLICATIONS ?
YES
NO
17
64
81
18. WOULD THE PROCESS TIME BE NORMAL IN THE FUTURE ?
NO
YES
7
9
16
19. WAS APPROVAL PROCESS INFLUENCED BY FEDERAL PRESENCE ?
Y
NO
2
79
81
20. WOULD PROCESS DIFFER FOR NON-DEMONSTRATION SOLAR SITES ?
Y
NO
3
78
81

Figure 7

7. BUILDING CODE AND SOLAR SYSTEMS APPLICATIONS IN GENERAL

This Section, Questions 21 through 30, documents the responses of the local building code official regarding the administration of non-demonstration solar installations. The questions address waivers requested and granted, design changes required, the approval system used and process time required, training, site inspection, etc. These questions for the most part repeat the questions asked of the local building official concerning his reactions to the Residential Solar Demonstration Program (Section 6, Questions 10 through 20). Because of this, a comparison is possible to determine differences, if any, between the local building code official's administration of the solar demonstration project and other non-demonstration solar projects in his jurisdiction.

Not all local building code officials represented jurisdictions that had processed non-demonstration solar applications. In fact, the responses to Question 21 indicate that approximately sixty-four percent (64%) of the local building code officials have had experience with non-demonstration solar units in their jurisdictions in addition to the demonstration program. This, of course, reduces the sample size since only the local code officials who have processed non-demonstration solar units could respond to the specific questions asked. This sample size of fifty-four (54) is still adequate to gain some insight on how these non-demonstration solar sites were handled.

QUESTION 21: "Has your office/agency reviewed or processed any applications for building permits for other solar units in this jurisdiction?"

RESPONSES

	NO	YES
CYCLE 1	9	12
CYCLE 2	6	17
CYCLE 3	15	25
	30	54

Observations and Comment

Fifty-four (54) of the eighty-four (84) local building code officials interviewed (approximately 64%) indicated that they had processed applications for building permits for other solar units in their jurisdictions. Of the thirteen (13) demonstration builder/developers who indicated problems in obtaining approval from the local building code officials (see Section 3), six (6) were located in jurisdictions in which the local building code official had not processed solar applications for non-demonstration solar units and five (5) of these six (6) demonstration builder/developers had the comment, "Inspector Not Knowledgeable of Solar." The other seven (7) builder/developers who cited problems in obtaining approval from the local building code official were located in jurisdictions in which the local building code official had processed solar applications for non-demonstration units. Three (3) of these builder/developers also had the comment, "Inspector Not Knowledgeable of Solar."

The types and/or number of non-demonstration solar projects as reported by the local building code official are as follows:

Unspecified	17
Single Family and Multi-Family	11
All Types	11
Active/Passive/Pools	5
Over 10 - A Variety of Systems	4
Hybrid Systems	2
Air Collectors	2
12 Projects	1
One Retrofit	1
	54

QUESTION 22: "Were any waivers requested to accommodate the solar systems?"

QUESTION 23: "Were these waivers granted?"

RESPONSES

Question 22

	NO	YES
CYCLE 1	10	2
CYCLE 2	15	1
CYCLE 3	22	0
	47	3

Question 23

	NO	YES
CYCLE 1	0	2
CYCLE 2	0	1
CYCLE 3	0	0
	0	3

Observations and Comment

Three (3) of the fifty (50) local building code officials interviewed (6%) indicated that they had had requests for waivers from non-demonstration solar builders and that these waivers were granted.

QUESTION 24: "Were any design changes required prior to approval?"

RESPONSES

	NO	YES
CYCLE 1	10	2
CYCLE 2	10	6
CYCLE 3	16	6
	36	14

Observations and Comment

Fourteen (14) of the fifty (50) local building code officials responding (28%) indicated that they required design changes prior to approval on non-demonstration solar projects. These are tabulated below by frequency:

Historical Design Requirement	3
Styrofoam Insulation	2
Separate Water Tanks	2
Roof Structure	2
Tank Capacity	1
Additional Ventilation	1
Unspecified	3
	14

One solar demonstration builder/developer reported difficulty in obtaining approval from the building inspector and commented,""Inspector Not Knowledgeable of Solar." Yet, the inspector required separate water tanks on non-demonstration solar projects, indicating an awareness of potential solar-related difficulties.

QUESTION 25: "Were system approvals handled in the normal manner by regulatory personnel or did special considerations prevail? Please explain."

RESPONSES

	NORMAL	OTHER
CYCLE 1	11	1
CYCLE 2	16	0
CYCLE 3	21	3
	48	4

Observations and Comment

Four (4) of the fifty-two (52) local building code officials interviewed (8%) indicated that non-demonstration solar approvals were handled in a special way. Two local building code officials reported extra reviews and discussions were needed with the builder/developer; one local building code official required the contractor to be bonded; and one official turned the review over to a "Mechanics' Department" (details unspecified).

QUESTION 26: "Was special training needed for regulatory staff or field inspectors?"

RESPONSES

	NO	YES
CYCLE 1	11	1
CYCLE 2	16	1
CYCLE 3	18	5
	45	7

Observations and Comment

Seven (7) of the fifty-two (52) local building code officials interviewed (approximately 13%) indicated that special training was needed. The majority of the reasons cited was to obtain general familiarity with solar systems. This perceived need increased substantially during the interviews conducted during the Cycle 3 time frame, perhaps indicating that as the local building code official becomes more involved with solar systems he recognizes a need to be better informed. Four (4) local building code officials indicating no special training required for non-demonstration solar sites, reported that training was needed for the solar demonstration sites (Question 14).

QUESTION 27: "Were job inspections handled in a normal way or by special personnel? Please explain."

RESPONSES

	NORMAL	OTHER
CYCLE 1	12	0
CYCLE 2	14	0
CYCLE 3	23	1
	49	1

Observations and Comment

Forty-nine (49) of the fifty (50) local building code officials interviewed (98%) indicated that the non-demonstration solar sites were handled normally.

QUESTION 28: "Were any additional job site inspections necessary?"

RESPONSES

	NO	YES
CYCLE 1	11	1
CYCLE 2	13	3
CYCLE 3	13	9
	37	13

Observations and Comment

Thirteen (13) of the fifty (50) local building code officials interviewed (26%) indicated that additional job site inspections were necessary on non-demonstration solar sites. Eight (8) of the thirteen (13) responded similarly for the solar demonstration program (Question 12). However, twelve (12) local building code officials who indicated that no additional site inspections were necessary for non-demonstration solar installations responded that additional site inspections were required for the solar demonstration projects.

The reasons cited for additional non-demonstration site inspections are tabulated by frequency:

Water Test	6
Unfamiliarity with System	3
Problems with Supporting Structure	2
Storage and Structural	1
Unspecified	1
	13

QUESTION 29: "Did it take longer to process the solar application than it would have for conventional property?"

QUESTION 30: "If the time factor was increased, would this hold true for future residential applications using solar energy systems?"

RESPONSES

Question 29

	NO	YES
CYCLE 1	11	1
CYCLE 2	13	4
CYCLE 3	15	8
	39	13

Question 30

	NO	YES	NO RESPONSE
CYCLE 1	1	0	0
CYCLE 2	0	3	1
CYCLE 3	3	4	1
	4	7	2

Observations and Comment

Thirteen (13) of the fifty-two (52) local building code officials responding (25%) indicated that it takes longer to process solar applications than to process applications for conventional property. In addition, seven (7) of these local building code officials responded that the increased processing time is expected to continue. The reasons cited for longer process times for solar applications are as follows:

Initial Solar Installations Require Close Inspections	8
Extra Plumbing Inspection	2
Need to Ascertain Performance Levels	1
Need to See Plan	1
Unspecified	1
	13

7.1 Conclusions

7.1.1 Non-Demonstration Assessments

The results for each question in this Section are summarized graphically in Figure 8 and discussed below.

1. Approximately sixty-four percent (64%) of the local building code officials interviewed indicated that they also had processed permits for non-demonstration solar units in their jurisdictions. Builders/developers involved in the solar demonstration program, however, cited problems in obtaining approvals from the local building code official in jurisdictions that had never processed a solar application before, as well as with local building code officials that had experience with non-demonstration solar installations in their jurisdictions.

2. A small number of local building code officials reported waivers being requested by non-demonstration solar builders/developers and these waivers were granted.

3. Twenty-eight percent (28%) of the local building code officials indicated that design changes were required of non-demonstration solar builders/developers in their jurisdictions. These design change requirements imply an interplay between the builder/developer and the local building code official and may account for the relatively few waivers requested by non-demonstration solar builders/developers.

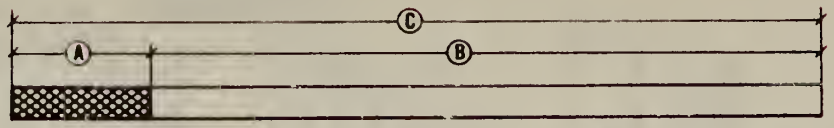
4. System approvals for non-demonstration solar installations were generally handled in a normal manner, although some review and discussion was held with the builder/developer.

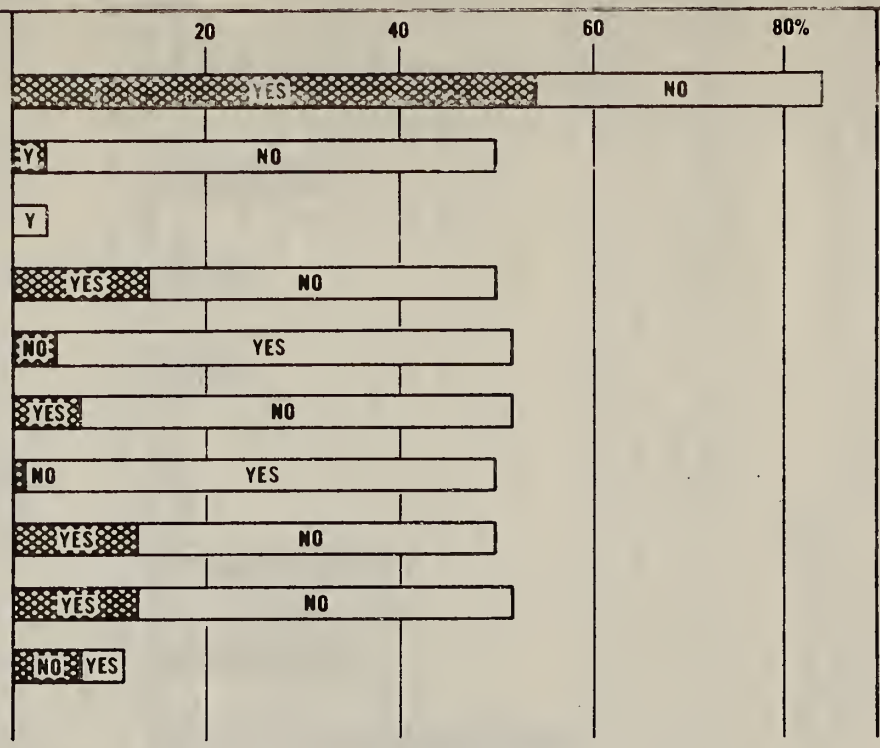
5. Specific training, basically to obtain general familiarity with solar systems, was reported by approximately thirteen percent (13%) of the local building code officials.

6. For non-demonstration solar installations, the local building code official reported that with few exceptions, site inspections were handled in a normal manner. However, twenty-six percent (26%) of these local building code officials also acknowledged that additional site inspections were necessary to become more familiar with the solar systems and to run additional tests.

7. Twenty-five percent (25%) of the local building code officials indicated that it took longer to process solar applications and over one-half of these officials had the opinion that the process time for solar applications would continue to be longer than for conventional units because of the checking and testing of additional equipment involved in solar systems.

BUILDING CODE AND SOLAR SYSTEMS APPLICATIONS IN GENERAL





	Ⓐ	Ⓑ	Ⓒ
21. HAVE YOU PROCESSED PERMITS FOR OTHER SOLAR UNITS ?	54	30	84
22. WERE WAIVERS REQUESTED FOR SOLAR SYSTEMS ?	3	47	50
23. WERE WAIVERS GRANTED ?	0	3	3
24. WERE DESIGN CHANGES REQUIRED ?	14	36	50
25. WERE SYSTEM APPROVALS HANDLED NORMALLY ?	4	48	52
26. WAS SPECIAL TRAINING NEEDED ?	7	45	52
27. WERE SITE INSPECTIONS HANDLED NORMALLY ?	1	49	50
28. WERE ADDITIONAL SITE INSPECTIONS NECESSARY ?	13	37	50
29. DID IT TAKE LONGER TO PROCESS SOLAR APPLICATIONS ?	13	39	52
30. WOULD THE PROCESS TIME BE NORMAL IN THE FUTURE ?	7	4	11

Figure 8

7.1.2 Comparison of Solar Demonstration and Non-Demonstration Data

The RERC questionnaire asked identical questions of the local building code official regarding his views relative to "Experience with Demonstration Program" (Section 6, Questions 10 through 18) and "Building Code and Solar Systems Applications in General" (Section 7, Questions 22 through 30). These paired questions, in effect, allow a comparison to be made that is more meaningful than each of the individual responses separately.

The results of the comparison is indicated in Figure 9 and plotted in percentage form to normalize the data. In reviewing Figure 9, the following observations are offered:

1. The percentage of site locations where waivers were requested is comparable for solar demonstration and non-demonstration solar sites and this percentage is low (5-6%). If a waiver is requested, it appears that the chances of having the waiver granted is excellent. However, note that the percentages shown for granted waivers are based on a very small sample size.

2. The percentage of local building code officials requiring design changes varied from twenty percent (20%) for solar demonstration site locations to twenty-eight percent (28%) for non-demonstration solar site locations. The lower percentage for solar demonstration sites may be due to the Federal presence on the demonstration program which may have inherently selected better designed systems during the preliminary evaluation and review process. On the other hand, these differences simply may be caused by variations in the sample sizes.

3. The number of local building code officials indicating special handling of system approvals was in the range of ten percent (10%); both for the solar demonstration and non-demonstration solar installations.

4. The handling of site inspections was very similar for solar demonstration sites and non-demonstration solar sites. A very small percentage of local building code officials handled these site inspections in a special manner; however, approximately one-quarter of the local building code officials reported additional site inspections required. In several cases, the reason given for these additional site inspections was the need to become familiar with the solar installations, while in other cases the additional site inspections were conducted for the purpose of running plumbing or other physical tests.

5. Approximately one-quarter of the local building code officials responding indicated that for both the solar demonstration and the non-demonstration solar installation, the solar application

COMPARISON OF NON-SOLAR
AND SOLAR DEMONSTRATION DATA

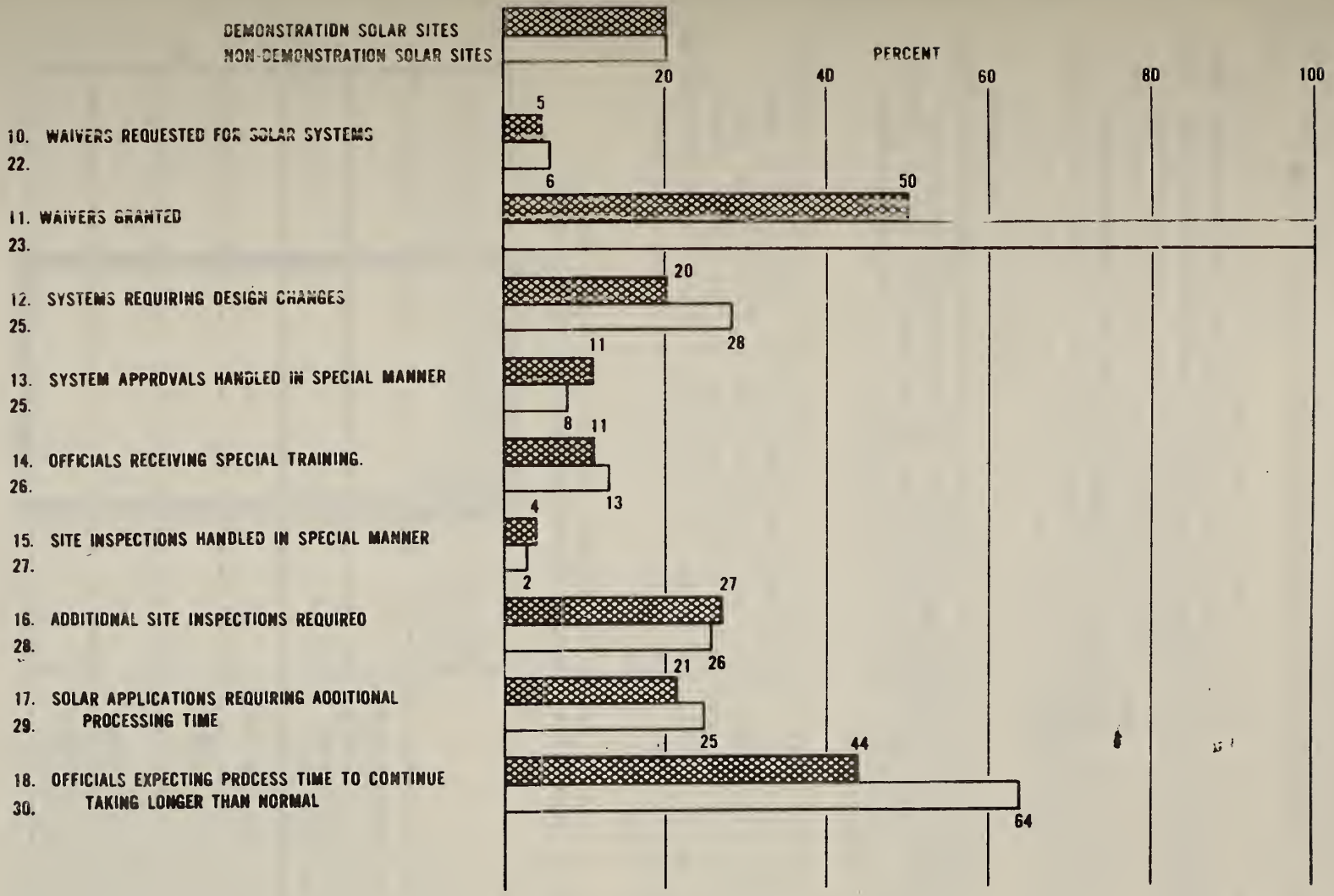


Figure 9

required additional processing time; and approximately one-half of the local building code officials having this view expect that this process time will continue to take longer than normal.

7.1.3 The Solar Demonstration/Non-Demonstration Approval Process

Questions 19 and 20 indicate that the vast majority of local building code officials felt that the approval process was not influenced by the Federal presence on the demonstration program, and that the process used would not differ for non-demonstration solar sites. Because of the identical questions asked of the local building code officials for the demonstration sites (Questions 12 through 17) and non-demonstration solar installations (Questions 24 through 29), this perception of equal treatment can be tested.

The methodology used is to select only the responses for those local building code officials who had experience processing both demonstration and non-demonstration solar applications in their jurisdictions. A comparison is then possible by reviewing the procedures used in processing solar demonstration applications as opposed to non-demonstration solar applications.

In order to make this comparison, the responses are organized in matrix form in Figure 10, and the paired questions listed along with a short description of the question. The number of the local building code officials responding positively to the question is tabulated. Local building code officials indicating that they processed both demonstration and non-demonstration solar units in a similar manner are tabulated in the center (outlined) column.

POSITIVE RESPONSES RELATED TO THE PROCESSING OF
SOLAR DEMONSTRATION AND NON-DEMONSTRATION INSTALLATIONS

QUESTION		DEMONSTRATION SITES ONLY	BOTH DEMONSTRATION AND NON-DEMONSTRATION SITES	NON-DEMONSTRATION SITES ONLY
12/24	DESIGN CHANGES REQUIRED	4	5	9
13/28	SYSTEM APPROVAL HANDLED IN SPECIAL MANNER	7	1	3
14/26	SPECIAL TRAINING NEEDED	3	5	2
15/27	SITE INSPECTION HANDLED IN SPECIAL WAY	2	1	0
16/28	ADDITIONAL SITE INSPECTIONS NECESSARY	4	8	4
17/29	TOOK LONGER TO PROCESS SOLAR APPLICATIONS	5	7	5
		25	27	23

Figure 10

If the local building code official really treated the solar demonstration sites the same way he treated non-demonstration solar installations, the responses would all fall under the column "BOTH DEMONSTRATION AND NON-DEMONSTRATION SITES." Since the responses are almost divided into thirds, one might conclude:

1. Approximately one-third of the local building code officials having both demonstration and non-demonstration solar installations processed both in a similar manner.

2. Approximately one-third of the local building code officials having both demonstration and non-demonstration solar installations required more emphasis and effort with the solar demonstration sites.

3. Approximately one-third of the local building code officials having both demonstration and non-demonstration solar installations required more emphasis and effort with the non-demonstration solar installation.

8. SOLAR ENERGY SYSTEMS' IMPACT ON BUILDING CODES

This Section contains responses centered on the local building code official's general attitude toward solar energy and building codes. It encompasses Questions 31 through 44 of the RERC questionnaire.

The Section queries the local building code official about any studies that were made in his jurisdiction relative to the impact of solar systems on building codes; elicits the results of these studies; and, the usefulness of studies of this type in general. In addition, it attempts to determine if any code provisions for solar systems are contained in the jurisdiction's existing codes. The local building code official's attitude is solicited concerning organizations which could certify solar systems from a product approval point-of-view, including the need for such certification and the candidate organizations which could provide this service.

Questions also are asked to determine what kinds of solar systems would have problems meeting the code requirements; the specific problems encountered with solar system installation in existing buildings; and, any unique considerations associated with multi-family solar installations as compared to single family units. And finally, responses are provided concerning compliance with the Federal Housing Administration-Minimum Property Standards (FHA-MPS), building code approvals, enabling legislation, and administrative rules.

QUESTION 31: "Does your code contain provisions for solar system installations?"

RESPONSES

	NO	YES
CYCLE 1	16	5
CYCLE 2	19	4
CYCLE 3	34	7
	69	16

Observations and Comment

Sixteen (16) of the eighty-five (85) local building code officials responding (approximately 19%) reported that their jurisdictional codes contained provisions for solar system installations. These are tabulated by frequency:

Sections of Uniform Building Code	8
Solar Not Precluded	1
Basic Plumbing	1
Plumbing Requirement	1
Government Regulations	1
Part of State Code	1
Chapter of Energy Conservation Laws	1
No Explanation Provided	2
	16

A cross-correlation with builders/developers expressing difficulty in obtaining approval from the building inspectors during the planning and construction phase (see Section 3) indicated that three (3) of these demonstration builders/developers were in the sixteen (16) jurisdictions that had solar provisions in their codes.

In reviewing the responses of the local building code officials who required design changes prior to approval (Question 12), approximately nineteen percent (19%) were officials in jurisdictions that had provisions for solar systems and a like percentage were in jurisdictions that had no solar provisions in their local codes.

QUESTION 32: "Has your department studied the question of the potential impact of solar energy systems on the building codes?"

QUESTION 33: "What were the conclusions of the study?"

QUESTION 34: "As a result of this study, have procedures or regulations been modified or changed to facilitate the installation of solar energy systems in residential developments?"

RESPONSES

Question 32

	NO	YES
CYCLE 1	18	2
CYCLE 2	17	6
CYCLE 3	27	11
	62	19

Observations and Comment

Nineteen (19) of the eighty-one (81) local building code officials interviewed (approximately 23%) responded that their departments studied the question of potential impact of solar energy systems on building codes. The conclusions of the study are tabulated below by frequency.

Need Standards Established	6
No Conclusion	6
No Impact	3
Impact of Costs	1
Greater Roof Bearing	1
No Response	2
	19

As a result of these studies, four (4) jurisdictions of the nineteen (19) responding positively to Question 32 (approximately 21%) have modified their procedures to facilitate the installation of solar energy systems.

QUESTION 35: "Would such a study be useful?"

RESPONSES

	YES	NO
CYCLE 1	9	5
CYCLE 2	12	4
CYCLE 3	16	10
	37	19

Observations and Comment

Of the local building code officials who replied that their jurisdictions had not studied the impact of solar systems on building codes, thirty-seven (37) of fifty-six (56) (approximately 66%) indicated that such a study would be useful.

QUESTION 36: "Are you seeking organizational certification (product approval) of a solar energy system as a prerequisite to issuing a building permit?"

QUESTION 37: "To which organization(s) would you look for product approval?"

RESPONSES

	NO	YES
CYCLE 1	16	5
CYCLE 2	16	7
CYCLE 3	36	15
	58	27

Observations and Comment

Twenty-seven (27) of the eighty-five (85) local building code officials interviewed (approximately 32%) indicated that they are seeking organizational certification as a prerequisite to issuing a building permit for solar systems and commented on the type of approval desired. These local building code officials also indicated the organization they would look to for this certification. In addition, five (5) local building code officials not seeking organizational certification indicated their preference if they were to seek such certification. These data are summarized on the next page by type of approval and approving organization.

From the matrix, it can be noted that fourteen (14) of the thirty-two (32) local building code officials (approximately 44%) preferred some type of approved testing as a prerequisite to issuing a building permit. Organizations most supported for product approval are "Any Testing Institute"(approximately 31%) and "IAPMO" (25%). No clear combination of type of approval and approval organization is dominant, with the highest combination (approximately 16%) being "Approved Testing by Any Testing Institute."

SUMMARY OF ORGANIZATIONAL CERTIFICATION DESIRED

ARE YOU SEEKING ORGANIZATIONAL CERTIFICATION?	WHAT TYPE OF APPROVAL IS NECESSARY?	WHAT ORGANIZATION WOULD YOU LOOK TO FOR PRODUCT APPROVAL?							
		ASHRAE	Any Testing Institute	ICBO	State Solar Energy Center	Underwriters' Laboratories	IAPMO	Unspecified	
YES	Approved Testing	2	5	-	1	3	2	1	14
	Building Code Approval	-	2	-	-	1	1	-	4
	IAPMO Product Listing	-	-	-	-	-	3	-	3
	National Minimum Standards	2	1	-	-	-	-	-	3
	Knowledge of System	-	-	2	-	-	-	-	2
	Unspecified	-	-	-	-	-	1	-	1
NO	-	-	2	1	1	-	1	-	5
		4	10	3	2	4	8	1	32

QUESTION 38: "What kinds of solar energy systems would have problems meeting code requirements? Why?"

RESPONSES

	DON'T KNOW	NONE	OTHER
CYCLE 1	6	8	7
CYCLE 2	7	7	8
CYCLE 3	16	18	6
	29	33	21

Observations and Comment

Twenty-one (21) of the eighty-three (83) local building code officials (approximately 25%) indicated that certain types of solar systems would have problems meeting local code requirements. In addition, thirty-three (33) of the eighty-three (83) officials (approximately 40%) said that solar systems would not have problems meeting code requirements in their jurisdictions. The problems identified by twenty-one (21) officials are tabulated by frequency.

Toxic Carriers 5	8
Hydro Systems Using Antifreeze 3	
Unworkable Systems	5
Plastic Tubing	3
Liquid Systems	2
Roof Systems - Structural	1
Free Standing Systems	1
Less than 70% Efficient	1
	21

Eight (8) of the twenty-one (21) local building code officials are concerned with contamination of the potable water supply with some toxic substance--a typical safety concern by a local building code official. On the other hand, five (5) of the local building code officials are concerned with the working or efficiency of the system--a role which may be beyond the normal scope of the local building code official.

QUESTION 39: "Does this jurisdiction require compliance with FHA-MPS?"

RESPONSES

	NO	YES
CYCLE 1	14	4
CYCLE 2	16	6
CYCLE 3	30	6
	60	16

Observations and Comment

Sixteen (16) of the seventy-six (76) local building code officials interviewed (approximately 21%) indicated that their jurisdictions required compliance with the FHA-MPS.* The significance of this question and the responses indicated are of unknown value, but since this question was included in the RERC questionnaire the results are tabulated here for completeness.

*Federal Housing Administration - Minimum Property Standards

QUESTION 40: "Would there be building code problems in retrofitting a solar system in an older structure?"

RESPONSES

	NO	YES
CYCLE 1	10	11
CYCLE 2	8	12
CYCLE 3	12	24
	30	47

Observations and Comment

Forty-seven (47) of the seventy-seven (77) local building code officials interviewed (approximately 61%) indicated building code problems could arise with installation of solar systems in older structures. The reasons offered are tabulated by frequency.

Structural Adequacy	38
Financial Hardship to Connect	2
Need New Water Lines	1
Roof Structure, Storage Placement	1
Unspecified	5
	47

By far, structural adequacy is the largest concern of the local building code official in the installation of solar systems in older structures. A review of Question 12, which queries the local building code official about design changes needed prior to approval, indicates that approximately one-half of the design changes required were due to concern with structural adequacy; however, the units involved with design changes were new and not retrofitted units.

QUESTION 41: "Apart from normal differences, would any unique considerations prevail for a multi-family vs. single family solar residence?"

RESPONSES

	NO	YES
CYCLE 1	14	4
CYCLE 2	14	7
CYCLE 3	30	4
	58	15

Observations and Comment

Fifteen (15) of the seventy-three (73) local building code officials interviewed (approximately 21%) indicated that unique considerations would prevail for a multi-family versus single family solar residence. These considerations are tabulated by frequency.

Problems Multiplied in Multi-Family	4
Central vs. Individual Heating	3
Storage Capacity vs. Use	3
Temp/Heating Adequate	2
Living Area Requirement	1
Fire Hazard	1
Unspecified	1
	15

Although multi-family solar residences often involve unique considerations as compared to single family solar residences, only six percent (6%) of the required design changes needed prior to approval applied to multi-family solar installations, while multi-family installations (garden apartment low-rise, multi-family medium rise, and multi-family high-rise) comprised twenty-three percent (23%) of the site locations for the three cycles studied in this report. Of course, because of the greater complexity associated with multi-family installations, a more comprehensive engineering effort may have been required in the design of these units, thus, requiring fewer design changes by the local building code official.

QUESTION 42: "About how long does it take to get a major building code change approved? Please explain."

QUESTION 43: "Is enabling legislation necessary in order to amend or modify the building code?"

RESPONSES

Question 42

	Less Than 1 Month	3 Months for Local Action	Up to 1 Year Usually	1 to 3 Years	Lengthy State Procedure	Variable
CYCLE 1	0	10	3	2	3	0
CYCLE 2	0	6	7	7	2	0
CYCLE 3	2	14	8	6	5	4
	2	30	18	15	10	4

Question 43

	YES	NO
CYCLE 1	8	10
CYCLE 2	15	7
CYCLE 3	20	17
	43	34

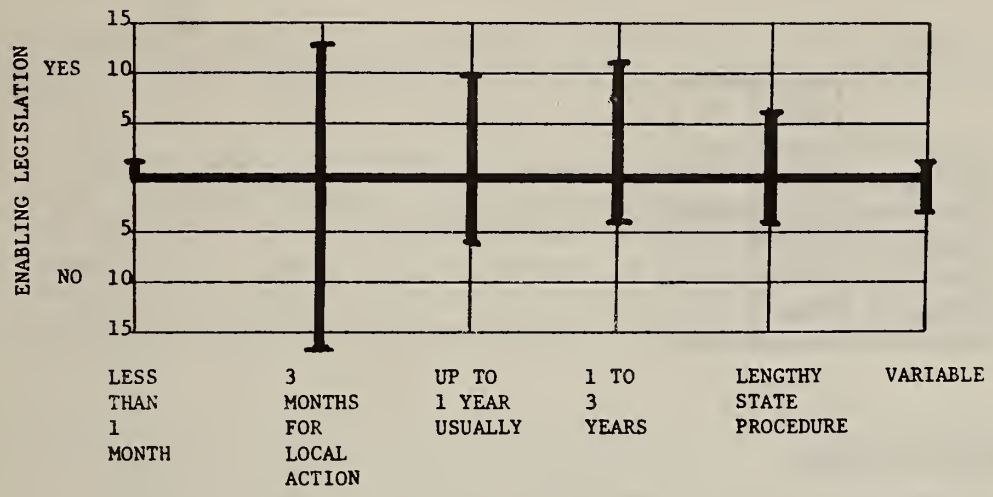
Observations and Comment

The seventy nine (79) responses regarding the time frame required to get a major building code change approved and the seventy-seven (77) responses concerning enabling legislation are tabulated below:

Approval Time	Code Officials Responding	Enabling Legislation	
Less Than 1 Month	2	Yes	2
		No	0
3 Months for Local Action	30	Yes	13
		No	17
Up to 1 Year Usually	18*	Yes	10
		No	6
1 to 3 Years	15	Yes	11
		No	4
Lengthy State Procedure	10	Yes	6
		No	4
Variable	4	Yes	1
		No	3

*2 local building code officials did not respond regarding enabling legislation.

These data are graphically illustrated below:



The highest frequency (mode) for the approval time is the range "3 Months for Local Action" (approximately 38%) and approximately fifty-six percent (56%) of the total jurisdictions responding indicated that enabling legislation is required to amend or modify the building code.

Although these data have been tabulated and cross-correlated, few meaningful conclusions can be drawn from the results. Question 42 addressed "major building code change approvals" but does not define "major." The length of time specified does not signify, "from when." Does enabling legislation have to be re-enacted, is it a one-time occurrence or does it take place each time the jurisdiction wishes to amend the building code?

QUESTION 44: "Are there administrative rules and regulations which could impede the widespread acceptance of solar energy systems in residential development?"

RESPONSES

	NO	YES
CYCLE 1	21	0
CYCLE 2	22	0
CYCLE 3	36	1
	79	1

Observations and Comment

Seventy-nine (79) of the eighty (80) local building code officials interviewed (approximately 99%) indicated that there are no administrative rules which could impede the widespread acceptance of solar energy systems in residential development. However, this is in conflict with the responses to Question 52 where seven (7) of the eighty-four (84) local building code officials responding (approximately 8%) indicated "Administrative Difficulties" as a major barrier which may impede the installation of solar energy systems in their jurisdictions.

8.1 Conclusions

The individual responses to Questions 31 through 44 are summarized in Figure 11. The following observations and comments pertain to these responses.

1. Although some local building code officials reported that the code used in their jurisdictions contains provisions for solar systems, the majority (over 80%) indicated no solar provisions in their local codes. There was no indication that jurisdictions that had adopted such provisions, or jurisdictions that had not adopted such provisions, offered any barriers or advantages to the acceptance of solar installations.

2. Approximately twenty-five percent (25%) of the local building code officials indicated that their departments had studied the question of potential impact of solar energy systems on building codes, and of the remaining seventy-five percent (75%), approximately two-thirds thought such a study would be useful.

3. Approximately one-third of the local building code officials whose departments studied the question of potential impact of solar energy systems on building codes indicated a need for standards. Processing procedures in approximately one-quarter of the jurisdictions have been changed as a result of the solar study.

4. Approximately one-third of the local building code officials indicated that they are seeking organizational certification of solar systems prior to issuing a building permit. Ten (10) of the thirty-two (32) local building code officials responding (approximately 31%) indicated that this certification could be administered by any testing laboratory and showed no organizational preference. However, eight (8) preferred IAPMO; four (4) ASHRAE; four (4) Underwriters' Laboratories, Inc.; three (3) ICBO; and two (2) a State Solar Energy Center.

5. The greatest concern of the local building code officials identifying problems with solar systems meeting code requirements lies in the area of toxic fluids used in these systems. A secondary concern is one with systems which do not work well. This could be an area of controversy since system efficiency is not considered by some to be the purview of the local building code official.

6. Approximately two-thirds of the local building code officials indicated potential building code problems with installing solar systems in older structures; the overwhelming concern being the structural adequacy of the buildings. In addition, approximately twenty-one percent (21%) of the local building code officials

indicated that multi-family solar installations would entail unique considerations from an approval point-of-view, because of the inherent complexity of these larger installations.

7. The amount of time necessary to make a major change to the local building code varies considerably from jurisdiction to jurisdiction, as well as the need for enabling legislation. However, there was a large consensus that there are no present administrative rules and regulations which would impede the widespread acceptance of solar energy systems in residential development.

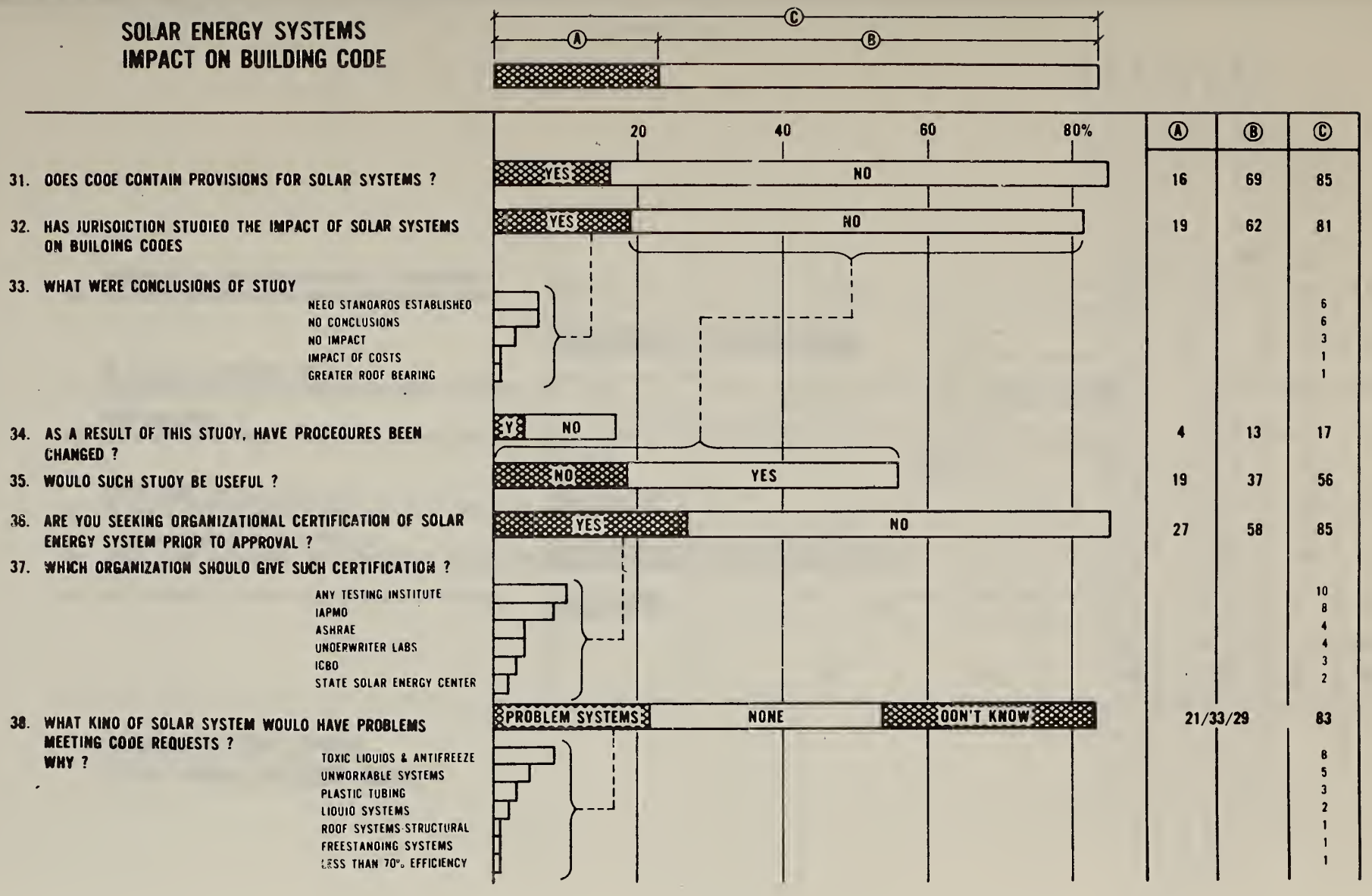

SOLAR ENERGY SYSTEMS
IMPACT ON BUILDING CODE
Ⓒ
Ⓐ
Ⓑ
20
40
60
80%
Ⓐ
Ⓑ
Ⓒ
31. OOES COOE CONTAIN PROVISIONS FOR SOLAR SYSTEMS ?
YES
NO
16
69
85
32. HAS JURISOICTION STUOIEO THE IMPACT OF SOLAR SYSTEMS ON BUILOING COOES
YES
NO
19
62
81
33. WHAT WERE CONCLUSIONS OF STUOY
NEEO STANOAROS ESTABLISHEO
NO CONCLUSIONS
NO IMPACT
IMPACT OF COSTS
GREATER ROOF BEARING
6
6
3
1
1
34. AS A RESULT OF THIS STUOY, HAVE PROCEOURES BEEN CHANGED ?
Y
NO
4
13
17
35. WOULO SUCH STUOY BE USEFUL ?
NO
YES
19
37
56
36. ARE YOU SEEKING ORGANIZATIONAL CERTIFICATION OF SOLAR ENERGY SYSTEM PRIOR TO APPROVAL ?
YES
NO
27
58
85
37. WHICH ORGANIZATION SHOULO GIVE SUCH CERTIFICATION ?
ANY TESTING INSTITUTE
IAPMO
ASHRAE
UNOERWRITER LABS
ICBO
STATE SOLAR ENERGY CENTER
10
8
4
4
3
2
38. WHAT KINO OF SOLAR SYSTEM WOULO HAVE PROBLEMS MEETING COOE REQUESTS ?
PROBLEM SYSTEMS
NONE
OON'T KNOW
21/33/29
83
WHY ?
TOXIC LIOUIOS & ANTIFREEZE
UNWORKABLE SYSTEMS
PLASTIC TUBING
LIOUIO SYSTEMS
ROOF SYSTEMS-STRUCTURAL
FREESTANOING SYSTEMS
LESS THAN 70% EFFICIENCY
8
5
3
2
1
1
1

Figure 11

SOLAR ENERGY SYSTEMS IMPACT ON BUILDING CODE (Cont'd)

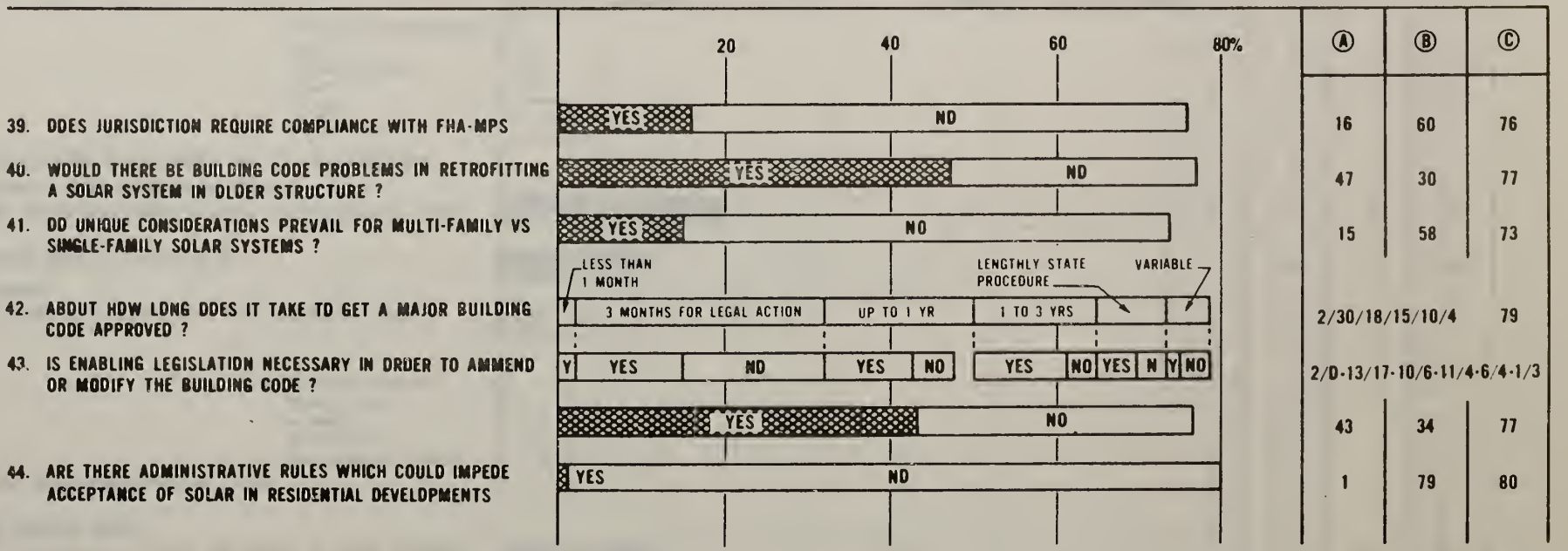


Figure 11

9. BUILDING CODE AND ENERGY CONSERVATION

Questions 45 through 48 include the local building code official's observations relative to the jurisdiction's building code and energy conservation. The local building code official's views are presented regarding the effectiveness of the existing building codes in encouraging or discouraging energy conservation. In addition, other questions address the existence of energy conservation programs within the building department and within other organizations of the city/county government.

QUESTION 45: "Would you say that the existing building code tends to encourage or discourage conservation?"

QUESTION 46: "In what way does the code encourage (or discourage) energy conservation?"

RESPONSES

	ENCOURAGE	DISCOURAGE	NO IMPACT
CYCLE 1	8	1	11
CYCLE 2	10	2	10
CYCLE 3	22	4	16
	40	7	37

Observations and Comment

Forty (40) of the eighty-four (84) local building code officials responding (approximately 48%) indicated that their existing building codes tend to encourage energy conservation. Moreover, seven (7) of the responding building code officials (8%) indicated that their existing building codes tend to discourage conservation, while thirty-seven (37) or approximately forty-four percent (44%) indicated that their building codes have no impact on energy conservation. The reasons cited are tabulated by frequency.

ENCOURAGES ENERGY CONSERVATION

Demands Insulation Factor	34
National Requirements	1
Insulation and Plastic	1
No Reason Given	4
	40

DISCOURAGES ENERGY CONSERVATION

No Insulation Requirements	4
No Financial Incentives for Solar	1
Requires Windows/Heat Loss	1
Demands Insulation Factor	1
	7

One (1) of the local building code officials responding that the code discourages energy conservation cited "Demands Insulation Factor" as the reason. Thirty-four (34) other local building code officials cited the same reason as encouraging energy conservation.

The responses to this question along with the responses to Question 6, the basis for the code used in the jurisdiction, provide an opportunity to determine if any of the code bases particularly encourage or discourage energy conservation. This comparison is presented in the matrix below.

CODE BASIS (FROM QUESTION 6)	ENCOURAGES ENERGY CONSERVATION	DISCOURAGES ENERGY CONSERVATION	NO IMPACT
BOCA	10	-	6
AInA	-	-	1
SBCC	5	-	4
ICBO	18	4	13
IAPMO	1	1	2
NFPA	-	-	1
NEC	-	-	-
STATE	3	-	2
COMBINATION	2	2	3

It can be seen that there are divided perceptions in the local building code official's responses. The same code basis sometimes encourages energy conservation; sometimes discourages energy conservation; and sometimes has no impact. The reasons for these differences could be many--the local jurisdictions may have unilaterally modified the model code to obtain a different effect on energy conservation; the local jurisdictions may not have adopted all the changes of the model code addressing energy conservation; etc. This study does not go into this depth to determine the differences.

QUESTION 47: "Does the building department have an established energy conservation program that it promotes among builders in the area?"

QUESTION 48: "Does an energy conservation program exist within the city/county government?"

RESPONSES

Question 47

	YES	NO
CYCLE 1	4	16
CYCLE 2	6	17
CYCLE 3	4	37
	14	70

Question 48

	YES	NO
CYCLE 1	8	13
CYCLE 2	7	16
CYCLE 3	19	19
	34	48

Observations and Comment

Fourteen (14) of the eighty-four (84) local building code officials interviewed (approximately 17%) indicated that their building departments have established energy conservation programs that are promoted among builders in the area. Thirty-four (34) of the eighty-two (82) local building code officials interviewed (approximately 41%) indicated that an energy conservation program exists within the city/county government. The comments made by these local building code officials are cross-tabulated below.

ENERGY CONSERVATION PROGRAM EXISTS WITHIN CITY/COUNTY GOVERNMENT / BUILDING DEPARTMENT HAS AN ESTABLISHED ENERGY CONSERVATION PROGRAM	NO RELATION TO BUILDING DEPARTMENT	SEASONAL HVAC CUTBACK	STATE PROGRAM	COMPUTERIZED LOAD SYSTEM	SOLAR ENCOURAGED	FOR MUNICIPAL FACILITIES ONLY	CUTBACKS, CITY GOVERNMENT OFFICES	INSULATION REQUIRED BY SAVING AND LOAN	UNSPECIFIED	NO PROGRAM	
STATE LAW FOR ENERGY CONSERVATION										2	2
DEMANDS INSULATION FACTOR	1					1				2	4
CITY ENERGY CONSERVATION ORDINANCE	1									1	2
NATIONAL ASSOCIATION CODE, LOCAL GOALS							1				1
ENERGY AUDITS AND INSULATION	1										1
WATER CONSERVATION										1	1
UNSPECIFIED		1	1						1		3
NO PROGRAM	7	2	8	1	2	2		2	2		26
	10	3	9	1	2	3	1	2	3	6	

The number of responses within the outlined rectangle indicates that eight (8) jurisdictions (20%) have energy conservation programs in both their building department and somewhere else within the city/ county government.

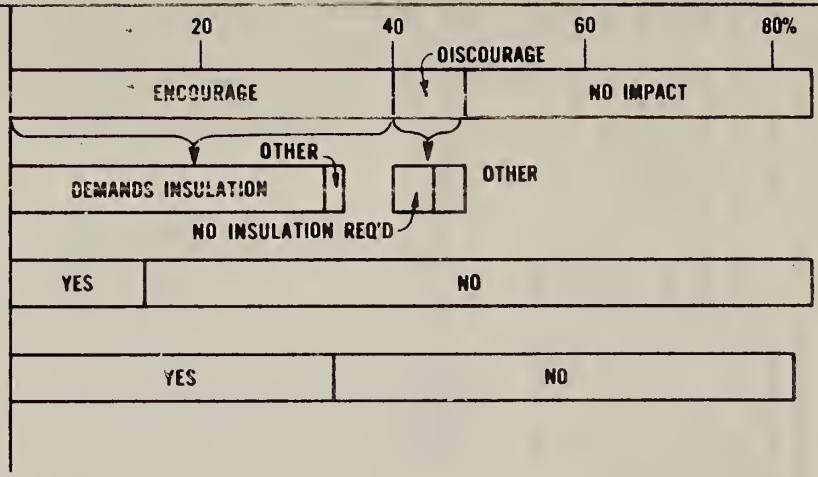
9.1 Conclusions

Figure 12 summarizes the responses for each question in Section 9. The local building code official's observations toward his building code and energy conservation can be stated as follows:

1. Approximately one-half of the local building code officials indicated that their local codes encourage energy conservation and the overwhelming reason is the insulation provisions of the code. Approximately eight percent (8%) of the remaining officials indicated that their local codes tend to discourage energy conservation. The remainder indicated that their jurisdictional codes had no impact on the matter. No particular model code was identified as superior in encouraging or discouraging energy conservation.

2. Only seventeen percent (17%) of the local building code officials reported that their building departments had established an energy conservation program that it promotes among builders in the area. The existence of an energy conservation program within the city/county government was reported by forty-one percent (41%) of the local building code officials responding.

BUILDING CODE AND ENERGY CONSERVATION



45. WOULD YOU SAY THAT THE EXISTING BUILDING CODE TENDS TO ENCOURAGE OR DISCOURAGE CONSERVATION	40	7 37	84
46. IN WHAT WAY DOES THE CODE ENCOURAGE (OR DISCOURAGE) ENERGY CONSERVATION	33 2	4/3	35 7
47. DOES THE BUILDING DEPARTMENT HAVE AN ESTABLISHED ENERGY CONSERVATION SYSTEM ?	14	70	84
48. DOES AN ENERGY CONSERVATION PROGRAM EXIST WITHIN THE CITY/COUNTY GOVERNMENT ?	34	48	82

Figure 12

10. KNOWLEDGE AND ATTITUDES RE: SOLAR ENERGY SYSTEMS

This Section, consisting of Questions 49 through 56, summarizes the response of the local building code official concerning his knowledge and attitude toward solar energy systems.

Addressed is the degree of knowledge that the local building code official and other members of his department have concerning solar energy systems; the educational background and training of personnel available to process applications dealing with solar energy systems; and the information sources used to gain solar energy knowledge. In addition, data are presented regarding the identification of current and future barriers in building codes which might impede the application of solar energy for use in residences. Questions are also asked concerning specific areas where assistance is needed by the local building code official; the kinds of information needed by the local building code official to intelligently process solar applications; and, the organizations relied upon by the local building code official for building code issues related to solar.

These final questions complete the RERC questionnaire concerning the local building code official's responses to the regulatory aspects of the Residential Solar Demonstration Program and other related topics (Reference A5).

QUESTION 49. "How knowlegeable are you and others in your department/ agency about residential solar energy systems?"

QUESTION 50. "What is the educational background and training of the staff available to process applications dealing with solar energy systems in residential development?"

QUESTION 51. "Where did you learn about solar energy systems?"

RESPONSES

Question 49

	VERY KNOWLEDGEABLE	SOMEWHAT KNOWLEDGEABLE	SLIGHTLY KNOWLEDGEABLE	NOT AT ALL KNOWLEDGEABLE	DO NOT KNOW
CYCLE 1	4	7	6	3	1
CYCLE 2	5	9	5	4	0
CYCLE 3	4	16	13	7	1
	13	32	24	14	2

Question 50

	HIGH SCHOOL GRADUATE	NO SPECIAL REQUIREMENT	CONFERENCE TRAINED	STATE CERTIFIED	COLLEGE DEGREE	GENERAL EXPERIENCE	MECHANICAL INSPECTOR WITH HEATING EXPERIENCE	GENERAL EXPERT WITH OUTSIDE CONSULTANTS
CYCLE 1	1	8	2	4	0	6	0	0
CYCLE 2	1	5	1	6	5	3	0	0
CYCLE 3	2	12	3	2	5	12	1	1
	4	25	6	12	10	21	1	1

Question 51

	NEWSPAPERS	POPULAR MAGAZINE	TRADE PUBLICATIONS	PROFESSIONAL JOURNALS	TELEVISION	RADIO	LOCAL EXPERTS	LOCAL SCHOOLS/SEMINARS	ALL OF THE ABOVE	THROUGH CONSTRUCTION	COMBINATION OF ABOVE	EXHIBITIONS	BUILDING CODE MEETINGS	HUD GRANT HOUSE
CYCLE 1	2	1	4	3	0	0	4	4	2	1	0	0	0	0
CYCLE 2	3	1	5	2	0	0	5	2	3	0	0	0	1	0
CYCLE 3	3	4	7	2	1	0	3	5	6	1	1	2	1	2
	8	6	16	7	1	0	12	11	11	2	1	2	2	2

Observations and Comment

Only thirteen (13) of the eighty-five (85) local building code officials (approximately 15%) consider themselves "Very Knowledgeable," while approximately the same number of officials admit to being "Not at All Knowledgeable" about solar energy systems. The remainder fall somewhere in-between. From the wording of the question, "How knowledgeable are you and others. . .," it is unclear if the responses apply directly to the local code official interviewed, or if, indeed, the responses represent an overall characterization of the combined solar knowledge of his department.

Concerning the educational background and training of the staff available to process applications dealing with solar energy systems in residential development, the highest frequency of response was "No Special Requirement" (approximately 31%) with "General Experience" (approximately 26%) next. Only twenty-two percent (22%) of the local building code officials interviewed (those that answered "Conference Trained" and "State Certification") could, perhaps, be considered to have some formal knowledge of solar through training or completion of requirements imposed by the state.

Varied are the sources used by the local building code official to obtain his knowledge of solar energy systems (Question 51). Only eleven (11) of the eighty-two (82) officials (13%) indicated that they had attended local schools/seminars, and an additional eleven (11) indicated "All of the Above," which included local schools/seminars. This brings the total who had specialized training in solar systems to twenty-six percent (26%). Yet, in Question 49, only fifteen percent (15%) of the local building code officials indicated "Very Knowledgeable" as a response. The differences might be explained in that Question 51, "Where did you learn about solar systems," and Question 49 was worded, "How knowledgeable are you and others . . ." Or, the condition could exist that just attending a local school/seminar does not make one very knowledgeable about solar systems.

The responses to these three questions are cross-tabulated in Figure 13. The knowledge, educational background and training, and information as applied to local building code inspectors, is varied. Additional training would certainly be desirable to bring the local building code officials up to the "Very Knowledgeable" level, regardless of the sources used to obtain this expertise. The characteristics of the local building code inspector, as determined from the highest frequency in the matrix (although only a frequency of four (4)) is "he is somewhat knowledgeable, has no special educational background and training, and he learned about solar systems through trade publications."

LOCAL BUILDING CODE OFFICIAL KNOWLEDGE, EDUCATIONAL BACKGROUND AND SOURCE OF INFORMATION

	VERY KNOWLEDGEABLE	SOMEWHAT KNOWLEDGEABLE	SLIGHTLY KNOWLEDGEABLE	NOT AT ALL KNOWLEDGEABLE	DON'T KNOW
HIGH SCHOOL GRADUATE	Trade Publications 1 1		Newspapers 1 Popular Magazines 1 2	Newspapers 1 1	
NO SPECIAL REQUIREMENT	Not Specified 1 1	Local Schools/ Seminars 1 Newspapers 1 Trade Publications 4 Professional Journals 1 All of the Abcve 2 9	Local Experts 2 Trade Publications 2 Professional Journals 1 Newspapers 1 HUD Grant House 1 All of the Above 1 Not Specified 1 9	Newspapers 2 Trade Publications 1 Not Specified 1 4	Local Schools/ Seminars 1 Television 1 2
CONFERENCE TRAINED	Local Schools/ Seminars 1 1	All of the Above 2 Local Schools/ Seminars 1 3	Popular Magazines 1 Local Experts 1 2		
STATE CERTIFICATION	Local Experts 1 All of the Above 1 2	Local Experts 3 Trade Publications 2 5	Professional Journal 1 Local Schools/ Seminars 1 Popular Magazines 1 All of the Above 1 4	Local Experts 1 Professional Journals 1 2	
COLLEGE DEGREE	Trade Publications 1 Local Schools/ Seminars 1 2	Professional Journals 1 Newspapers 1 Through Construction 1 Local Experts 1 Exhibitions 1 5	Trade Publications 1 Local Schools/ Seminars 1 2	Popular Magazines 1 Local Schools/ Seminars 1 2	
GENERAL EXPERIENCE	Local Experts 2 Local Schools/ Seminars 1 3	All of the Above 1 Through Construction 1 Trade Publications 1 Professional Journals 2 Local Experts 1 Local Schools/ Seminars 1 Not Specified 1 8	Building Code Meetings 1 Popular Magazines 1 Combination of Above 1 Trade Publications 2 5	Trade Publications 1 Popular Magazines 1 HUD Grant House 1 All of the Above 1 Exhibitions 1 5	
MECHANICAL INSPECTION WITH HEATING EXPERIENCE	Building Code Meetings 1 1				
GENERAL EXPERIENCE AND OUTSIDE CONSULTANTS		Trade Publications 1 1			

Figure 13

In reviewing the sites where the solar builder/developer commented "Inspector Not Knowledgeable of Solar," the inspector at one such site reported he "was not at all knowledgeable, there was no special requirement regarding the educational background of the staff available to process solar applications, and he learned about solar systems through newspapers." At another site location, the official indicated that he was "somewhat knowledgeable of solar systems, had general building experience and learned about solar through newspapers, popular magazines, trade publications, professional journals, local experts, local schools/ seminars, etc." It could be concluded that contradicting perceptions by the builder/developer can be alleviated if all concerned with solar installations strive to attain, a "Very Knowledgeable" posture, so that decisions could be made as a result of a sound technical background.

One might also wonder whether experience with processing solar systems increases the perceived knowledge level of the local building code official. Tabulated below are the data for Question 49 regarding, "How knowledgeable are you and others in your department/agency?" The data have been separated by those jurisdictions whose local building code officials processed only solar demonstration units (DEMO ONLY) and those whose local building code officials processed both solar demonstration and non-demonstration solar units (DEMO AND OTHER SOLAR UNITS).

	VERY KNOWLEDGEABLE	SOMEWHAT KNOWLEDGEABLE	SLIGHTLY KNOWLEDGEABLE	NOT AT ALL KNOWLEDGEABLE	DO NOT KNOW
DEMO ONLY	3	7	11	10	-
DEMO AND OTHER SOLAR UNITS	10	25	13	4	2
	13	32	24	14	2

As can be noted, the local building code officials whose jurisdiction has processed only solar demonstration units seem to have a lower overall knowledge level of solar systems than those local building code officials who processed both solar demonstration units and non-demonstration solar units.

QUESTION 52: "In your position, what major barriers do you see today regarding building codes which may impede the installation of solar energy systems in your jurisdiction?"

RESPONSES

	ADMINISTRATIVE DIFFICULTIES	HISTORIC PRESERVATION ORDINANCES	NONE	NEED RESEARCH AND DEVELOPMENT	DIMINISHED LOT SIZE	SOLAR RIGHTS ISSUES	COST OF STRUCTURAL IMPROVEMENT
CYCLE 1	2	1	17	0	1	0	0
CYCLE 2	0	1	20	1	0	0	0
CYCLE 3	5	0	30	2	1	1	2
	7	2	67	3	2	1	2

Observations and Comment

Sixty-seven (67) of the eighty-four (84) local building code officials (approximately 80%) indicated that presently there are no major barriers which would impede the installation of solar energy systems in their jurisdictions. Seven (7) officials (approximately 8%) indicated a concern with administrative difficulties; however, in Question 44, only a single local building code official acknowledged that there are "administrative rules and regulations which could impede the widespread acceptance of solar energy systems in residential developments."

QUESTION 53: "What problems do you foresee regarding builing codes for the future application of residential solar energy systems in this jurisdiction?"

RESPONSES

	NONE	DO NOT KNOW	HEIGHT LIMITATIONS	ROOF SUPPORTS	NEW UNIFORM CODE REQUIREMENTS	STRUCTURAL	TOWNHOUSE DEVELOPMENT ON 0 LOT LINE	PRODUCT CERTIFICATION	SUN RIGHTS	LACK OF TRAINING
CYCLE 1	11	1	1	2	2	1	1	1	0	0
CYCLE 2	13	0	0	0	3	3	0	1	0	0
CYCLE 3	28	5	0	1	4	0	0	0	2	1
	52	6	1	3	9	4	1	2	2	1

Observations and Comment

Fifty-two (52) of the eighty-one (81) local building code officials (approximately 64%) indicated that they did not foresee problems in the future with building codes. This may be compared to the approximately eighty percent (80%) who do not have problems with their current codes with regard to solar applications (see Question 52). Of those local building code officials who anticipated problems with building codes for future application of residential solar energy systems, nine (9) officials (approximately 11%) anticipated problems with new Uniform Code Requirements and this is interpreted to mean new provisions developed by a central organization such as a model code group with subsequent adoption by the local jurisdictions. In addition, approximately seven percent (7%) of the local officials did not know if there would be problems or, if there there were problems, what these would be. The rest of the problems identified were miscellaneous in nature.

Seven (7) local building code officials who responded that they are currently having problems also expect problems in the future. Ten (10) local building code officials who are currently having problems apparently expect them to be resolved, while sixteen (16) local building code officials who do not report problems, anticipated problems in the future.

QUESTION 54: "Please identify specific areas where assistance to the building official might be required for solar application."

RESPONSES

	TRAINING EVALUATORS/ INSPECTORS	MANUALS OF ACCEPTED PRACTICE	INSPECTION GUIDELINES	CERTIFICATION	TECHNICAL SUPPORT/ ADDITIONAL STAFF	MODEL CODE/ORDINANCES	ALL OF THE ABOVE	NONE NEEDED	TRAINING AND MANUALS	INSPECTION GUIDELINES AND PRODUCT CERTIFICATION	ALL EXCEPT TECHNICAL SUPPORT	ALL EXCEPT TRAINING/ TECHNICAL SUPPORT	MORE DETAILED SUBMISSION BY BUILDER
CYCLE 1	2	6	2	2	0	1	6	0	0	0	1	1	0
CYCLE 2	5	1	1	0	1	0	11	0	0	0	0	0	0
CYCLE 3	4	2	3	4	0	2	16	1	1	1	4	2	1
	11	9	6	6	1	3	33	1	1	1	5	3	1

Observations and Comment

One (1) of the eighty-one (81) local building code officials reported that no assistance is required to the building code official for solar applications. The types of assistance required of the other eighty (80) local building code officials are tabulated under "Responses." Of these local building code officials who indicated that assistance might be required, forty-one percent (41%) responded, "All of the Above," meaning help is needed with training of evaluators/inspectors, manuals of accepted practice, inspection guidelines, certification, and technical support/additional staff. Other local building code officials not interested in the "package" approach singled out such items as manuals of accepted practice (11%); inspection guidelines and certification (both 7%); and, others as tabulated above.

QUESTION 55: "What specific kinds of information do you need to make a better decision regarding solar systems application in residential development?"

RESPONSES

	TECHNICAL DATA ON FEASIBILITY	MANUALS FOR DIFFERENT SYSTEMS	EFFICIENCY OF SOLAR SYSTEMS	PRODUCT CERTIFICATION AND STANDARDS	NONE NEEDED	KEEP ABREAST OF DEVELOPMENTS	WEIGHT OF MATERIALS	PRODUCT SAFETY	MODEL CODES, INSPECTION GUIDES, ACCEPTED PRACTICES
CYCLE 1	11	5	1	3	0	0	0	0	0
CYCLE 2	7	2	5	4	0	0	0	0	0
CYCLE 3	6	13	3	6	5	5	1	1	1
	24	20	9	13	5	5	1	1	1

Observations and Comment

The specific information needed by the local building code official is tabulated under "Responses," above. The most frequent responses; "Technical Data on Feasibility" (approximately 30%); "Manuals for Different Systems" (approximately 25%); and, "Efficiency of Solar Systems" (approximately 11%); in general, relate to a technical knowledge of the operation of solar systems. Taken together, this indicates that approximately two-thirds of the local building code officials recognize the overall complexity and configuration variations possible with solar systems, and apparently would welcome reliable solar system information. In addition, approximately sixteen percent (16%) of the local building code officials identified a need for "Product Certification and Standards" to make better decisions in processing solar systems. This may be compared to the response in Question 36, which indicated that thirty-two percent (32%) of the local building code officials are seeking product certification as a prerequisite to issuing a building permit.

QUESTION 56: "To which of the following sources would you normally look for building code issues related to solar energy systems? Please rank them by order of importance."

RESPONSES

	TRADE PUBLICATIONS							BANKS							DEVELOPERS							MANUFACTURERS						
RANK	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
CYCLE 1	6	2	2	2	1	-	-	1	1	-	-	-	2	3	1	1	1	-	1	3	1	4	5	2	-	-	-	1
CYCLE 2	7	6	3	2	1	1	-	-	1	-	-	-	2	9	-	2	4	1	-	5	1	2	7	2	6	1	-	-
CYCLE 3	5	6	3	5	2	1	-	-	4	-	-	-	1	10	5	2	2	2	3	3	1	7	8	4	5	4	-	-
	18	14	8	9	4	2	0	1	6	0	0	0	5	22	6	5	7	3	4	11	3	13	20	8	11	5	0	1

	NATIONAL/LOCAL ASSOCIATIONS							UNIVERSITIES AND INDEPENDENT ORGANIZATIONS							GOVERNMENT AGENCIES							
RANK	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	OTHER
CYCLE 1	2	2	5	1	1	-	-	4	3	1	3	2	-	-	4	5	1	1	1	-	-	1
CYCLE 2	2	2	3	4	4	-	-	3	-	4	1	4	3	-	7	3	2	1	1	2	1	0
CYCLE 3	13	8	2	2	1	2	-	4	10	3	5	2	1	-	8	5	5	4	1	3	-	3
	17	12	10	7	6	2	0	11	13	8	9	8	4	0	19	13	8	6	3	5	1	4

Observations and Comment

The data presented under "Responses" have been summarized in Figure 14. to give an integrated view of the sources of information identified. An average rank has been determine by cycle in addition to an overall average rank for each source. The most popular sources used by the local building code official are Trade Publications, Manufacturers, National/Local Associations and Government Agencies, with Universities/ Independent Organizations slightly less favored. If reviewed on a cyclical basis, Trade Publications, Government Agencies, and possibly Manufacturers, have lost some influence in later cycles, while National/ Local Asscciations have increased in rank.

RANKING OF INFORMATION SOURCES USED BY
LOCAL BUILDING CODE OFFICIALS

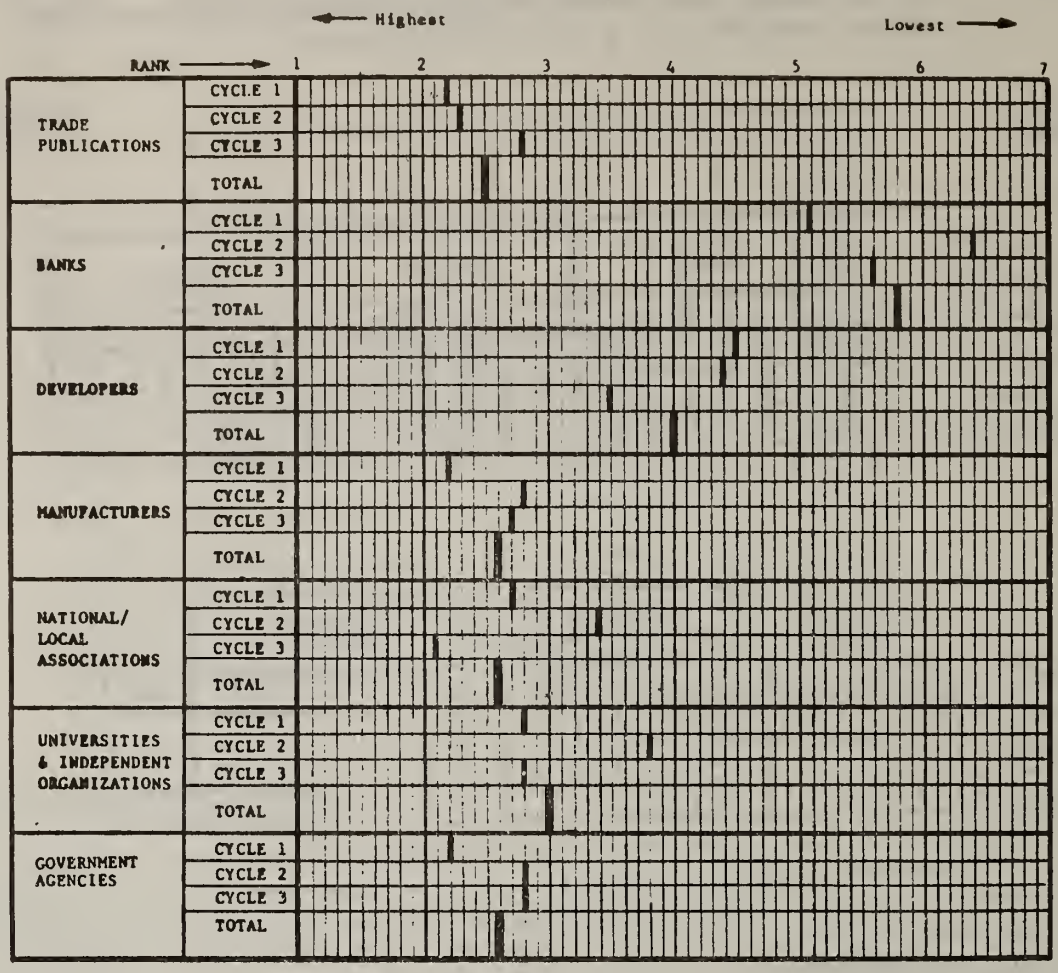


Figure 14

10.1 Conclusions

The individual responses related to each question are shown graphically in Figure 15. A summary of the observations and comments follow:

1. Generally, the knowledge and educational background of the local building code official and the sources of solar energy information available to him vary greatly from jurisdiction to jurisdiction. If the processing of solar applications is to be accomplished more effectively, the code official's knowledge of solar energy systems must be upgraded by education, training, and actual experience.

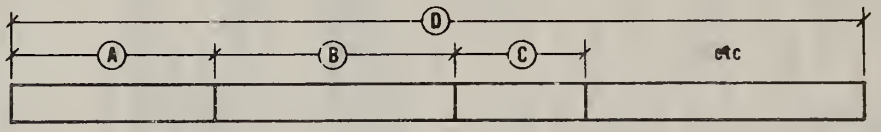
2. Approximately eighty percent (80%) of the local building code officials indicated that there are no major barriers in building codes at present which would impede the installation of solar energy systems in their jurisdictions, while a smaller percentage (approximately 64%) saw no future problems. Those identifying current problems specified administrative difficulties most frequently as the reason for these problems, while anticipated new code requirements and structural concerns were identified by those who expect future problems.

3. Areas of assistance required for processing solar applications include: training of evaluators and inspectors, manuals of accpeted practice, inspection guidelines and certification of equipment and systems.

4. The local building code official identified a variety of technical information needed by him to make better decisions regarding solar systems applications in residential development. These include: technical data and manuals for different systems; solar system efficiency information, and product certification and standards.

5. The sources most depended upon by the local building code official for issues related to solar energy are: trade publications; manufacturer's data; national and local associations; and government agencies. Other important sources are universities and independent agencies. Developers and banks were rated low as a source for solar information.

KNOWLEDGE AND ATTITUDES RE: SOLAR ENERGY SYSTEMS



		A B C etc.	D
49.	HOW KNOWLEDGEABLE ARE YOU AND OTHERS IN YOUR DEPARTMENT/AGENCY ABOUT RESIDENTIAL SOLAR ENERGY SYSTEMS ?	13/32/24/14/2	85
50.	WHAT IS EDUCATIONAL BACKGROUND AND TRAINING OF STAFF AVAILABLE TO PROCESS SOLAR ENERGY SYSTEM APPLICATIONS ?	25/4/12/6/10/21/2	80
51.	WHERE DID YOU LEARN ABOUT SOLAR SYSTEMS ?	17/12/11/9/6/6/1/11/9	82
52.	WHAT MAJOR BARRIERS DO YOU SEE TODAY REGARDING BUILDING CODES WHICH MAY IMPEDE INSTALLATION OF SOLAR ?	67/7/10	84
53.	WHAT PROBLEMS DO YOU FORSEE REGARDING BUILDING CODES FOR THE FUTURE APPLICATION OF RESIDENTIAL SOLAR SYSTEMS ?	52/9/6/4/10	81
54.	PLEASE IDENTIFY SPECIFIC AREAS WHERE ASSISTANCE TO THE BUILDING OFFICIAL MIGHT BE REQUIRED ?	11/9/6/6/1/3/33/10/1	81
55.	WHAT KIND OF INFORMATION DO YOU NEED TO MAKE A BETTER DECISION REGARDING SOLAR APPLICATIONS FOR RESIDENTIAL ?	24/20/9/13/5/9	80
56.	TO WHICH OF THE FOLLOWING SOURCES WOULD YOU NORMALLY LOOK FOR BUILDING CODE ISSUES RELATED TO SOLAR ?		

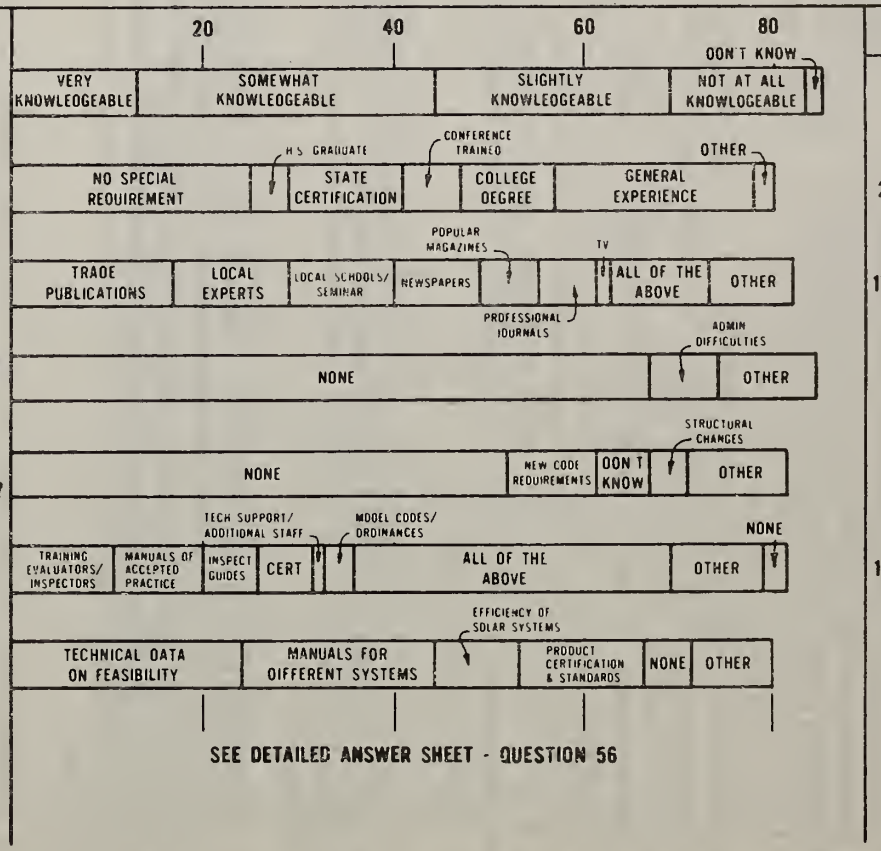


Figure 15

PART IV - ADDITIONAL DATA SOURCES

11. DATA RELATED TO REGULATORY INFORMATION FROM OTHER SOURCES PARTICIPATING IN SOLAR RESIDENTIAL DEMONSTRATION PROGRAM

11.1 General

This Section addresses the data not previously covered. The collection of these data was identified at the start of the program as a possible source of information for this regulatory study. Included in this list are:

(a) Building and Site Description - AIA/RC (Reference B1)
(b) Design Process Data - AIA/RC (Reference B2)
(c) Report #3 - Construction Report - HUD (Reference C1)

Each of these data sources are treated individually.

11.2 American Institute of Architects' Research Corporation (AIA/RC)

Data retrieved from the Design Integration Monitor's Handbook, Rev. II, dated March 3, 1977, which was prepared by the American Institute of Architects' Research Corporation (AIA/RC) was to be included in this report (See Figure 1). Although the Design Integration Monitor's Handbook is oriented primarily to collect technical data and applies only to the instrumented solar demonstration sites, two (2) regulatory questions were identified as being of possible interest to this study.

The first question of interest (Reference B1) is oriented toward the regulatory codes used at these instrumented solar demonstration sites. The second question (Reference B2) asked, "Did the governing building code or other regulations affecting the design of the building specifically relate to the use of solar energy?"

This information, unlike the data presented in the previous Sections, was not included in the NBS Solar Data Base, but rather was retrieved from an examination of the AIA/RC files. As can be noted from the Appendix 1 under the AIA/RC columns (References B1 and B2), the volume of information from this source is generally smaller than the RERC data presented in this report. In effect, the data concerning the regulatory codes (Reference B1) correlate closely to the data shown in Questions 5 and 6 of the RERC questionnaire and the data gathered from the HUD Grantee Reports (discussed in Section 11.3). To avoid redundancy, these data are omitted from this report.

The responses to the other question of interest in the AIA/RC's data collection instrument (Reference B2) are shown below; however, the number of responses are rather small to develop any meaningful conclusions. Only four (4) of the twenty-five (25) grantees (16%) reported that the governing building code or other regulations affected the design of the building relative to the use of solar energy. These are tabulated below. The wording of the question, however, is rather ambiguous and the grantee's responses unclear.

	"Did the governing building code or other regulations affect the design of the building specifically relate to the use of solar energy?"		
	NO	YES	
CYCLE 1	5	0	—
CYCLE 2	16	4	Roof loading psf increased to carry weight of panels Detailing and appearance of collectors FHA Minimum Property Standards and Section 8 No increased insulation
CYCLE 3	0	0	—
	21	4	

11.3 Grantee Reports

The only question of interest identified in the Grantee Reports (Reference C1) relates to the identification of building codes used in the solar demonstration jurisdictions and the national code basis for these local codes. Although all grantees were required to provide these data, Appendix I indicates an availability of approximately sixty-one percent (61%), the remainder not being included in the NBS Solar Data Base. Tabulations concerning these data are included in Appendix III.

APPENDIX I

DATA AVAILABILITY SUMMARY

APPENDIX I

The tables in this appendix present site specific information relative to the Solar Residential Demonstration Program, including availability of regulatory data. The general information tabulated includes:

1. Project Location
   State
   City

2. Grantee

3. Housing Type
   SFD - Single Family Detached
   SFA - Single Family Attached
   GAL - Garden Apartment Low Rise
   MFM - Multi-Family Medium Rise
   MFH - Multi-Family High Rise

4. Construction Type
   New
   Retrofit

5. Number of Units

6. System Type
   H - Heating
   H/C - Heating and Cooling
   W - Hot Water

7. Kind of System
   A - Active
   P - Passive

8. Status of Availability of Codes and Standards Data

Some sites are listed more than once. This occurs within a specific cycle and also between cycles where questions were asked of more than one builder or local code official at a specific location.

The first two columns (References A1 and A2) under availability of data, represent responses from the solar builder/developer of single family units and responses from comparative single family builders/ developers in the same jurisdictions, respectively.

The next two columns (References A3 and A4) represent another set or data pair relative to the multi-family builder/developer and the comparative multi-family builder/developer. The number of data pairs are smaller than those in References A1 and A2. However, this is to be expected because of the smaller number of multi-family sites compared to single family sites in the Solar Residential Demonstration Program.

The final column under the RERC heading (Reference A5) represents those sites where the local building code official was interviewed and consists of responses to fifty-six (56) questions. These responses would be of most value if either References A1 and A2 or References A3 and A4 are also paired with responses from the local building code official (Reference A5). In effect, the combintation A1, A2 and A5 and combination A3, A4, and A5 would give the greatest potential for the correlation of building regulatory issues. This condition occurs in a sufficiently large number of cases, and correlations using these data are presented throughout this report, when appropriate.

The AIA/RC regulatory data are shown in References B1 and B2. These data are limited at best, with no data available for Cycle 3.

The HUD/Boeing regulatory data from the Grantee Reports (Reference C1) list the titles of the local building codes and the national model code bases, if applicable. Although each site would be expected to have a report showing this information, the computer run which was used to present these data was not 100% complete. A summary of the list of applicable codes as reported in the Grantee Reports is shown in Appendix III.

RESIDENTIAL PROGRAM - REGULATORY DATA SUMMARY CYCLE 1

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MFH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
AZ	Tucson	Bobrick Construction Co.	X					X		1		X			X								
CA	Camarillo	Leisure Tech. of CA.		X				X		4			X	X		X	X			X			X
	Mission Viejo	Mission Viejo Co.	X					X		5			X	X									
	Santa Clara	City of Santa Clara	X					X		5	X		X	X		X	X			X			X
	Selma	Self Help Enterprises	X					X		3		X			X								
CO	Arvada	Waverly Homes, Inc.	X					X		2	X		X	X									X
	Aurora	Perl-Mack Enterprises Co.	X					X		1		X	X	X		X	X				X	X	X
	Aurora	Mission Viejo Co.	X					X		5	X		X	X									
	Boulder	Stonbraker Investments			X			X		8	X		X	X									X
	Colorado Springs	City of Colorado Springs			X				X	12		X	X	X									X
	Fort Collins	Solar Engineering Const. Co.	X					X		1	X		X										X
	Fort Collins	ECO-ERA, Inc.	X					X		1	X		X			X	X			X			X
	Pueblo	City of Pueblo	X						X	5	X			X									X
	Westminster	Waverly Homes, Inc.	X					X		1	X			X		X	X			X			X
FL	Coral Gables	Babcock Company	X	X				X		2			X	X		X	X			X			X
	St. Petersburg	City of St. Petersburg			X				X	4			X	X									X
GA	Dacula	Winford Lindsay	X					X		1	X		X	X		X	X			X			X
	Marietta	Christopher David Assoc., Inc.	X					X		3			X	X		X	X			X	X		
	Shenandoah	Peachtree Homes	X					X		1	X		X	X		X	X			X			X
HI	Honolulu	A Frame Industries	X					X		1			X	X		X	X				X	X	X
IL	Vernon Hills	United Development Co.		X				X		4	X		X	X		X	X			X			X
MA	Needham	Saddle Hill Trust	X					X		3	X		X	X		X	X			X	X	X	X
MN	Bloomington	Marvin H. Anderson Const. Co.	X					X		1	X		X	X		X	X			X			X
MT	Browning	The Blackfeet Tribe	X					X		5	X		X	X									
NJ	Blackwood	Korman Corp.	X					X		2	X		X	X		X	X						X

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFH	MFR	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
NJ	Newark	Newark Housing Authority	X	X				X		6	X		X	X									
	Old Bridge	Jespa Enterprises	X					X		1	X		X	X									X
NM	Santa Fe	Wayne Nichols Communico	X					X		1	X		X		X	X	X			X			X
NY	Buffalo	Innovative Building Systems	X					X		1	X		X	X		X	X						X
	Lagrangeville	Solar Structures, Inc.	X					X		1	X		X	X		X	X			X			X
OH	Cleveland	D.C. Winslow Constr. Co.	X					X		1			X	X									
	Columbus	Davidson-Phillips, Inc.	X					X		2		X	X	X		X	X			X	X	X	
OK	Okmulgee	Creeknation Hsg. Auth.	X						X	5	X		X	X									
OR	Ashland	Vincent L. Oredson	X					X		1	X		X	X		X	X						X
PA	Philadelphia	University of PA		X					X	1	X		X	X									X
	Philadelphia	Drexel University			X				X	5			X	X									X
RI	Newport	Church Community Corp.	X					X		1	X		X	X									X
SC	Columbia	Cambridge Dev. Group, Inc.		X				X		4	X		X	X		X	X	X		X			X
	Greenville	Helio Thermics, Inc.	X					X		1		X	X	X		X	X			X			X
TX	Dallas	W. Brown Custom Builders	X					X		2	X		X	X		X	X			X			X
	Lubbock	Gordon Deering	X					X		1	X		X	X									X
	San Antonio	San Antonio Ranch, LTD.	X					X		3		X	X	X									
UT	Salt Lake City	Terracor Utah	X					X		1	X			X		X	X			X			X
VA	Berryville	Ritter Buildings, Inc.	X					X		1		X	X	X		X	X			X			X
	Vienna	The Yeonas Company	X					X		1			X	X		X	X			X			X
	Virginia Beach	Sir Galahad, Co.	X					X		1	X		X	X		X	X			X	X	X	X
WI	Milwaukee	University of Wisconsin	X						X	1	X		X	X									
	Summit	Friedman, Rosen & Zien	X					X		1	X		X	X		X	X			X			X
PR	Rio Pedras	Puerto Rico Urban Renewal Corp.				X		X		12			X	X									X

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MTH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
AL	Huntsville	Chester West, Inc.	X					X		1	X		X	X		X	X			X	X	X	X
CA	Davis	Corbett, Michael N.			X				X	10			X	X				X	X	X			X
	Hemet	Blue-Skies Radiant Homes	X					X		16	X		X	X		X	X			X			X
	Palo Alto	Colorado Park Housing Corp.			X				X	60			X	X									X
	San Bernadino	San Bernadino West Side Comm. Dev. Co.	X						X	10	X		X	X									X
	San Diego	Facilities Development Co.			X			X		31			X	X				X	X	X	X	X	X
CO	Boulder	Naumann, Robert C.		X					X	2	X		X	X	X								X
	Boulder	University of Colorado				X			X	95	X		X	X									X
	Boulder	Wonderland Hill Devel. Co.		X				X		35	X		X	X		X	X			X			X
	Boulder	Bell, Ervin J.	X					X		1	X		X	X									X
	Brighton	Colorado Rural Hsg. Dev. Corp.	X						X	18			X	X									X
	Denver	Brothers Redevelopment, Inc.	X						X	2			X	X									X
	Denver	Perl-Mack Enterprises, Co.	X					X		25	X		X	X							X	X	X
	Evergreen	David L. Vickerman, Inc.	X					X		1	X		X	X		X	X			X			X
CT	New Haven	J. Capone Construction Co.		X				X		10	X		X	X									X
FL	Gretna	Town Council, City of Gretna	X					X		16	X		X	X									
	Winter Park	Florida Gas Co.	X					X		1		X	X	X		X	X			X	X	X	X
GA	Clarkston	F.E. Fortenberry & Sons, Inc.	X					X		2	X		X	X		X	X			X			X
	Dalton	Dalton Housing Authority		X				X		12			X	X									
	Lawrenceville	Fairview Bldrs/Winford Lindsey	X					X		3	X		X	X		X	X						X
	Macon	Kenilworth Manor, Inc.					X		X	80			X	X									X
	S. Wainsboro	Unified Development, Inc.		X				X		3	X		X	X									X
HI	Honolulu	Hawaii Housing Authority			X				X	19			X	X									X
	Honolulu	Hei Wai Wong				X		X		55			X	X								X	X
	Honolulu	Finance Reality Co., Ltd.		X				X		5			X	X		X	X			X			X

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MFH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
IA	West Des Moines	Spence-Urban & Associates	X					X		2	X		X	X	X	X	X			X	X	X	X
ID	Pocatello	TAS Development & Const.	X					X		1	X		X	X		X	X						X
IN	Greenwood	Moulder, Corp.	X					X		1	X		X	X		X	X			X	X	X	X
KS	Overland Park	Du-Mac Investment Co.	X					X		1	X		X	X		X	X			X	X	X	X
	Shawnee Mission	Byram, John C.	X					X		1	X		X	X		X	X			X	X	X	X
LA	Baton Rouge	E. Baton Rouge Parish Hsg. Authority		X					X	2		X	X	X									
MA	Boston	Exec. Office of Comm. and Dev.	X						X	1	X		X	X									
	Marion	Town of Marion		X				X		12	X		X	X									
MD	Columbia	Evans, J.D.	X					X		4	X		X	X		X	X			X	X	X	X
ME	Perry	Pleasant Point Housing Auth.	X						X	1	X		X	X									
MI	Battle Creek	Battle Creek Housing Comm.					X		X	150			X	X									X
	Flint	City of Flint		X				X		6		X	X	X									
MN	Apple Valley	Houston Const., Inc.	X					X		1	X		X	X		X	X			X	X	X	X
	Minneapolis	Creek Associates				X		X		77	X		X	X									
	New Brighton	Gridley Const. Co.	X					X		1	X		X	X		X	X			X			X
MO	Poplar Bluff	Wren, Oscar P., Jr.	X					X		1	X		X	X	X		X				X	X	X
MT	Bigfork	Design Const. Assoc.	X					X		1	X		X	X							X	X	X
NC	Durham	Durham Housing Auth.			X			X		18		X	X	X									
	Winston-Salem	GLS Construction Co.	X					X		5			X	X		X	X						X
NH	East Derry	Fletcher Myer, Inc.	X					X		1	X		X	X		X	X						X
	Harrisville	Total Envir. Action, Inc.	X					X		1	X		X	X	X								X
	North Conway	Kearsarge Building Co., Inc.		X				X		5	X		X	X									
NJ	Dover	Dover Housing Auth.				X			X	61			X	X									X
	New Brunswick	Raritan Valle Comm. Dev. Found.		X				X		8			X	X									
NM	Albuquerque	Albuquerque Western				X		X		101	X		X	X							X	X	X

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MFH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
NM	Albuquerque	Homes by Marilynn	X					X		2	X		X	X		X	X			X	X	X	X
	Santa Fe	Stanley Associates	X					X		1	X		X	X		X	X						X
	Santa Fe	Communico	X					X		1	X		X		X								X
NY	Bronx	Peoples Development Corp.				X			X	28			X	X									X
	Chester	Suntech Homes, Inc.	X					X		1	X		X	X		X	X			X	X	X	X
	Clifton Park	Stewart-Teele-Mitchell Const.	X					X		1	X		X	X		X	X			X			X
	New York	D.W.S. Holdings, Inc.		X				X		6	X		X	X									
	Smithtown	Pinewood Manor, Inc.	X					X		1	X			X									X
OH	Cincinnati	Locke & Strassel, Bldrs.	X					X		1	X		X	X		X	X			X			X
	Cleveland	Forest City Dillion, Inc.				X		X		188			X	X									X
	Youngstown	Homes by Stan-Jim, Inc.	X					X		4	X		X	X									X
OR	North Bend	Twin City Builders, Inc.	X					X		1	X		X	X		X	X			X	X	X	X
PA	Bryn Mawr	Felton, William, Inc.	X					X		1	X		X	X	X	X	X			X			X
	Langhorne	Gigliotti Corp.	X					X		1	X		X	X		X	X						X
	Murrysville	Contemporary Imp. & Exp. Co.		X				X		4	X		X	X									X
SC	Columbia	Phillips, Kauric, Adams & Branham		X				X		12	X		X	X									X
	Greenville	Helio Thermics, Inc.	X					X		6	X		X	X							X	X	X
	Hilton Head Island	Solar Development Assoc.	X					X		1	X		X	X		X	X						X
TX	Austin	College Houses			X				X	80		X	X	X							X	X	X
	Austin	Univ. of Texas/Austin			X				X	12		X	X	X									
VA	Calverton	J. & J. Const., Inc.	X					X		1	X			X									
UT	Waitsfield	Greenmoss Builders, Inc.	X					X		1	X		X	X	X	X	X				X	X	X
WA	Seattle	WA Natural Gas Co.	X					X		1	X		X	X		X	X			X	X	X	X
WI	Birchwood	William C. Burokk	X					X		1	X		X	X	X	X	X				X	X	X
	Sheboygan	Kuck, Theodore A.	X					X		1	X		X	X		X	X			X			X

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MFH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
AL	Mobile	Edsel, Inc.	X					X		1	X		X	X									
AZ	Prescott	Hullco Const. Co.	X					X		1	X				X	X	X			X			X
	Prescott	Ray L. Hasse	X					X		1	X		X	X		X	X						X
CA	Davis	John Delapp Design & Const.	X					X		1	X		X	X	X								
	Escondido	Ortiz & Reill Developers	X					X		12	X		X	X		X	X			X			
	Irvine	Creative Real Estate Dev., Inc.	X					X		2	X		X	X			X			X			X
	Los Angeles	L & S Operating Co.					X		X	317	X		X	X									
	Monterey	Mar-Mac Development, Inc.	X					X		2	X		X	X		X				X			X
	Occidental	Sunhouse Des. & Env. Des.	X					X		2	X		X	X	X								
	Ramona	San Diego Estates & Gas & Elec. Co.	X					X		1	X		X	X		X	X			X			X
	Santa Rosa	Monticito Pines Ltd. Partnership			X			X		76	X		X	X				X	X	X			
	Winters	Living Systems & Jonathan Hamond	X					X		2		X	X	X	X	X	X						
CO	Boulder	CO Sunworks Partnership	X					X		1	X		X		X								
	Boulder	Douglas E. Myers	X					X		1	X		X	X									X
	Brighton	CO Rural Housing Dev. Corp.	X					X		8	X		X	X	X								
	Denver	Gutrich Dev. Co., Inc.	X					X		1	X		X	X									
	Denver	JMC Co. & Charles Schaffier Assoc.	X	X				X		28	X		X	X		X	X			X			
	Ft. Collins	Sunland Realty, Inc.	X					X		1	X		X	X									
	Granby	Grand County Fuel & Supply Co.	X					X		1	X		X	X									X
	Littleton	Witkin Homes, Inc.	X					X		1	X		X	X									X
	Salida	United Construction of CO	x					x		2	x		x	x									x
CT	New Haven	Utility Electrical Contractors			X				X	52	X		X	X									
	New Haven	Frank Chapman			X			X		5			X	X					X	X			X
	Unionville	William Francini	X					X		1	X		X	X		X	X			X			X
	Vernon	The Madrid Group	X					X		1	X		X	X		X	X						X

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MFH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
DE	Wilmington	Bestfield Builders		X				X		14			X	X									
FL	Daytona Beach	Embry-Riddle Aero Univ.				X			X	186			X	X									X
	Gainsville	Matt D. Cannon			X			X		4	X		X	X				X	X	X			X
	Gainsville	Univ. of Florida			X				X	8			X	X									
	Hialeah	Hialeah Housing Auth.	X						X	25			X	X									X
	Kissimmee	Kissimmee Court Apts.			X				X	87			X	X									X
GA	Decatur	Harbor Oaks Apartments			X				X	40	X			X									X
HI	Honolulu	Diamond Head Alii Corp.				X			X	54			X	X									X
IA	Glenwood	Glenwood Hsg., Inc.			X			X		8	X		X	X									
ID	Pocatello	Idaho State University				X			X	160			X	X									
	Rexburg	Cascade Construction, Ltd.	X					X		1	X		X	X									
IL	Addison	Found. For the Handicapped			X			X		22	X		X	X									
	Highland Park	Robert M. Roloson, Arch.	X					X		1	X		X	X									X
IN	Auburn	Graber Homes, Inc.	X					X		1	X		X	X		X	X			X			X
	Batesville	Steinkamp and Co.	X					X		1	X		X	X		X	X			X			X
	Chandler	Trica Corporation		X				X		8	X		X	X		X				X			X
	Cumberland	R & R Builders, Inc.	X					X		1	X		X	X		X	X			X			X
	Greenwood	Ron Smith Custom Bldr., Inc.	X					X		1	X		X	X		X							X
	Indianapolis	Historic Landmarks Foundation of IN	X						X	1			X	X									X
	Liberty	Miles-Richmond, Inc.	X					X		1	X		X	X									X
	Mexico	W.J. Leffel Construction	X					X		1	X		X	X		X	X						
	Muncie	Vernon O. Freeman	X					X		1	X		X	X									
	Terra Haute	Stan Peebles & Co.	X					X		1	X		X	X		X	X			X			
KS	Louisburg	Ed Thomas & Associates	X					X		5	X		X	X		X	X			X			
KY	Lexington	Whitman & Associates, Inc.	X					X		1	X		X	X									

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MFH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
KY	Lexington	Philip Sims		X				X		2	X		X	X									
MA	Arlington	Friends' Community Devel.			X			X		69	X		X	X									
	Boston	Barratt Mountain	X					X		2	X		X	X		X	X						
	Bourne	Sundman Reality Co.	X					X		1	X		X	X									
	Chestnut Hill	Oak Street Associates				X			X	91	X		X	X									
	Falmouth	Laura L. Baker		X				X		5	X		X	X									
	Gloucester	Gloucester Hsg. Auth.				X			X	97			X	X									X
	Milton	John M. Corcoran & Co.			X			X		24			X	X									
	Norwell	R.L. Seaberg Assoc.		X				X		1	X		X	X	X		X						
	Quincy	Corcoran, Mullins, Jennison, Inc.		X				X		2	X		X	X									X
	Quincy	Hancock House Realty Trust				X			X	92			X	X									X
	Raynham	Raynham Housing Auth.			X			X		62			X	X									
	Springfield	Landgraf Associates, Inc.	X					X		2	X		X	X									X
	West Springfield	Joseph Real Estate & Dev. Co.	X					X		2	X		X	X		X	X						X
	Worcester	Worcester Polytech. Inst.				X			X	36			X	X									
MD	Baltimore	Centenial Dev. & Bldg. Corp.		X				X		15	X		X	X									
	Jarrettsville	Duerbeck Building Corp.	X					X		1	X		X	X		X	X			X			X
ME	Orr's Island	Aidco Maine Corp.	X					X		1	X		X	X									
	Perry	Pleasant Point Hsg. Auth.	X					X		1	X				X								
MI	E. Lansing	Willowcreek II, Ltd.			X			X		71			X	X									
	Lansing	Sam Eyde Const. Co.	X					X		1	X		X	X	X								
	Union Pier	Sanford & Son, Builders	X					X		1	X		X	X		X	X			X			X
MN	Minneapolis	Hobmar Homes, Inc.	X					X		1	X		X	X	X								
	New Brighton	Gridley Const. Inc.	X					X		2	X		X	X	X								X
	Scandia	Nelson-Lewis Const. Co.	X					X		1	X		X	X		X	X			X			X

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MFH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
MO	Barnhart	Parkton Dev. Co.	X					X		1	X		X	X									X
	Gladstone	Bond Construction Co.	X					X		3	X		X	X		X	X			X			X
	St. Louis	Pantheon Corp.				X			X	112			X	X									
MT	Browning	Blackfeet Indian Tribe			X			X		10	X		X	X									
	Harlem	Fort Belknap Indian Comm.	X					X		5	X		X	X									
	Kalispell	Sun Spec	X					X		1	X		X	X									X
	Lame Deer	Northern Cheyenne Ind. Hsg. Auth.	X					X		5	X		X	X									
NC	Belmont	Habitat 2000, Inc.	X					X		1	X		X	X		X	X			X			
	Fayetteville	L&O Investments, Inc.	X					X		1	X		X	X									X
	Pinehurst	Page Associates, Inc.	X					X		1	X		X	X		X	X			X			X
ND	Grand Forks	Liberty Estates Devel.		X				X		12	X		X	X		X	X			X			
NE	Callaway	Callaway Housing Corp.			X			X		8	X		X	X									
	Lincoln	Peterson Const. Co.	X					X		1	X		X	X		X	X			X			X
	Plattsmouth	Quadro, Inc.		X				X		6	X		X	X									
NH	Keene	Stylecraft Homes, Inc.	X					X		2	X		X	X	X	X	X			X			X
	North Conway	Forest Park Village, Inc.			X			X		12		X	X	X	X								
NJ	Newark	Ferry Street Group NJ Sch. of Arch.			X				X	1			X	X									X
NM	Albuquerque	Public Serv. Co. of NJ	X					X		25	X		X	X		X	X			X			X
	Albuquerque	Sandia Homes, Inc.	X					X		1	X		X	X		X	X			X			
	Santa Fe	Stanley Associates	X					X		1	X		X	X									X
	Santa Fe	Schepps Const. Co.	X					X		1	X		X	X									X
NY	Bronx	S. Bronx Comm. Hsg. Corp.			X				X	8	X		X	X									
	Brooklyn	Sunset Park Redev. Comm., Inc.		X					X	4			X	X									
	Brooklyn	Bedford Stuyvesant Restor. Corp				X			X	10			X	X									
	Forest Hills	Lefrak Org., Inc.					X	X	X	303			X	X									X

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MFH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
NY	New York	Mount Batten					X		X	188			X	X									
	New York	Jefferson Adams Rehab. Co.				X			X	172			X	X									X
	New York	924 West End Avenue, Inc.					X		X	68			X	X									X
	Spring Valley	Pomona Heights, Inc.	X					X		1	X		X	X									
OH	Canton	Alpha Const. Co.	X					X		4	X		X	X		X	X			X	X	X	X
	Columbus	Davidson Phillips, Inc.	X					X		1	X		X	X			X			X			
	Fairfield	Universal Home Builders, Inc.	X					X		2	X		X	X									X
	Findlay	Boyle & Schey Builders	X					X		3	X		X	X									
	Marietta	Sims Brothers Builders, Inc.	X					X		3	X		X	X									X
	Piqua	First Piqua Corp.	X					X		1	X		X	X		X	X			X			
	Troy	Caprice Builders, Inc.		X				X		1	X		X	X									X
	Youngstown	Volpini & Sorice, Bldrs. Found., Inc.	X					X		1	X		X	X		X	X						X
OK	Norman	Moore-Norman Vo.-Tech.	X					X		1	X		X	X									X
	Tulsa	Conners Const. Co., Inc.	X					X		3	X		X	X		X	X			X			
OR	Woodburn	Landura Corp.	X					X		2	X		X	X		X	X			X			
PA	Gladwyne	William Felton, Inc.	X					X		1	X		X	X									
	Lansdale	Regent Valley Builders, Inc.	X					X		2	X		X	X		X	X						
	Mechanicsburg	United Meth. Homes for Aging				X		X		150			X	X									
	Philadelphia	The Fumo-Manfredi Partnership				X			X	9			X	X									
	Washington	Walnut Ridge, Inc.	X					X		1	X		X	X		X	X						
	West Grove	Christopher Shipp Prod.	X					X		1	X		X	X		X	X						X
RI	Jamestown	M. F. Smith Associates	X					X		1	X		X	X		X	X			X			
SC	Greenville	Batesville Prop. Assoc.	X					X		3	X		X	X									X
	Summerville	Everett A. Knight Agency	X					X		2	X		X	X									
SD	Rapid City	Harney Lumber Co.		X				X		9	X		X	X		X	X			X			

PROJECT LOCATION		GRANTEE	HOUSING TYPE					CONSTRUCTION TYPE		NO. OF UNITS	SYSTEM TYPE			KIND OF SYSTEM		STATUS OF AVAILABILITY OF CODES AND STANDARDS DATA							
																RERC					AIA		HUD
STATE	CITY		SFD	SFA	GAL	MFM	MFH	NEW	RETRO		H	H/C	W	A	P	A1	A2	A3	A4	A5	B1	B2	C1
TN	Memphis	Rainey Bros. Const. Co., Inc.	X					X		1	X		X	X		X	X			X			X
	Memphis	Acropolis Joint Venture	X					X		1	X		X	X		X	X						X
TX	Austin	Carl Morris, Custom Bldrs.	X					X		1	X		X	X									X
	Corsicana	Navapro College				X			X	25			X	X									X
	Dallas	Brad Popkin, Inc.	X					X		1	X		X	X									
	El Paso	Lambert & Winton, Inc.	X					X		20	X		X	X		X	X			X			
	Lago Vista	Starr Homes		X					X	3			X	X									
	San Antonio	Housing Auth., San Antonio				X			X	100			X	X									X
UT	Logan	Villatek	X					X		1	X		X	X									
	Salt Lake City	Tios Corporation	X					X		1	X		X	X		X	X			X			
	Salt Lake City	IPK Corporation	X					X		3	X			X		X	X			X			
VA	Falls Church	Balcroft Hills Council Co-Owner				X			X	140			X	X									
	Lynchburg	Solar Structures	X					X		1	X		X	X									X
VT	Burlington	Cathedral Square Corp.				X		X		100			X	X									
WA	Williamsburg	S. M. Nichols Bldr. Inc.	X					X		1	X		X	X		X	X			X			
WI	Baraboo	J.A. Verthein Const. Co.	X					X		1	X		X	X		X	X			X			X
	Eldorado	Robert J. Zimmerman	X					X		1	X		X	X									X
	Milwaukee	Zien Mechnical Const.	X					X		2	X		X	X		X				X			X
	Omro	Family Homes United, Inc.	X					X		5	X		X	X									
	Racine	Lincoln Lutheran Racine, WI, Inc.			X				X	50			X	X									
WV	Clarksburg	City of Clarksburg				X			X	21			X	X									
	Inwood	Middle Creek Invest. Corp.	X					X		6	X		X	X									
DC	Washington	Damascus Land Corp.	X					X		1	X		X	X									X

APPENDIX II

SECTION A

Selected Questions from RERC Data Collection Instruments Relative to Codes and Standards

Appendix Reference	Volume II	
II-A1	Single Family Builder/Developer	Question 21e
II-A2	Comparative Single Family Builder/Developer	Question 17e
II-A3	Multi-family Builder/Developer	Question 20e
II-A4	Comparative Multi-family Builder/Developer	Question 19e
	Volume III	
II-A5	Local Building Code Official	Entire Questionnaire (56 Questions)

21. Did you have any problems with the following during the planning and construction phase of the project?

		Yes	No
a.	Getting construction loans		
	for development	1	2
	for solar houses	1	2
	If yes, please explain _____		
b.	Getting permanent financing		
	for development	1	2
	for solar houses	1	2
	If yes, please explain _____		
c.	Getting zoning approval		
	for development	1	2
	for solar houses	1	2
	If yes, please explain _____		
d.	Getting site plans approved		
	for development	1	2
	for solar houses	1	2
	If yes, please explain _____		
e.	Obtaining approval from building inspectors		
	for development	1	2
	for solar houses	1	2
	If yes, please explain _____		
f.	Getting solar equipment	1	2
	If yes, please explain _____		

II. PHASE OF DEVELOPMENT

A. Construction Phase

Now, I'd like to ask you a few questions about the construction phase of the development and the houses:

17. Did you have any problems with the following during the planning and construction phase of the project?

		Yes	No
a.	Getting construction loans for development	1	2
	If yes, please explain		
b.	Getting permanent financing for development	1	2
	If yes, please explain		
c.	Getting zoning approval for development	1	2
	If yes, please explain		
d.	Getting site plans approved for development	1	2
	If yes, please explain		
e.	Obtaining approval from building inspectors for development	1	2
	If yes, please explain		

20.

		Yes	No
b.	Getting permanent financing		
	for development	1	2
	for solar apt.	1	2
	If yes, please explain		
c.	Getting zoning approval		
	for development	1	2
	for solar apt.	1	2
	If yes, please explain		
d.	Getting site plans approved		
	for development	1	2
	for solar apt.	1	2
	If yes, please explain		
e.	Obtaining approval from building inspectors		
	for development	1	2
	for solar apt.	1	2
	If yes, please explain		
f.	Getting solar equipment	1	2
	If yes, please explain		
g.	Securing servicing for the solar units	1	2
	If yes, please explain		
h.	Securing warrantees for the solar systems	1	2
	If yes, please explain		

Appendix II-A3 - Multi-Family Builder/Developer

II. PHASE OF DEVELOPMENT

A. Construction Phase

Now, I'd like to ask you a few questions about the construction phase of the development and the rental units:

19. Did you have any problems with the following during the planning and construction phase of the project?

		Yes	No
a.	Getting construction loans for development	1	2
	If yes, please explain _____ _____		
b.	Getting permanent financing for development	1	2
	If yes, please explain _____ _____		
c.	Getting zoning approval for development	1	2
	If yes, please explain _____ _____		
d.	Getting site plans approved for development	1	2
	If yes, please explain _____ _____		
e.	Obtaining approval from building inspectors for development	1	2
	If yes, please explain _____ _____		

___/___/_____/_____/_____
(Cycle ident.) (Grant ident.) (Surveyee ident.) (Data Source)

Respondent ID# (Circle one)

Participating Construction Lender	BA	Alternative Utility	BF
Participating Permanent Lender	BB	Local Planning/Zoning Official	BG
Non-Participating Lender	BC	Local Building Code Official	BH
Participating Insurance Co/Agency	BD	Local Tax Assessor	BJ
Auxiliary Utility	BE		

HUD GRANT NO. ____ ____ ____ ____

LOCAL BUILDING CODE OFFICIAL INTERVIEW GUIDE

NAME OF RESPONDENT _____

TITLE _____

NAME OF AGENCY/DEPARTMENT _____

JURISDICTION _____

ADDRESS _____

TELEPHONE _____

DATE OF INTERVIEW _____

NAME OF INTERVIEWER _____

(Detach after completing Interview)

__/__/__ __/__ __/__ __

Real Estate Research Corporation
1101 17TH STREET, N.W. • WASHINGTON, D.C. 20036

LOCAL BUILDING CODE OFFICIAL INTERVIEW GUIDE

INTRODUCTORY STATEMENT

Real Estate Research Corporation is conducting a study of market acceptance of solar energy in residential dwelling units for the U.S. Department of Housing and Urban Development. This research effort is part of a national demonstration program for residential solar heating and cooling. Part of our research is focused on the role of institutions which may or may not be involved in the development of solar energy in residential construction. In order to assess institutional response to solar energy we are talking to representatives of banks, savings and loans, planning and zoning officials, tax assessors, utility companies, and others. Essentially, we are interested in finding out what these institutions think about solar, what impact, if any, solar development would have on the institution, and whether their existing or projected policies would have a material impact on the development of solar.

__/__/__ __/__ __/__ __

LOCAL BUILDING CODE OFFICIAL INTERVIEW GUIDE

I. PROFILE OF BUILDING CODE ADMINISTRATION

1. Where is your department located within the government's organizational structure?

2. This department is part of what level of government?

City	1
City/County	2
Regional	3
Other; specify_____	

3. How many inspectors do you have in the department? _____ EXACT

4. Does your department have (an) established building code(s)?

Yes	1
No	2 (skip to Q.8)
Don't know/not applicable	3 (skip to Q.8)
Did not answer	4 (skip to Q.8)

5. What is (are) the name(s) of the code(s)?

6. On what code(s) is (are) it (they) modeled?

BOCA -- Basic	1
AIA -- National	2
SBCC -- Southern	3
ICBO -- Uniform	4
IAPMO -- Uniform Plumbing	5
NFPA -- NEC and life safety	6
ANSI	7
FHA-MPS	8
Other; specify_____	
Don't know/not applicable	9

7. How closely does (do) your code(s) conform to the model code(s)?

Modeled with some variations	1 (skip to Q.9)
Mandatory minimum	2 (skip to Q.9)
Mandatory	3 (skip to Q.9)
Don't know	4 (skip to Q.9)
Does not apply	5 (skip to Q.9)
Other, specify_____	

8. If not, how are buildings and structures evaluated with regard to public health and safety?

II. EXPERIENCE WITH DEMONSTRATION PROGRAM

Recently, the U.S. Department of Housing and Urban Development provided a local builder with a grant to install a solar system in one (or more) of his residential units.

9. Are you familiar with the solar house(s)/apartment(s) that was (were) built with a federal grant in your jurisdiction?

Yes	1
No	2 (skip to Q.21)

10. Were any waivers requested to accommodate the solar system?

Yes	1
No	2 (skip to Q.12)
Don't know/not applicable	3 (skip to Q.12)
Did not answer	4 (skip to Q.12)
Other; specify	

If yes, please explain _____

11. Were these waivers granted?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify	

Please explain _____

12. Were any design changes required prior to approval?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify	

If "yes", please explain _____

13. Were system approvals handled in the normal manner by regulatory personnel or did special considerations prevail? Please explain.

14. Was special training needed for regulatory staff or field inspectors?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please explain_____
_____
_____

15. Were job site inspections handled in a normal way or by special personnel? Please explain.

16. Were any additional job site inspections necessary?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please explain_____
_____
_____

17. Did it take longer to process the solar application than it would have for conventional property?

Yes	1
No	2 (skip to Q.19)
Don't know/not applicable	3 (skip to Q.19)
Did not answer	4 (skip to Q.19)

Other, specify_____

If "yes", please explain_____
_____
_____

18. If the time factor was increased, would this hold true far future residential applications using solar energy systems?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4

Other; specify_____

Please explain_____
_____
_____

19. Did the fact that the solar unit(s) was (were) funded by a federal grant impact the appraval process?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4

Other; specify_____

If "yes", please explain_____
_____
_____

20. Would the process have differed for a solar unit built outside of the demonstration project?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please explain_____

_____

_____

III. BUILDING CODE AND SOLAR SYSTEMS APPLICATION IN GENERAL

21. Has your office/agency reviewed or processed any applications for building permits for other solar units in this jurisdiction?

Yes	1
No	2 (skip to Q.31)
Don't know/not applicable	3 (skip to Q.31)
Did not answer	4 (skip to Q.31)

If "yes", how many and what type of units were they?_____
_____
_____

22. Were any waivers requested to accommodate the solar system(s)?

Yes	1
No	2 (skip to Q.24)
Don't know/not applicable	3 (skip to Q.24)
Did not answer	4 (skip to Q.24)
Other; specify	

If "yes", please explain_____
_____
_____

23. Were these waivers granted?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify	

Please explain_____
_____
_____

24. Were any design changes required prior to approval?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please explain_____
_____
_____

25. Were system approvals handled in the normal manner by regulatory personnel or did special considerations prevail? Please explain.

26. Was special training needed for regulatory staff or field inspectors?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please explain_____
_____
_____

27. Were job inspections handled in a normal way or by special personnel? Please explain.

28. Were any additional job site inspections necessary?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please explain_____
_____
_____

29. Did it take longer to process the solar application than it would have for conventional property?

Yes	1
No	2 (skip to Q.31)
Don't know/not applicable	3 (skip to Q.31)
Did not answer	4 (skip to Q.31)
Other; specify_____	

If "yes", please explain_____
_____
_____

30. If the time factor was increased, would this hold true for future residential applications using solar energy systems?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

Please explain_____
_____
_____

IV. SOLAR ENERGY SYSTEMS IMPACT ON BUILDING CODE

31. Does your code contain provisions for solar systems installation?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please explain these provisions. (Interviewer obtain copies).

_____
_____
_____

32. Has your department studies the question of the potential impact of solar energy systems on the building code?

Yes	1
No	2 (skip to Q.35)
Don't know/not applicable	3 (skip to Q.35)
Did not answer	4 (skip to Q.35)
Other; specify_____	

33. What were the conclusions of the study? (Interviewer try to obtain copy of study).

_____
_____
_____
_____
_____

34. As a result of this study, have procedures or regulations been modified or changed to facilitate the installation of solar energy systems in residential developments?

Yes	1 (skip to Q.36)
No	2 (skip to Q.36)
Don't know/not applicable	3 (skip to Q.36)
Did not answer	4 (skip to Q.36)
Other; specify_____	

Please explain_____
_____
_____

35. Would such a study be useful?

Yes	1
No	2
Don't know/not applicable	3
Did nat answer	4
Other; specify_____	

36. Are you seeking organizational certification (product approval) of a solar energy system as a prerequisite to issuing a building permit?

Yes	1
No	2 (skip to Q.38)
Don't know/not applicable	3 (skip to Q.38)
Did not answer	4 (skip to Q.38)
Other; specify_____	

If "yes", please explain what type of approval would be necessary:

_____

_____

_____

37. To which organization(s) would you look for product approval?

38. What kinds of solar energy systems would have problems meeting code requirements? Why?

39. Does this jurisdiction require compliance with FHA-MPS?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

40. Would there by building code problems in retrofitting a solar system in an older structure?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please explain_____
_____
_____

41. Apart from normal differences, would any unique considerations prevail for a multifamily vs. single-family solar residence?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please explain_____
_____
_____

42. About how long does it take to get a major building code change approved? Please explain.

Appendix II-A5 (Continued - Local Building Code Official

43. Is enabling legislation necessary in order to amend or modify the building code?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4

Other; specify_____

If "yes", please explain the nature of this legislation and the administrative process_____

_____

_____

_____

44. Are there administrative rules and regulations which could impede the widespread acceptance of solar energy systems in residential development?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4

Other; specify_____

If "yes", please explain_____

_____

_____

_____

V. BUILDING CODE AND ENERGY CONSERVATION

45. Would you say that the existing building code tends to encourage or discourage energy conservation?

Encourage	1
Discourage	2
No impact	3 (skip to Q.47)
Don't know/not applicable	4 (skip to Q.47)

46. In what way does the code encourage (or discourage) energy conservation?

_____
_____
_____
_____

47. Does the building department have an established energy conservation program that it promotes among builders in the area?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please describe the program:_____
_____
_____

48. Does an energy conservation program exist within the city/county government?

Yes	1
No	2
Don't know/not applicable	3
Did not answer	4
Other; specify_____	

If "yes", please describe the program and its relation to the building department:_____
_____
_____

VI. KNOWLEDGE AND ATTITUDES RE: SOLAR ENERGY SYSTEMS

49. How knowledgeable are you and the others in your department/agency about residential solar energy systems?

Very knowledgeable	1
Somewhat knowledgeable	2
Slightly knowledgeable	3
Not at all knowledgeable	4
Don't know	5
Did not answer	6
Other; specify_____	

50. What is the educational background and training of the staff available to process applications dealing with solar energy systems in residential development?

51. Where did you learn about solar energy systems?

Newspaper	1
Popular magazines	2
Trade publications	3
Professional journals	4
Television	5
Radio	6
Other; specify_____	

52. In your position, what major barriers do you see today regarding building codes which may impede the installation of solar energy systems in your jurisdiction?

53. What problems do you foresee regarding building codes for the future application of residential solar energy systems in this jurisdiction?

54. Please identify specific areas where assistance to the building official might be required for solor applications:

(Note to interviewer: cite these as examples)

	Check
Training of Evoluators/Inspectors	1
Manuals of Accepted Proctice	2
Inspection Guidelines	3
Certification	4
Technical Support/Additional Staff	5
Model Codes/Ordinonces	6

Others; please explain_____

_____

_____

55. What specific kinds of information do you need to make a better decision regarding solar systems opplications in residential development?

56. To which of the following sources would you normally look for building code issues related to solar energy systems? Please rank them by order of importance.

	Rank
Trade Publications	____
Banks	____
Developers	____
Manufacturers	____
National/Local Associations	____
Universities & Independent Organizations	____
Government Agencies	____
Other; specify_____	

Note to Interviewer: Obtain copies of all building code regulations and related materials applicable for solar energy systems in residential development.

END OF INTERVIEW

Time elapsed_____

Comments_____

_____

_____

_____

APPENDIX II

SECTION B

Selected Questions from AIA/RC Data Collection Instruments Relative to Codes and Standards

Appendix Reference		
II-B1	Building and Site Description	Page A-2
II-B2	Design Process Data	Page C-11; Question 19

TYPE OF SOLAR SYSTEM INTEGRATION

.. The design is:
( ) a new design
( ) an adaptation of an existing design
( ) a retrofit, original building completed, 19 ___.

REGULATORY CODES

. The applicable codes are:
( ) state
( ) local
( ) other (specify) _____

NAME OF STATE OR LOCAL CODE/REGULATION

		Edition (Year)
. Building	_____	_____
. Mechanical	_____	_____
. Electrical	_____	_____
. Plumbing	_____	_____
. Other	_____	_____

MODEL CODES WHICH ARE THE BASIS FOR REGULATIONS

NOTE: Use abbreviations from below

		Edition (Year)
. Building	_____	_____
. Mechanical	_____	_____
. Electrical	_____	_____
. Plumbing	_____	_____
. Other (specify)	_____	_____

Abbreviations

ICBO - Uniform
BOCA - Basic Building Code
SBCC - Southern Building Code
AIA - National Building Code
HUD - Minimum Property Standards
NON - None
OTH - Other (specify) _____

A - 2

page 2 of 6

Appendix II-B1 - Building and Site Description

BUILDING DESIGN

18. Did the use of solar energy affect the specifications normally used by the builder/developer?
( ) no (go to Q.19) ( ) yes. How were they affected and why?

How: _____

Why: _____

19. Did the governing building code or other regulations affect the design of the building specifically relate to the use of solar energy?
( ) no (go to Q.20) ( ) yes. What was the effect?

_____

_____

20. Did the cost of the solar system affect the design of the building?
( ) no (go to Q.21) ( ) yes. What was the effect?

_____

_____

21. Was energy conservation considered during the design process?
( ) no
( ) yes, the building was designed to require _____% less energy for space heating than buildings normally built by the builder/developer.
Why was this done? Was it a direct result of the use of solar energy?

_____

_____

_____

What techniques, methods, products or devices were used?

_____

_____

_____

( ) yes, other (specify what, why and how) _____

_____

_____

_____

_____

C - 11

Appendix II-B2 - Design Process Data

APPENDIX II

SECTION C

Selected Questions from HUD/Boeing Data Collection Instruments Relative to Codes and Standards

Appendix Reference		
II-C1	Report N. 3, Construction Report	Page 3; Question Qd

Q d. Building Code:

1) Name of Local Building Code: _____

_____

2) Is this code based on a National Model Code:

Yes ( ); No ( )

If "Yes", which Model Code: _____

e. Back-up System Energy.

1) Back-up system energy used. Name & Address of Utility Company or Supplier

a. Gas ( ) _____

b. Electric ( ) _____

c. Fuel Oil ( ) _____

c. Other ( ) _____

Identify type. (Propane, Wood, Coal, etc. _____

3) Rate Structure requested _____

_____

3) Rate Structure granted: _____

_____

4. Current Cost of Fuel Oil or other: _____

5. Experience (including problems, if any) in obtaining back-up energy: _____

_____

_____

_____

_____

_____

_____

_____

_____

Appendix II-C1 - Report No. 3, Construction Report

APPENDIX III

LIST OF APPLICABLE CODES

AS REPORTED IN

GRANTEE REPORT #3

LIST OF APPLICABLE CODES
AS REPORTED IN
GRANTEE REPORT #3

Location	Local Code	National Code Basis
Huntsville, AL	Huntsville City Code	UBC
Prescott, AZ	UBC, UPC	UBC, UPC
Camarillo, CA	UBC	UBC '73
Davis, CA	UBC	UBC
Helmet, CA	UBC	UBC
Irvine, CA	UBC '76	UBC
Monterey, CA	UBC	UBC
Palo Alto, CA	UBC	UBC
Ramona, CA	UBC	UBC
San Bernadino, CA	Residential and Commercial Building Code	EP&S Codes
San Diego, CA	UBC	UBC
Santa Clara, CA	UBC, NEL, UPC	UBC, NEL, UPC
Aurora, CO	UBC	UBC
Boulder, CO	UBC	UBC
Brighton, CO	UBC	UBC
Colorado Springs, CO	Regional Building Code	UBC
Denver, CO	Denver Building Code	UBC
Evergreen, CO	UBC	UBC
Fort Collins, CO	UBC	UBC
Granby, CO	UBC	UBC
Littleton, CO	UBC	UBC
Pueblo, CO	UBC	UBC
Salida, CO	UBC	UBC
Westminster, CO	UBC	UBC
New Haven, CT	State of Connecticut Basic Building Code	BBC
Unionville, CT	State of Connecticut Basic Building Code	BBC
Vernon, CT	Seate of Connecticut Basic Building Code	BBC
Washington, DC	BBC	BBC
Coral Gables, FL	South Florida Building Code	None
Daytona Beach, FL	SBC	SBC
Gainsville, FL	SBC	SBC
Hialeah, FL	South Florida Building Code	UBC, NBC, SBC

Location	Local Code	National Code Basis
Kissimmee, FL	SBC	None
St. Petersburg, FL	SPC, NEL	NEL '75
Winter Park, FL	SBC	SBC
Clarkston, GA	1&2 Family Dwelling Code	UBC, SBC, NBS
Dacula, GA	SBC	SBC
Decatur, GA	National Model Code '67	National Model Code '67
Macon, GA	SBC	SBC
Shenandoah, GA	Coweta County & Shenandoah South Bldg. Code	None
Swainsboro, GA	SBC	SBC
Honolulu, HI	UBC	UBC
West Des Moines, IA	UBC	UBC
Pocatello, ID	UBC	UBC
Highland Park, IL	Lake Forest	BBC
Vernon Hills, IL	BBC	BBC
Auburn, IN	City-County Building Code	1&2 Family Dwelling Code
Batesville, IN	City of Batesville	1&2 Family Dwelling Code
Chandler, IN	UBC	UBC
Cumberland, IN	Shelby County Code	None
Greenwood, IN	1&2 Family Dwelling Code	UBC, SBC, NBC
Indianapolis, IN	Division of Building Dept. of Metro Govt.	None
Liberty, IN	UBC	UBC
Overland Park, KS	BBC	BBC
Shawnee Mission, KS	None	None
Glouster, MA	MA State Building Code	BBC
Needham, MA	MA State Building Code	BBC
Quincy, MA	MA State Building Code	BBC
Springfield, MA	MA State Building Code	BBC
West Springfield, MA	Town of West Springfield Building Code	None
Columbia, MD	BBC	BBC
Jarretsville, MD	BBC	BBC '75
Battle Creek, MI	BBC	BBC
Union Pier, MI	Bainbridge Township Building Code	UBC

Location	Local Code	National Code Basis
Apple Valley, MN	UBC	UBC
Bloomington, MN	MN State Building Code	BBC
New Brighton, MN	MN State Building Code	UBC
Scandia, MN	Village of Osceloa	None
Barnhart, MO	BBC	BBC
Gladstone, MO	City of Gladstone	UBC
Poplar Bluff, MO	BBC	BBC
Big Fork, MT	None	None
Kalispell, MT	MT State Building Code	UBC '76, NEL
Fayetteville, NC	NC Building Code	None
Pinehurst, NC	NC Building Code	BBC, SBC
Winston-Salem, NC	None	None
Lincoln, NE	UBC	UBC
East Derry, NH	BBC	BBC '70
Harrisville, NH	None	None
Keene, NH	BBC	BBC
Blackwood, NJ	BBC	BBC
Dover, NJ	BBC	BBC
Newark, NJ	BBC	BBC
Old Bridge, NJ	BBC	BBC
Albuquerque, NM	City of Albuquerque	UBC
Santa Fe, NM	UBC	UBC
Bronx, NY	New York City Building Code	None
Buffalo, NY	NY State Building Code	None
Chester, NY	NY State Building Code	None
Clifton Park, NY	NY State Building Code	None
Forest Hills, NY	New York City Building Code	None
Lagrangeville, NY	NY State Building Code	None
New York, NY	New York City Building Code	None
Smithtown, NY	NY State Building Code	None
Canton, OH	Stark County	None
Cincinnati, OH	Hamilton County Building Code	None
Fairfield, OH	City of Fairfield Building Code	None
Marietta, OH	Participating H.O.W. Builder	FHA
Troy, OH	None	None
Youngstown, OH	Mahoning County Building Code	None

Location	Local Code	National Code Basis
Norman, OK	NBC	NBC
Ashland, OR	UBC	UBC
North Bend, OR	UBC	UBC
Bryn Mawr, PA	BBC	BBC
Murrysville, PA	Shelby County Code	None
Philadelphia, PA	Philadelphia Building Code '79	BBC
West Grove, PA	BBC	BBC
Newport, RI	BBC	BBC
Columbia, SC	Lexington County Building Code	SBC
Greenville, SC	SBC	SBC
Hilton Head Isle, SC	SBC	SBC
Memphis, TN	City of Memphis	BBC
Austin, TX	City of Austin and Lakeway Municipal Water District	SBC
Corsicana, TX	SBC	SBC
Dallas, TX	UBC	UBC
Lubbock, TX	City of Lubbock	UBC
San Antonio, TX	UBC	UBC
Salt Lake City, UT	UBC	UBC
Berryville, VA	BBC	BBC
Lynchburg, VA	BBC	BBC
Vienna, VA	1&2 Family Dwelling Code	BBC
Virginia Beach, VA	BBC	BBC
Waitsfield, VT	None	None
Seattle, WA	UBC '70	UBC
Baraboo, WI	City of Baraboo Building Code	None
Birchwood, WI	None	None
Eldorado, WI	Applicable WI Codes	None
Milwaukee, WI	Milwaukee Code of Ordinances	None
Sheboygan, WI	WI Uniform Building Code	None
Summit, WI	SE Wisconsin Uniform Building Code	None

NBS-114A (REV. 9-78)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBSIR 79-1957	2. Gov't Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

Analysis of Code Related Responses From the Solar Demonstration Program

5. Publication Date

January 1980

6. Performing Organization Code

7. AUTHOR(S)

Joseph Greenberg

8. Performing Organ. Report No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, DC 20234

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS *(Street, City, State, ZIP)*

U.S. Department of Housing and Urban Development
451 7th Street, S.W.
Washington, D.C. 20410

U.S. Department of Energy
20 Massachusetts Avenue, N.W.
Washington, D.C. 20545

13. Type of Report & Period Covered

Final

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

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

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

This report was prepared jointly for the Department of Housing and Urban Development (HUD) and the Department of Energy (DoE) under activities carried out by the National Bureau of Standards (NBS) relative to the National Solar Heating and Cooling Demonstration Programs. This report documents and analyzes the building regulatory information gathered during the course of the Residential Solar Demonstration Program from inception of the program through September 30, 1978. The report is based primarily on data collected by HUD contractor personnel and are data which have been transmitted to NBS for inclusion in the NBS Solar Data Base. Although not all builders and local code officials participating in the demonstration program were interviewed for this study, the total number of participants interviewed was of sufficient size to postulate trends and draw reasonable conclusions regarding the building regulatory aspects of the program. The report concludes that existing codes do not present a barrier to the installation and acceptance of solar systems; however, code officials need additional training and better back-up material to properly evaluate solar systems.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Building code; code official; demonstration program; institutional constraints; solar builder/developer; solar energy.

18. AVAILABILITY

[x] Unlimited

[ ] For Official Distribution. Do Not Release to NTIS

[ ] Order From Sup. of Doc., U.S. Government Printing Office, Washington, DC 20402, SD Stock No. SN003-003-

[x] Order From National Technical Information Service (NTIS), Springfield, VA, 22161

19. SECURITY CLASS (THIS REPORT)	21. NO. OF PRINTED PAGES
UNCLASSIFIED	153
20. SECURITY CLASS (THIS PAGE)	**22. Price**
UNCLASSIFIED	$11.00

USCOMM-DC