INTERNAL ELCAP DOCUMENT

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SUMMARY REPORT ASSIGNMENT OF METEOROLOGICAL STATIONS TO ELCAP RESIDENCES

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1.0 INTRODUCTION

One of the objectives of the BPA sponsored End-use Load and Conservation Assessment Program (ELCAP) was to perform a thermal analysis of the metered residences, either singularly or in the aggregate, according to various structure characteristics and/or climate zones. In order to complete this analysis and other analytic activities, hourly data on ambient dry bulb temperature, insolation and wind speed was required for each residence. In the early planning stages of ELCAP, it was recognized that the conventional National Weather Service data would not be applicable to all areas in the Northwest. Therefore, supplementary meteorological stations measuring outdoor temperature, insolation, wind speed and direction, were installed on 55 residences, primarily in data sparse areas (for details on the selection and location of the ELCAP meteorological stations, the reader is referred to Hadley (1987)).

Since it was not possible to instrument every residence with its own meteorological station, it was necessary to identify a meteorological station that would provide reasonable data representative of conditions expected to occur at each of the ELCAP residences. Meteorological stations were limited to the 55 ELCAP stations and 19 National Weather Service (NWS) first order stations in the region. In addition, data from the U.S. Department of Energy Hanford Reservation meteorology station 25 miles NW of Richland, Washington was available. From this assemblage of available stations, an attempt was made to identify a representative meteorological station for each ELCAP residence.

It is the purpose of this report to describe the procedures used in the assignment of meteorological stations to each of the ELCAP residences. Also described are some of the constraints and implications of these assignments.

2.0 METEOROLOGICAL/CLIMATOLOGICAL CONSIDERATIONS

If weather is defined as the instantaneous or short-term summation of the state of the atmosphere (meteorological conditions) at any given point in time and space, significant differences can be expected to exist in the concurrent weather conditions at two locations. These differences are the result of (1) the normal spatial variation in meteorological conditions; (2) the effect of differences in those factors that control the climate; or (3) differences in the local physical environment. These three differences are explained the following paragraphs.

Certain meteorological conditions can result in significant short-term (less than 24 hrs) weather differences in ambient temperature, wet bulb temperatures, insolation and wind speed, even though the two sites are climatologically similar. As an example, isolated summer convective activity will result in overcast conditions, rain showers, lowered temperatures and gusty winds at one location, while at the same time, at another site a few miles away, not affected by the localized convection, it will be sunny and dry. However, over a period of several days, both locations would have an equal opportunity to experience the same type of convective activity. This type of difference is minimized as the data is aggregated over longer time periods.

On the other hand, climate is defined as the long term (10 years or more) integrated effect of the weather. Differences between two sites resulting from differences in one or more of the underlying fundamental climate controls (i.e., latitude, elevation, proximity to large bodies of water) will be evident in longer aggregation period data. The most significant climate control in the northwest is elevation. Each 1000 foot increase in elevation will cause on the average a 3.5°F decrease in air temperature. For example, Richland and Spokane, Washington are subjected to the same general large scale weather phenomenan, yet Spokane, because its elevation is 2000 feet higher, has a mean annual temperature about 5°F cooler and experiences 2200 more heating degree-days (65°F base temperature).

By the very nature of the meteorological variables being measured, the meteorology of each site is uniquely influenced by the local physical environment surrounding the site. Trees, buildings, nearby bodies of water, etc. are micro-scale controls that can modify the prevailing weather. The degree to which data can be successfully transferred to and is applicable to another site depends upon the degree of similarity of the environment between the two sites.

The environment of the NWS site, because of the principle activity of the airport location, is open and free from any local obstruction to air movement. In some respects the local environment has been modified from "natural" conditions for the area exclusive of the airport. The original intent of the weather data obtained at airports was (1) to support the aviation industry with specific terminal weather conditions/forecasts, and (2) to provide data on large-scale weather conditions for general weather forecasts. It was not intended to provide meaningful data to describe small-scale weather/climate variations.

As an example, it is possible to find a greater differences in daily mean temperature between an airport station and a location within the urban environment separated by a few miles, than between two airport stations separated by 100 miles, but within the same climate region. Within the urban environment, ambient temperature and wind speed will be the two parameters most severely modified. The urban heat island will elevate ambient temperatures above those recorded at the airport site while the increased surface roughness, or resistance to wind flow, will decrease wind speed.

3.0 ASSIGNMENT PROCEDURES

A specific set of procedures was developed to quickly and uniformly determine the meteorological station most representative of conditions to be expected at the residence. These procedures are illustrated in the flow diagram shown in Figure 1 and described in detailed below.

Step 1: Identify ELCAP Meteorological Sites and NWS Stations

All ELCAP meteorological stations and NWS stations were identified and their exact locations determined. The NWS stations were restricted to those with hourly surface observations (including cloud cover data) available from the National Climatic Data Center (NCDC), Ashville, North Carolina.

Step 2: Determine Exact Locations of all ELCAP Residences

In order to correctly assign a meteorological station to each residence, the exact location (street address) of each residences was required. This information was obtained from the original ELCAP residential recruiting data base.

Step 3: Assign Residences and Meteorological Stations to Climate Regions

The Northwest was divided into 23 climate regions as delineated in the monthly report "Climatological Data" published by NCDC. The basis for these divisions was primarily on climatological and geographical differences. Each residence and NWS station were assigned to one of the 23 regions. These 23 regions are not the same as the 22 ELCAP recruiting and installation regions, but do overlap with the 3 climate zones defined by the Power Council.

Step 4: Assess Representativeness of Meteorological Sites to Residences

The representativeness of each meteorological station to each residences in the same climate region was assessed. This assessment was based first on the similarity of topography and local physical environment, and second, on the distance between the two sites. This was repeated until all available meteorological stations were examined. In most cases, only two or three stations were available and in some instances, only one stations was available. If other factors were equal, preference was given to an ELCAP meteorological site over a NWS site because of the assumed similarity of the local environment.

Step 5: Assign Primary and Secondary Meteorological Station

From the assessment in step 4, whenever possible, a primary and secondary meteorological station was assigned to the residence. An assignment was made only if it was determined that a suitable meteorological station was available.

4.0 RESULTS

The assignment of a meteorological station as a primary or a secondary site implies a certain degree of similarity in the weather conditions expected to occur at the residence and what is actually recorded at the assigned meteorological station. In the absence of direct measurement or observation, the degree of similarity was subjectively estimated using indirect indicators such as topographic features. A primary assignment should be viewed as having a high degree of similarity, while the secondary site would still be representative, the degree of uncertainty is greater. An assignment was made only if it was judged that the differences between the two sites was minimal. A residence was not assigned a meteorological station (primary or secondary) if an acceptable site could not be identified.

Assignments were made for 447 ELCAP residences. Of these, 20 residences were located such that neither a suitable primary nor a secondary meteorological station could be identified (i.e., John Day, Oregon). Another 37 residences were assigned a primary meteorological station, but not a secondary station (i.e., Klamath Falls, Oregon). In a few instances, a secondary site was identified, but no primary site (i.e., St. Helens, Oregon). In these instances, it was felt that enough differences existed between the residence and the nearest meteorological station that assignment of a primary site was not justified. However, it was judged that there were enough similarities to justify assignment at the second level.

For those sites without assigned meteorological stations, supplemental daily maximum and minimum temperature data are available for most towns in the Northwest from the NCDC monthly publication "Climatological Data". This data may be useful for various analytical studies, and can be obtained directly from the NCDC or through the ELCAP project office for the period beginning January, 1984.

REFERENCES

Hadley, D. L., 1987, Design of the ELCAP Meteorological Station Network, (to be published)

FIGURE 1. FLOW DIAGRAM OF METEOROLOGICAL STATION ASSIGNMENT PROCESS