The 1994 Washington State Nonresidential Energy Code: Quality Assurance Program Results

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In April 1994, the State of Washington adopted a Nonresidential Energy Code (NREC), based on ASHRAE/IES standard 90.1-1989. Washington required several important features to be developed prior to Code adoption: (1) a simplified Code; (2) an industry supported implementation plan; (3) support for local governments to enforce the code; and (4) a well-funded, industry based training and technical assistance program.

Beginning in June 1995, a Baseline Awareness Study and a Mid-Term Quality Assurance Review were conducted. More than 600 architects, engineers, and building officials were interviewed for the baseline study, with a goal of determining the effect of marketing and training efforts of the NREC implementation. Forty buildings were evaluated for compliance with the new energy code, including interviews with architects and engineers involved in the construction process. Comparison was made between these compliance levels and the results of the extensive 1991 energy code compliance survey conducted in the three geographic areas targeted for the quality assurance review. In addition, a large number of building officials, designers and contractor-installers were interviewed regarding the impact of the energy code on their business and industry. Their views on the perceived benefits of reviews by third party plans examiners/inspectors and the other support programs targeted to aiding implementation of the code were solicited.

Compliance levels identified at about 50% in 1992 were improved to 94% in the cases where third party review was used, and 55% in other cases. The impact of code enforcement attitudes from building officials was shown to be an important factor in determining levels of compliance in local jurisdictions.

A continuing state-wide sample is planned for mid-1996 to extend the results of this review to the entire state. In addition, an extensive effort will be made to interview most building officials in Washington State in order to assess the impact of training and certification efforts that have been conducted since the introduction of the new energy code.

BACKGROUND

In 1980, the State of Washington adopted a Nonresidential Energy Code (NREC), based largely on ASHRAE 90-75, the current version of ASHRAE's Energy Design Standard at that time. Washington revised the NREC in 1986 to respond to the revised version of the ASHRAE Standard 90-80. Washington added additional lighting revisions in 1990.

The Code Compliance Study

In 1991 and 1992, Ecotope conducted an energy code compliance study of 141 nonresidential buildings in Oregon and Washington (Baylon et al. 1992). The purpose of this study was to provide guidance to the individual states during their consideration of NREC revisions and support of implementation efforts. This review showed that only about 50 percent of the buildings complied with their respective energy codes. Washington State began an effort to enhance the 1986 energy code.

As part of the compliance study, Ecotope made several recommendations: (1) develop significant enhancements to NREC enforcement, particularly in lighting; (2) standardize code language and requirements so that enforcement could be simplified for building officials, especially in small buildings without complex components; (3) provide larger amounts of technical assistance and training to building officials to assess complicated buildings; and (4) provide a prescriptive energy code which does not require large amounts of technical understanding for effective enforcement in lieu of additional training.

At the same time the compliance study was published, the Washington State Building Code Council (WSBCC) was developing it's first draft of a revised energy code. The Council's Technical Advisory Group had produced a draft based largely on ASHRAE/IES Standard 90.1-1989. In light of the study results, the Council refused to adopt the code, citing its complexity and the lack of a comprehensive implementation strategy. Washington then established two addi-

tional committees to tackle the respective issues: an energy code ''Simplification Committee''; and an energy code ''Implementation Committee'' (Madison et al. 1994).

THE SIMPLIFIED NREC

The Code Council asked the Simplification Committee to prepare another draft energy code, and to: (1) reduce the overall volume of the code; (2) more completely address common construction practices; (3) create a separate ''stand alone'' NREC, separating commercial from residential requirements, especially related to HVAC systems and control systems; (4) eliminate superfluous language, design-related guidelines and unenforceable requirements; (5) consider alternative, simpler approaches to achieve the same energy efficiency goals; and (6) maintain the overall energy efficiency levels of the code.

The resulting draft was about half the size of the original draft and also incorporated the following features: (1) separate chapters addressing envelope, mechanical and lighting requirements; (2) adoption of computer simulation compliance methods by reference; (3) multiple explicit prescriptive envelope options; (4) wholesale substitution of a prescriptive standard for mechanical systems; (5) addition of a prescriptive path for lighting; and (6) allowance of building officials to utilize certified Special Plans Examiners/Inspectors (SPE/Is) for energy code review under the provisions of the Uniform Building Code.

In comparison to the 1986 NREC, the new code had fairly modest changes: (1) better thermal performance when using electric resistance heat; (2) slightly better mechanical equipment and motor/drive efficiencies; and (3) lower installed lighting power, especially in office and retail spaces.

The Implementation Plan

The Implementation Committee's tasks were much more complicated and politically volatile. The committee (comprised of about 40 design, construction, utility, enforcement, conservation and regulatory professionals) developed a plan with three major components: (1) training and technical assistance, (2) enforcement support, and (3) quality assurance and evaluation.

The Implementation Committee agreed that training and technical assistance should be managed by a single provider and should include a broad array of products and services. Though completing the Implementation Plan was a significant accomplishment indeed, the document itself is not nearly as significant as the new organizations which resulted from the planning process.

Utility funding of the Implementation Plan was clearly expected by design and construction interests, the WSBCC, regional and state energy policy organizations and building code official organizations. All state utilities, including public utilities, investor-owned electric and natural gas utilities and the Bonneville Power Administration, joined together to form the Utility Code Group (UCG). This non-profit corporation provided the mechanism by which utilities could cooperatively fund, manage and coordinate implementation efforts.

Eleven design, construction and enforcement associations formed Building & Design 2000 (BD2000), another non-profit corporation, with the expectation of providing all training, technical assistance and support materials necessary to support the new NREC. BD2000 offered a unique mechanism for industry groups to work cooperatively toward higher NREC compliance. In essence, these industry groups would accept responsibility for training and education of the construction industry. An extensive Implementation Plan was adopted by the utilities, the industry groups and the code committees. UCG, as an agent for utility funding, was made responsible for providing the services, reviews, and products made necessary by this Implementation Plan.

In accordance with the agreements and the Implementation Plan, an enforcement program was established. This included several important innovations designed to improve overall compliance with the NREC: (1) a voluntary certification program for building officials and other interested parties to provide a trained and certified cadre of individuals demonstrating extensive familiarity with the NREC; (2) a ''third party'' review process, in which permit applicants or building officials have access to certified Special Plans Examiners/ Inspectors to review and enforce the energy code; and (3) utility reimbursement for fees charged by SPE/Is for plan review and/or building inspection.

The program called for extensive quality assurance work during the three year implementation period, followed by an impact evaluation at the end of the implementation period. Quality assurance would focus on quickly assessing the effectiveness of programs so that implementers could make mid-course corrections. Quality assurance would indicate needed improvements and new solutions but would not be punitive in its findings. The impact evaluation would be more openly conclusive and directly comparable to the 1992 code compliance work.

Where We Are Today

Table 1 provides a time line of the products and services performed to date. The remainder of this paper discusses the two primary quality assurance projects—the Baseline Awareness Survey (BAS) and the Mid-Term Quality Assur-

Table 1. *NREC Products And Services*

Product/Description	Provider	Date
Compliance Forms	UCG	Mar 94
Special Plans Examiner Special Inspector Handbook & Fee Schedule	UCG	
First NREC Plans Examiner/Inspector Test (A total of 6 tests have been held to date)	WABO/ICBO	Mar 94
Begin overview classes	BD2000	Mar 94
Begin industry & enforcement Hotline	WSEO	Apr 94
Overview guide published	BD2000	May 94
Begin second phase classes	BD2000/UCG	Oct 94
Complete second phase classes	BD2000	Oct 95
Complete Q/A Baseline Awareness Survey	UCG/PEA/Ecotope	May 95
Technical Reference Manual published	BD2000	May 95
Begin marketing and promotion of services	UCG	Jun 95
Mid-Term Q/A report	Ecotope	Nov 95
Field Guide Published	BD2000	Oct 95
BD2000 and UCG agree to end relationship (UCG becomes funder and provider of training and technical assistance.)	BD2000/UCG	Dec 95
Local Circuit Riders activated for specialized training and technical assistance	UCG	Jan 96
Begin third phase classes	UCG	Jan 96
Plan review/inspection reimbursement level drops to 50 percent	UCG	Jan 96

ance project (MQA)—and how the results indicate the effectiveness of NREC products and services. In some cases, results supported mid-course corrections to the implementation efforts.

THE BASELINE AWARENESS SURVEY

During March and April of 1995, Ecotope served as the overall project manager of the Baseline Awareness Survey (Quaid et al. 1995). The specific research objectives were: (1) assess awareness of the NREC one year after it became effective; and (2) elicit feedback on the use and utility of NREC marketing, training and information products.

Ecotope administered the survey to a random sample of 400 architects, engineers, building officials and their staff, subcontractors, and general contractors who are involved with nonresidential construction in Washington State. The survey contained 31 questions, generally falling into the following categories: (1) demographic and geographic information about the firms; (2) types of equipment, technologies, media and technical assistance materials people use when performing energy code-related duties; (3) awareness of the existence of the NREC; (4) for those who were aware of the code, participation, usage, and an evaluation of current NREC training and technical assistance products and services; and (5) preferences and suggestions for potential new NREC products and services (i.e. any not listed in Table 1).

Addressing the first objective of assessing code awareness, about three-quarters of the sample were aware of the revised NREC (Figure 1). More than one-third of all respondents (38 percent) had participated in some NREC informational activity, with participation being much higher among building officials than private sector professionals (Figure 2).

Figure 1. *Have You Received Any Information on the NREC? (Aided Awareness)*

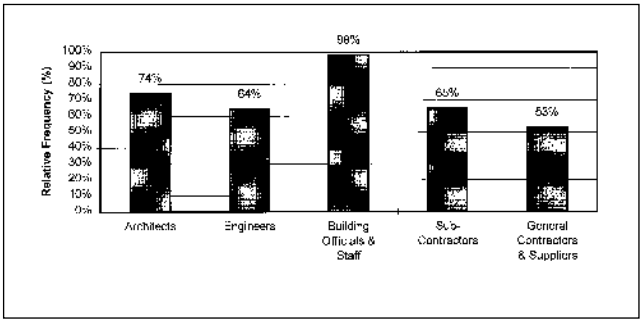
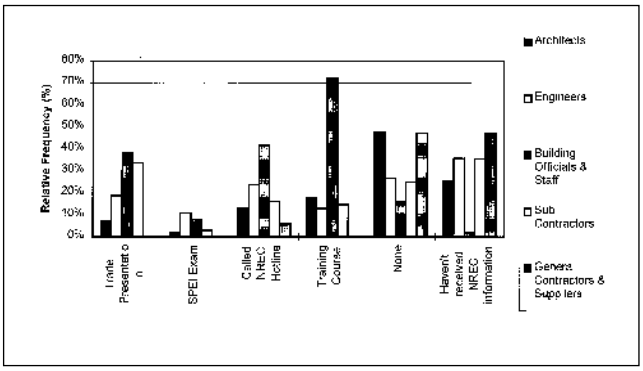


Figure 2. *NREC Activities*



The second goal was to measure the penetration of existing products and services related to the NREC, and to elicit preferences for potential products and services. The results indicated that the building official market had been reached effectively, but the design and construction industry audiences were far from saturated.

Respondents indicated that the single most important piece of information about the energy code was the actual NREC document, although only slightly more than half of those interviewed actually had a copy of the code. Design and construction industry audiences overwhelmingly preferred to receive NREC information from their local building departments. Their second choice for information, and building officials' first choice, was the State of Washington, which included a variety of agencies. Lesser preferred sources, although still modestly significant, were BD2000 and trade associations, with choices varying by industry group.

The top preference for a new product was a reference manual. Approximately 41 percent of the respondents said they would find it very useful (such a document was published by BD2000 about the same time the survey was completed). The second choice was energy code calculation software. This could indicate that energy code calculation software is not readily available, that products are not well known by professionals, or that the building community is not satisfied with existing products.

UCG Actions

The survey highlighted one of the most difficult paradoxes of code compliance—one which is not unique to the NREC. That is, the design and construction communities would most prefer to get code information from the local building department, yet local building departments rarely have the staff to provide this service. UCG is continuing its efforts to provide free and reduced-cost services to the design and construction sectors, as well as additional enforcement tools to jurisdictions. UCG helps to reduce the dependence of industry on building departments for information while simultaneously increasing the ability of building departments to assist customers.

Convenient to UCG, the results of the survey indicating that respondents felt a reference manual would be most useful were determined just after publication of the Nonresidential Energy Code Technical Reference Manual (BD2000, 1995). UCG began an aggressive direct mail and panel advertising campaign to promote this Technical Reference Manual.

THE MID-TERM QUALITY ASSURANCE PROJECT

Ecotope began work on this project in June 1995 (Baylon et al. 1995). UCG's objectives for this project were: (1) provide an initial early assessment of the impact of the Implementation Plan on overall NREC compliance; (2) review compliance and enforcement procedures, particularly in the Special Plans Examiner/Inspector program, in order to assess the overall impact on actual building practices; and (3) assess attitudes and training needs of building officials and their staff and of the design and construction communities with respect to the energy code and enforcement issues.

Methodology

Because the study began approximately one year after the initial implementation date of the NREC, there were substantial limitations on sampling. A total of 40 buildings were targeted in three counties containing 21 jurisdictions. This data set was designed to provide a case study for code implementation. (In part because the implementation dates in these areas were in early April, 1994, which provided an entire year of construction activity to sample. Many jurisdictions delayed implementation until 1995).

Sample Frame. Three areas were targeted for detailed review. Each area had multiple jurisdictions, including county and city building departments. Two of the selected areas (A and B) were located in those counties in Eastern Washington with the largest amount of construction activity, and the last was located in the Western Washington county with the highest number of projects. Unfortunately, many jurisdictions, while nominally implementing the NREC, delayed actual enforcement for up to a year after the initial implementation date. This allowed many important buildings to be permitted under the older code, so that the recruitment process tended to be biased toward buildings that were relatively simple and quick to construct. In general, the recruitment had to limit itself to buildings which were under construction by approximately the first of October, 1994 and substantially completed by June, 1995. As a result, the sample was not considered representative, but did provide a very strong basis for case studies in the areas reviewed.

In Area A, the selected jurisdictions were contrasts in implementation and enforcement strategies. One major jurisdiction had adopted the use of the SPE/I program to provide the basis for all its enforcement efforts at the plans examination level, and the local utility supported all permit applications made under the program. An adjacent jurisdiction had announced that it would not be enforcing the NREC and would require nothing further than an Affidavit of Compliance from the building owner as proof of compliance. This was the most striking example of the variety in attitudes toward enforcement throughout the state.

Building Review. The building review consisted of an abbreviated set of compliance indices which could be addressed while reviewing buildings which had already been completed and occupied. The review focused on lighting and mechanical systems, with secondary emphasis placed on insulation and glazing. These reviews addressed a subset of issues developed in the 1992 Compliance Study, but focused in the main on lighting, lighting systems, and mechanical equipment efficiency and specifications. The envelope and other issues were reviewed where documentation and access were readily available.

For all buildings, permit drawings were reviewed from sets available in the building departments or submitted by the designers and builders. In every case, the plan sets were noticeably incomplete, especially with respect to mechanical equipment efficiency and lighting power density. Following review of the plans, individual buildings were inspected to determine lighting power density and to compare the installed lighting systems with NREC requirements. In effect, this was a detailed energy code inspection of the lighting systems.

Compliance. Table 2 summarizes the compliance findings for the three regions reviewed. As can be seen, 36 of the 40 buildings reviewed were permitted and enforced under the 1994 NREC. The remaining four buildings were actually permitted after the implementation dates due only to delays within the building department. Although it was thought that these buildings were permitted under the 1994 Code, in fact, upon closer examination of permit records it was determined that the buildings were held to the 1991 standards.

The remaining 36 buildings provided a picture of compliance in those jurisdictions reviewed. Those building departments utilizing the SPE/I program showed a 94 percent compliance rate, even if only a portion of the services offered by the SPE/Is were actually used. In jurisdictions where none of the available SPE/I program options were used, the compliance rate was 55 percent. It should be pointed out that the non-compliance rate was dominated by a single jurisdiction in which normal enforcement of the NREC was not attempted and which publicized its acceptance of self-certification widely throughout the building and design community. While this is an important finding, the dominance of this one jurisdiction in the sample distorts the importance of this negative attitude statewide. For the SPE/I jurisdictions, however, performance is more representative of jurisdictions using this strategy, since sampling efforts were made to find those jurisdictions in which the SPE/Is were active. Given recruitment difficulties and time constraints, these jurisdictions represent a very high proportion of all jurisdictions using the SPE/I programs in the State.

Interviews. Interviews were conducted with 76 building professionals, including architects, engineers and contractors; with 24 building officials from 21 jurisdictions; and with SPE/Is active in the various jurisdictions reviewed. The interviews focused on questions which would help explain compliance, and elucidate compliance procedures used in the various jurisdictions. Virtually all the interviews were with parties directly associated with the 40 reviewed buildings. The architect and contractor interviews were conducted with individuals involved with on-site evaluations.

In general, these interviews attempted to review the findings of the 1991/1992 Compliance Study. For the building design professional, the contrast with the 1990 sample was striking. Table 3 shows the difference in energy code feedback between the two groups. Even taking into account the limited sample used in 1995, this finding shows a marked change in the enforcement procedures and attitudes. Even more striking is the contrast between SPE/I-reviewed buildings and the others. The interaction and feedback related to energy code issues had increased by more than a factor of 5 over the 1992 Compliance Study (Baylon, 1992), and was 50 percent greater than those jurisdictions currently using only their own building officials.

Table 2. *Overall Compliance Findings*

Region	N	SPE/I		NREC	
		Comply	Not Comply	Comply	Not Comply
Region A	15	9	1	1	4
Region B	5	2	0	1	2
Region C	16	6	0	8	2
Total	36	17	1	10	8

Table 3. *Buildings with Feedback on Code Compliance*

	All Buildings	SPE/I	1991 Buildings
Feedback on Design	40 percent	61 percent	11 percent
Red Line	10 percent	22 percent	—
Correction Notice	25 percent	28 percent	8 percent

Another area of deviation from the earlier review involved the level of responsibility for energy code compliance taken on by architects. In the 1992 study, one finding suggested that the lack of interaction with the energy code by architects contributed to non-compliance. In this recent sample, 87 percent of the architects took some responsibility to design buildings compliant with the NREC. This usually included a detailed review of the building envelope, and in some cases, design and lighting system compliance information. By contrast, only 40 percent of the architects interviewed in 1991 took any responsibility for complying with the energy code, and those studied provided almost no input on either mechanical or lighting systems to their customers.

A key aspect of the interviews with code officials undertaken in this review was the divergence of attitudes from jurisdiction to jurisdiction, especially from the one jurisdiction which publicly announced that it would not enforce the NREC to the other building departments. In general, the position of the dissenting jurisdiction was that the NREC was a socially- and economically-mandated requirement, and therefore, the responsibility for enforcement should fall to those parties interested in such a social/economic agenda. The building department took the position that it would provide a form to ensure that everyone was aware of the code, but would not spend any of its resources on enforcement. While officials in many other jurisdictions commented on the limited time and budget resources available to devote to NREC enforcement, no other jurisdiction exhibited the same degree of animosity toward its implementation. Even jurisdictions which were noticeably understaffed and provided very limited NREC enforcement did not publicly announce their lack of enforcement procedures. The result was that compliance was only about 30 percent in the dissenting jurisdiction, well below the sample as a whole, and well below the level of compliance observed in that same jurisdiction in the 1992 review. This compares with compliance levels of about 75 percent in the other jurisdictions.

Jurisdictions which elected to use SPE/Is were, in general, quite pleased with the program. There were misgivings about the longevity of the program, since it is known that utility funding is scheduled to end in 1997. However, the higher quality review and reduced workload helped provide confidence in energy code enforcement by building officials. In some cases, jurisdictions using the SPE/I program banded together and shared the services of a single person. This allowed several smaller jurisdictions without the resources necessary to conduct detailed NREC reviews themselves to have access to more in-depth plan review. In larger jurisdictions, the SPE/Is were not as widely used. These building departments were more likely to have one or more of their own employees go through the SPE/I training and certification program.

One issue raised during the initial interviews was the limited availability of time and resources for NREC review. Only the largest jurisdictions had sufficient ability to specialize in their reviews. While the SPE/Is offered some jurisdictions an attractive and effective solution, many jurisdictions felt that the SPE/Is were an unnecessary burden on their clients

and had misgivings about using them. However, publicity about the effectiveness of the SPE/I program on compliance levels has influenced several jurisdictions to begin using this program to ensure compliance while reducing the overall burden on the in-house Plans Examiners.

The most urgent problem found in the earlier review was the need for clear communication among those involved in various levels of energy code enforcement. During the 1992 review, it was learned that it was extremely rare for building inspectors to receive any information about a building's compliance with the NREC before or during the onsite inspection process. In very few jurisdictions was the information required to be shown on plans or permit documents. The 1994 code mandated the use of documentation on the plans and specifications to be available in the building department and at the site. The Implementation Plan provided a set of code compliance forms to be used in documenting compliance. The current review indicates that these documents are being used in lieu of direct documentation on the drawings. This suggests the possibility that architects, engineers and builders might not clearly communicate the energy code requirements in this documentation, and that the review process might not clearly communicate this information to those involved in the inspection process.

This issue was followed up with a series of additional in-depth interviews and reviews of 30 building departments. It became quite clear that energy code compliance documentation had become dominated by the standardized forms, which were used by both the building inspectors and plans examiners. It appears that this procedure has resulted in reasonably good communication between the various levels of building officials and has contributed to better overall compliance.

CONCLUSIONS

While this study did not provide a random sample representing the entire state, it accurately captured the striking contrast in compliance from the 1992 review. It is quite clear that the Implementation Plan has resulted in increased awareness of, concern for, and compliance with the Nonresidential Energy Code throughout the State of Washington. This appears to be causally linked to the large amount of outreach and marketing made by the state's utilities to the building community and building officials to make them aware of the NREC and provide adequate resources and information to allow implementation and enforcement. While several difficulties remain, the overall view is that a focused Implementation Plan which provides resources directly in the form of Special Plans Examiners/Inspectors, training to building officials and designers, and the provision or relatively clear enforcement guidelines for building inspectors can have a dramatic effect on overall energy code compliance.

During 1996, this finding will be tested on a random sample representative of the entire state, which will be coupled with more detailed reviews of building department processes and the impacts of training programs on design professionals and building officials.

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