UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY LICENSING BOARD

In the Matter of	)	
	)	
HOUSTON LIGHTING AND POWER COMPANY	)	Docket No. 50-466
	)	
(Allens Creek Nuclear Generating Station, Unit 1)	)	

NRC STAFF TESTIMONY OF CHARLES M. FERRELL
AND LEONARD SOFFER REGARDING POPULATION DENSITY PROJECTIONS

[Bishop Contention 1]

Q. Please state your names and positions with the NRC.

A. My name is Charles M. Ferrell. I am a site analyst in the Siting Analysis Branch, Division of Engineering. My name is Leonard Soffer. I am a Section Leader in the Siting Analysis Branch, Division of Engineering. Copies of our professional qualifications statements are attached to this testimony.

Q. What is the purpose of this testimony?

A. The purpose of this testimony is to respond to Bishop Contention 1 which states:

> The projected population density within a 50 mile radius of the proposed nuclear plant at Allens Creek is greater than the applicant estimates and exceeds criteria set by the Nuclear Regulatory Commission.

Q. In general, what will you attempt to show through this testimony?

A. This testimony will discuss the applicable NRC criteria, which are 10 C.F.R. Part 100 and Regulatory Guide 4.7, and will show that the present population densities meet these criteria, and that the projected population densities are expected to meet these criteria over the lifetime of the plant. The testimony will also present the bases for the staff's conclusion that the applicant has made reasonable projections of the population in the vicinity of the Allens Creek site.

1. NRC Siting Criteria

Q. What are the NRC siting criteria?

A. The Commission's criteria for determining the suitability of proposed sites for nuclear power plants are contained in 10 C.F.R. Part 100. Proposed sites are required to meet certain tests related to the surrounding population. The objective is to assure that the potential consequences of postulated accidents do not pose an undue risk to the health and safety of the public.

Q. What does 10 C.F.R. Part 100 require with respect to population criteria around a proposed site?

A. 10 C.F.R. Part 100 requires that in selecting the site for a proposed nuclear power plant that an exclusion area, low population zone and nearest population center by defined and selected.

Part 100 also requires that the distance from reactor to the nearest population center[1/] be at least one and one-third times the low population zone outer radius and, in addition, that the radiological consequences of an assumed hypothetical fission product release meet certain dose guidelines to an individual located at the boundaries of the exclusion area and low population zone. It should be noted that Part 100 contains no specific requirement relating to population density near a proposed site. The regulation does state that, with respect to the one and one-third rule, where very large cities are involved, a greater distance may be necessary. In the statement of considerations that led to Part 100, the Commission enunciated the policy that power reactors should be located away from densely populated centers, and stated that the population center distance criterion was added as a site requirement in order to provide for protection against excessive exposure doses to people in large centers, where effective protective measures might not be feasible. The Commission, however, issued no specific requirements on population density near a proposed site.

1/ 10 C.F.R. 100.3(c) defines a population center distance as the distance from the reactor to the nearest boundary of a densely populated center containing more than about 25,000 residents. Section 100.11(a) indicates that the boundary of the population center should be determined upon considerations of population distribution and that political boundaries are not controlling.

Q. In the absence of specific Commission requirements on population density, has the staff established any population density criteria to act as guidance to applicants?

A. Criteria on population density have been published in USNRC Regulatory Guide 4.7 (Revision 1, November 1975), "General Site Suitability Criteria for Nuclear Power Stations." These criteria, which are not part of the Commission's regulations but which do offer guidance on staff review practices, state with respect to population considerations the following:

> "Areas of low population density are preferred for nuclear power station sites. High population densities projected for any time during the lifetime of a station are considered during both the NRC staff review and the public hearing phases of the licensing process. If the population density at the proposed site is not acceptably low, then the applicant will be required to give special attention to alternative sites with lower population densities."
>
> "If the population density, including weighted transient population, projected at the time of initial operation of a nuclear power station exceeds 500 persons per square mile averaged over any radial distance out to 30 miles (cumulative population at a distance divided by the area at that distance), or the projected population density over the lifetime of the facility exceeds 1000 persons per square mile averaged over any radial distance out to 30 miles, special attention should be given to the consideration of alternative sites with lower population densities."
>
> "Transient population should be included for those sites where a significant number of people (other than those just passing through the area work, reside part time, or engage in recreational activities and are not permanent residents of the area. The transient population should be taken into account by weighing the transient population according to the fraction of time the transients are in the area."

Q. In general, why were these population density values selected?

A. The population density values were selected on the bases of allowing a good degree of site availability in all regions of the U.S., including the North-eastern U.S., while simultaneously implementing the Commission's policy that power reactors should be located away from densely populated centers.

For sites with population densities below these guidelines, it was considered unlikely that numbers of substantially better sites (from a population density standpoint) would be found in the north-east, reasonably near load centers. The population density at distances greater than 30 miles from a potential site was considered to have relatively little impact on siting. Supporting results of this view can be found in the Reactor Safety Study (WASH-1400) which indicate that, even in the event of a large accidental release of radioactivity, the consequences to the public would be expected to be low at distances greater than about 20 to 30 miles.

It should be pointed out that the population density levels mentioned do not represent upper bound limits of acceptability, but are merely "trip" levels which if exceeded, a site must be determined to have significant offsetting advantages as compared with available alternate sites of lower density.

Q. Are any NRC efforts underway to establish new siting criteria?

A. 10 C.F.R. Part 100 and Reg. Guide 4.7 are presently the only NRC siting criteria with regard to population. The Siting Policy Task Force, in its report (NUREG-0625) gave a numerical example merely to illustrate the concept. The examples in NUREG-0625 are not criteria, nor even proposed criteria. Although the Commission has announced its intention of revising 10 C.F.R. Part 100 (45 Fed. Reg. 50350) to incorporate population density and distribution limits, staff efforts are still underway in this area, and no new proposed criteria have been issued.

2. Compliance of the Allens Creek Site with 10 C.F.R. Part 100

Q. What has the applicant concluded regarding the compliance of the Allens Creek site with the requirements of 10 C.F.R. Part 100 and the guidelines set forth in Regulatory Guide 4.7?

A. The applicant has presented information in the PSAR and ER on the site including a discussion of the exclusion area, low population zone (LPZ), population center distance, nearest population center and has also presented information on the present as well as projected population in the site vicinity out to 50 miles. This information has also included a discussion of the methodology and sources used to develop the population projections as well as a discussion of the transient population in the site vicinity. The

applicant concluded, based upon the information obtained and submitted, that the site met the requirements of 10 C.F.R. Part 100, and was below the "trip" levels of Regulatory Guide 4.7, as well.

Q. What has the staff previously concluded with respect to the site meeting the population requirements of 10 C.F.R. Part 100?

A. The staff has independently evaluated the compliance of the site with respect to 10 C.F.R. Part 100, and the staff reported its conclusions in the original Safety Evaluation Report (SER) issued November 1974, as well as in Supplements 1 and 2, issued June, 1975 and March 1979, respectively. The SER and its Supplements noted that the site has an exclusion area, that the minimum distance from the plant to the exclusion area boundary is 4330 feet (1320 meters), that the LPZ outer radius is 3.5 miles and that nearest population center has been designated to be the city of Rosenberg located about 20 miles southeast of the site. The population center distance is at least one and one-third times the LPZ outer radius, as required by 10 C.F.R. Part 100.

The staff concluded, in the SER and in SER Supplement No. 1, that the site met the criteria of 10 C.F.R. Part 100. This Licensing Board also found in its Partial Initial Decision dated November 11, 1975, (LBP-75-66, 2 NRC 776 at 797) that the site met the criteria of 10 C.F.R. Part 100.

Q. Since these previous evaluations and conclusions as noted in the SER and Supplement No.1, have the applicant and staff reevaluated population and population distribution in the vicinity of the site in light of more recent population data?

A. Yes. As a result of delay in the application as well as a change from a two-unit to a single unit application, the applicant resubmitted population as well as other pertinent data in 1977. The staff reported its findings in SER Supplement No. 2 issued March 1979.

As the staff noted in SER Supplement No. 2, "Because high growth rates have been reported in areas east of the site, we reevaluated populations and population distribution in the vicinity of the site to determine whether our conclusions were still valid."

The staff, in the same SER Supplement 2, noted that Ft. Bend and Harris Counties had shown population increases of 53 percent and 17 percent, respectively, in the period from 1970 to 1976. The staff thereupon reviewed the designation of Rosenberg as the nearest population center. The potential growth of communities located closer to the site than Rosenberg was evaluated. These included the town of Katy, located about 19 miles east-northeast of the Allens Creek site, as well as the town of Sealy, located about 7 miles north-northwest. SER Supplement 2 noted that the 1978 estimated population for Katy was 5000 persons and the 1975 estimated

population for Sealy was 3211 persons. The staff noted, in view of the relatively low population of these communities compared with the value of about 25,000 persons defined in 10 C.F.R. Part 100 for the designation of a population center, that very rapid growth of these communities would be required within the lifetime of the plant before either could be considered as the nearest population center. The Staff further noted, based upon population projections at that time, that the possibility of either Sealy or Katy becoming population centers, as defined by 10 C.F.R. Part 100, could not be ruled out, although the staff considered it unlikely that Sealy would become the nearest population center during the plant lifetime. However, the staff concluded that even in the event Sealy or Katy become the nearest population center, the population center distance would still be greater than one and one-third times the LPZ outer radius. Therefore, the staff concluded, in SER Supplement 2, that the present exclusion area and present LPZ conform to the requirements of 10 C.F.R. Part 100 regardless of whether Rosenberg, Katy or Sealy is the nearest population center.

Q. Has the staff reexamined its conclusion in the SER Supplement 2 as the result of the publication of the preliminary 1980 Census data?

A. Since the publishing of SER Supplement 2, preliminary results of the 1980 Census have become available. The 1980 populations for the towns of Rosenberg, Katy and Sealy are shown in the table below.

Town	Population (1980 Census)
Rosenberg	17,707
Katy	5,677
Sealy	3,888

The staff, after evaluating this recent information concludes that our evaluation and conclusion reported in SER Supplement 2 remains unchanged and that the nearest population center is considered to be the city of Rosenberg, based upon its expected growth within the lifetime of the plant. The staff reaffirms, based upon data from the 1980 Census, that the exclusion area, low population zone and population center distance meet the requirements of 10 C.F.R. Part 100.

3. Comparison of Present and Projected Population Densities with Regulatory Guide 4.7

Q. What has the staff examined to determine if the applicant made reasonable population projections and whether present and projected densities will exceed the "trip" levels of Regulatory Guide 4.7?

A. The staff has examined the applicant's population data, including population projection sources and methodology and has independently made assessments aimed at comparing the present and projected population densities around the Allens Creek site with the "trip" levels of Regulatory Guide 4.7, and determining whether the applicant has made reasonable population projections.

Efforts by the staff included the following:

(1) The 1970 Census data in the Allens Creek site vicinity was independently confirmed by the staff using its own copy of a 1970 census computer tape.

(2) The staff, using 1980 preliminary Census data, has prepared estimates of the 1980 population and population densities within 5, 10, 20 and 30 miles of the Allens Creek site.

(3) The staff has assessed the population projections used by the applicant both with regard to the sources of data and the use of methodology, and has also compared the applicant's projections with those obtained from independent sources.

Q. What were the results of the staff's independent confirmation of population in the site vicinity based on the 1970 census?

A. Population data in the vicinity of the Allens Creek site based upon the 1970 census was prepared by the applicant and has been presented in the PSAR and ER. The staff, making use of its own computer program employing a copy of the 1970 census tape, has independently confirmed that the data presented by the applicant is reasonable. Table 1 presents the 1970 cumulative population and population densities in the Allens Creek site vicinity made both by applicant and staff.

TABLE 1-1970 POPULATION AROUND ALLENS CREEK

	Applicant		Staff	
Distance, Miles	Population	Pop. Density (people/mi^2)	Population	Pop. Density (people/mi^2)
0-5	1,844	23	2,471	31
0-10	7,999	25	7,327	23
0-20	34,000	27	35,647	28
0-30	94,000	33	97,662	35

It can be seen from a comparison of applicant's and staff's values that the agreement is very good (within 10%), except for the 0 to 5 mile distance, where the values differ by about 35%. This is explained by the fact that the applicant used an actual house count within this distance, while the staff computer program uses a technique which counts all of a census tract as being included whenever the center of the tract is within the circle in question. The staff has noted this phenomenon many times, and considers an actual house count to be more reliable at relatively close-in distances. It should also be noted that the 1970 population densities are well below the trip levels of Regulatory Guide 4.7.

Q. How does the preliminary population data obtained from the 1980 Census compare with applicant's projections for the year 1980?

A. Population data in the vicinity of the Allens Creek site for the year 1980 was projected by the applicant and has been presented in

testimony before the Licensing Board by W. T. White (following Tr. 8910). Preliminary data from the 1980 census for Texas Counties and county subdivisions has recently become available. The staff has used this data to estimate the 1980 population within the vicinity of the site by allocating the same fraction of population as that fraction area of a county or county subdivision lying within a given circle. Table 2 presents the 1980 cumulative population and population density around the site made by both applicant and staff.

TABLE 2-1980 POPULATION AROUND ALLENS CREEK

	Applicant*		Staff**	
Distance, Miles	Population	Pop. Density (people/mi^2)	Population	Pop. Density (people/mi^2)
0-5	2,260	29	2,545	32
0-10	11,120	35	10,156	32
0-20	46,830	37	56,[illegible]28	45
0-30	198,630	70	216,037	76

*From testimony of W.T. White using Rice/Dames & Moore Projections

**Based upon 1980 Census Preliminary Report - PHC80-P-45, Texas

A comparison of applicant's and staff's 1980 values indicate very good agreement within 10 miles of the site. Beyond 10 miles the staff estimates somewhat higher values than the applicant although we judge the overall agreement to be good. (The staff is about 20% higher at 20 miles, and about 10% higher at 30 miles.) It should

also be noted that the 1980 population densities are well below the trip levels of Regulatory Guide 4.7.

A comparison of the data of Tables 1 and 2 indicates that the major population growth around the Allens Creek site from 1970 to 1980 has occurred at distances of about 20 miles and beyond. Population growth within 10 miles of the site for this period was about 30 percent, while within 20 and 30 miles, the growth rates were about 65 percent and 130 percent, respectively.

Q. In the staff's assessment of the reasonableness of the applicant's population projections, did the staff review the applicant's sources of data?

A. Yes. The applicant's orignial population projections presented in the PSAR were based upon the 1972 study for the Houston-Galveston Area Council (HGAC). In 1977, the applicant provided revised projections based generally upon projections for Texas Counties made by the Texas Water Development Board (TDWB). Finally, in 1980 the applicant provided revised projections prepared originally by the Rice Center for the Houston-Galveston region and subsequently modified by Dames and Moore.

The staff notes that the sources used by the applicant are governmental groups or private institutions which are independent of the applicant. Such groups are typically interested in

examining future population growth for a variety of reasons and routinely prepare population projections making use of regional economic activity, observed growth patterns, transportation networks and other data considered appopriate and incorporating these by means of a suitable methodology. We further note that two of these projections concentrated on growth in the Houston area which is expected to be the major factor influencing future population growth in the vicinity of the site.

Q. Did the staff compare applicant's sources of data with those obtained from independent sources?

A. Yes. In the staff's SER dated November 1974, we compared the applicant's projections (at that time based upon the 1972 HGAC study) with independent projections made by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA), for BEA Area No. 141, a 17 county area including the Houston-Galveston area and surrounding counties. As we noted in the SER, on page 2-8:

> "The applicant projects population increases of about 122% and 208%, by the years 2000 and 2020 respectively, for the region within 50 miles of the plant. The BEA projects population increases of 79% and 154% by the year 2000 and 2020, respectively, for BEA Area No. 141. We find the applicants population projections to be in reasonable agreement with those of the Bureau of Economic Analysis (BEA)."

Since our original comparison of the applicant population projections was made in 1974, the staff has obtained more recent projections made by the Texas Department of Water Resources (TDWR) which were published in January, 1980 as Report No. LP-126. The

report contains projections for all Texas Counties up to the year 2000. In addition, unpublished projections for the year 2020 for a number of counties of interest were obtained by telephone from a representative of the TDWR. We compared the projected increase in total population in all Texas counties within 50 miles of the Allens Creek site with the revised population projections presented by the applicant's witness W. T. White in his recent testimony before the Board and using the population projections labeled Rice/Dames and Moore.

Q. How do these sources of data compare?

A. The applicant's revised population projections forecast increases of about 55% and 79%, by the years 2000 and 2020 respectively, for the region within 50 miles of the proposed plant. Using data from the January 1980 report issued by the TDWR, the population for all Texas counties within 50 miles of the site is projected to increase by 56% and 116% by the years 2000 and 2020, respectively. We find that the applicant's most recent population projections are in reasonable agreement with recent projections made by an independent source.

Q. What does the staff conclude with respect to the reasonableness of the applicant's population projections?

A. After an assessment of the applicant's population projections, the staff has determined that:

(1) They are based upon sources of data and studies from groups that are independent of the applicant, that such groups customarily prepare population projections for a variety of business and government users, and that these groups employ models using regionally applicable data and appropriate methodologies, and

(2) A comparison of the applicant's projections with those from completely independent sources indicates there is reasonable agreement between the two.

The staff, therefore, concludes that the applicant has made reasonable projections of the population in the vicinity of the Allens Creek site.

Q. How do the applicant's population projections compare with the "trip" levels of Regulatory Guide 4.7?

A. In the staff's comparison of the applicant's most recent population projections, we assumed 1990 to be the estimated beginning of plant life and 2030 to be the end of plant life. The staff extrapolated the applicant's projections from year 2020 to 2030 by assuming the same growth rate. The cumulative population and population densities are shown in Table 3.

TABLE 3

Population Projections for Allens Creek Site

	1990		2030	
Distance, Miles	Population	Density (people/mi^2)	Population	Density (people/mi^2)
0-5	3,630	46.	5,500	70.
0-10	18,060	57.	31,200	99.
0-20	71,030	57.	109,180	87.
0-30	311,130	110.	519,520	184.

From Table 3, it can be seen that the projected population density is well below the "trip" level of 500 persons per square mile in 1990, and also well below the value of 1000 persons per square mile at estimated end of plant life, in 2030.

We conclude that the present and projected population densities are well below the trip levels of Regulatory Guide 4.7.

Q. What is your overall conclusion regarding this testimony?

A. On the bases of the above testimony, the staff concludes that the applicant has made reasonable projections of the population in the vicinity of the Allens Creek site, and that the site meets the siting criteria set by the NRC.

CHARLES M. FERRELL

PROFESSIONAL QUALIFICATIONS

SITING ANALYSIS BRANCH

DIVISION OF ENGINEERING

I am a site analyst in the Siting Analysis Branch, Division of Engineering, U.S. Nuclear Regulatory Commission. My present duties in this position include the evaluation of site related environmental safety aspects of nuclear power generating facilities and design basis accident analysis. I graduated from Salem College in West Virginia in 1950 with a B.S. degree in physics and a teaching field in chemistry, biology, and mathematics. Upon graduation, I was drafted, and after completion of armored infantry training at Fort Knox, Kentucky, was assigned as a military physicist to the Radiological Division of the U.S. Army Chemical Corps at Edgewood, Maryland. I spent approximately two years in research involving nuclear weapon thermal radiation, nuclear radiation shielding studies and fallout analysis. I was released from active duty and worked for two years as a civilian physicist in Aerosol Physics (Aerobiology) Research at the U.S. Army Chemical Corps Biological Warfare Laboratory at Fort Detrick, Frederick, Maryland. In 1954, I applied for and was granted an AEC Fellowship in Radiological Physics at Vanderbilt University and the Oak Ridge National Laboratory in Tennessee. An additional year of graduate work in physics as taken at West Virginia University. Night school classes in Nuclear Engineering from the University of Maryland plus short summer courses from MIT in Air Pollution, Heat Transfer, and Nuclear Power Reactor Safety constitute the remainder of my formal education. In April, 1974, I completed a two week course in Pressurized Water Reactor Systems at the Westinghouse Training Center in Monroeville, Pennsylvania. I am a charter member of the Health Physics Society.

I have been a member of the AEC's (now NRC's) Regulatory Staff since 1956. Of these twenty-four years, five years were spend in duties involving the safe industrial and medical use of radioisotopes, in the evaluation of spent reactor fuel shipping casks and the promulgation of reactor fuel shipping regulations. Eight years were served as the Technical Assistant to the Office of Hearing Examiners, U.S. Atomic Energy Commission in which I assisted in approximately 40 hearings on nuclear power reactors, fuel reprocessing plants, and in addition contract appeals hearings on nuclear submarine components and nuclear equipment.

In January, 1969, I transferred to my present position. Since that time I have served as the site analyst on forty two nuclear power plants, two U.S. Navy nuclear submarine reactors and a proposed nuclear powered crude oil tanker. I served as one of the technical reviewers of Chapter 7, "Assessment of Reactor Safeguards" in Applied Radiation Protection and Control by J. J. Fitzgerald, published under the auspices of the Division of Technical Information United States Atomic Energy Commission. I am one of the co-authors of the report "Demographic Statistics Pertaining to Nuclear Power Reactor Sites" NUREG-0348, and the report "Control of Heavy Loads at Nuclear Power Plants" NUREG-0612, published by the U.S. Nuclear Regulatory Commission.

I have testified in licensing hearings on six nuclear facilities. These include San Onofre 2/3, Beaver Valley Unit 1, Hutchinson Island (now St. Lucie 1), Yellow Creek 1 and 2, Duane Arnold Unit 1 and Trojan Unit 1.

LEONARD SOFFER

PROFESSIONAL QUALIFICATIONS

SITING ANALYSIS BRANCH

DIVISION OF ENGINEERING

OFFICE OF NUCLEAR REACTOR REGULATION

I am Section Leader of the Site Analysis Section, Siting Analysis Branch, Division of Engineering, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. My duties in this position include responsibility for the review and evaluation of the population characteristics of nuclear power reactor sites as well as the evaluation of potential hazards posed by nearby man-related activities.

I received a B. S. Degree (with honors) in Physics from the City College of New York in 1952 and attended graduate school at Case Western Reserve University in Cleveland, Ohio.

Before joining the Commission, I was employed for 21 years as a Physicist and Nuclear Engineer with the National Aeronautics and Space Administration (NASA) at the Lewis Research Center in Cleveland, Ohio. In this capacity, I performed analyses on radiation shielding and nuclear safety requirements for nuclear power systems intended for lunar and space applications. I assisted in the radiation shielding design of the NASA Plum Brook reactor, served on an agency-wide study team investigating the radiological safety aspects of using radioisotopes for space power generation, and was section leader of a group responsible for research on radiation shielding and radiological safety concerns. I also monitored contracts and occasionally lectured on radiological physics and shielding to others within NASA.

I joined the Commission staff in July 1973, and have participated in the detailed review of over 20 nuclear power plants. My responsibilities in this regard have included evaluation of the demographic characteristics and nearby facilities of sites as well as the independent assessment of the likelihood and consequences of various postulated accidents. I have prepared and presented testimony at hearings on the population density and use characteristics of sites as well as the radiological consequences of accidents. In my capacity as Section Leader, Siting Analysis branch, I am responsible for reviewing the results of similar efforts by others.

Pertinent experience has also included participation in development of a draft standard entitled "Guidelines for Estimating Present and Forecasting Future Population Distributions Surrounding Power Reactor Sites", membership in the NRC Working Group that wrote the "Report of the Siting Policy Task Force" (NUREG-0625), and membership in a Siting Mission to Greece, to assist that Government in the development of demographic criteria for nuclear power plants.

I have also lectured on accident consequence assessment at several courses sponsored by the IAEA, have attended conferences devoted to population projection methodology for small geographic areas and have had discussions with expert demographers on this subject.

I have written about 12 technical papers on various topics related to radiological safety aspects of nuclear reactors. I am a member of the American Nuclear Society and the Population Association of America, which is the professional society of U. S. demographers.