REPORT TO THE CONGRESS

DOD's Requirement For Air-Conditioning Military Family Housing In Hawaii Is Unnecessary B-172376

Department of Defense

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-172376

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To the President of the Senate and the
Speaker of the House of Representatives

This is our report on DOD's unnecessarily requiring the air-conditioning of military family housing in Hawaii.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

Copies of this report are being sent to the Director, Office of Management and Budget, and the Secretaries of Defense, the Army, the Navy, and the Air Force.

Sincerely yours,

Acting Comptroller General
of the United States

Contents

ABBREVIATIONS

FHA	Federal Housing Administration
GAO	General Accounting Office
OASD (I&L)	Office of the Assistant Secretary of Defense (Installations and Logistics)

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

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D I G E S T

WHY THE REVIEW WAS MADE

The Department of Defense has directed the Army, Navy, and Air Force to install air-conditioning in all new and existing military family housing in Hawaii. (See p. 3.) The cost could go as high as $100 million. (See pp. 11 and 12.)

GAO examined the need for and reasonableness of this air-conditioning program because of the:

--Cost of installation.

--Increase in operation and maintenance costs.

--Effect the program will have on energy consumption. (See p. 3.)

FINDINGS AND CONCLUSIONS

There is no need to centrally air-condition all new and existing military family housing in Hawaii.

The requirements for across-the-board air-conditioning are unwarranted because:

--The military criterion used to authorize air-conditioning does not consider Hawaii's trade winds and moderate temperature and humidity conditions. (See p. 4.)

--The military services in Hawaii have gone on record as concluding that air-conditioning is not needed except at some locations having unusual weather and noise problems. (See pp. 7 to 9.)

--The U.S. Coast Guard and the Federal Housing Administration do not believe that central air-conditioning is needed in Hawaii except in certain locations. (See pp. 9 and 10.)

--Central air-conditioning is not common in Hawaiian townhouses and private homes, including those in the luxury category. (See p. 10.)

--Installing central air-conditioning in new and existing family houses could cost as much as $100 million. (See pp. 11 and 12.)

--Central air-conditioning will add many millions of dollars annually to utility, repairs and maintenance, and replacement costs. (See p. 13.)

--Central air-conditioning will significantly increase power demand and consumption during a time of growing concern about energy shortages in the United States. (See p. 13.)

RECOMMENDATIONS

To prevent future unnecessary expenditures for central air-conditioning in Hawaii, we recommend that the Secretary of Defense:

--Rescind the memorandum of June 17, 1971, requiring air-conditioning of all military family housing in Hawaii.

--Develop new criteria for areas that are subject to cooling trade winds that will allow central air-conditioning of military family housing only when it is determined essential because of unusual weather or excessive noise.

--Direct the military services in Hawaii to review existing or proposed air-conditioning projects and contracts to minimize expenditures that cannot be fully justified.

AGENCY ACTIONS AND UNRESOLVED ISSUES

The Department disagreed with GAO. In a response, it cited many reasons why it believes air-conditioning is needed. (See app. I.)

Although GAO believes that many of the Department's points have questionable relevance to the issues, chapter 6 contains GAO's observations on each point.

GAO feels the Department's opposing attitude is predicated on three major factors:

--Under departmental criteria, Hawaii qualified for air-conditioning.

--Hawaii's climate is characterized by high humidity, requiring air-conditioning.

--The Department's belief that the services in Hawaii, contrary to their previous objections, now feel central air-conditioning is warranted.

GAO believes the arbitrary application of the criteria to Hawaii is invalid since it ignores the effect of trade winds which make the climate pleasant and attractive. This position is supported by the National Weather Service. (See pp. 16 and 17.)

The Department's characterization of Hawaii's climate as humid conflicts with the positions of the National Oceanic and Atmospheric Administration and the National Weather Service. (See pp. 16 and 17.)

Recent discussions with military officials in Hawaii, subsequent to the Department's comments, have shown that none of the three services in Hawaii supports the Department's requirements for across-the-board air-conditioning. (See pp. 21 and 22.)

MATTERS FOR CONSIDERATION BY THE CONGRESS

This report brings to the attention of the Appropriation Committees and the Congress the potential unnecessary expenditure of as much as $100 million unless the Department acts to modify its plans to air-condition all military family housing in Hawaii.

CHAPTER 1

INTRODUCTION

On June 17, 1971, the Office of the Assistant Secretary of Defense (Installations and Logistics) (OASD (I&L)) issued a memorandum to the military services stating that "all future new construction of family housing in Hawaii shall include central air-conditioning systems as part of the basic construction." The memo also required the services to air-condition their existing family housing.

SCOPE OF REVIEW

We examined the need for and reasonableness of the air-conditioning requirements, including the cost that will be incurred if all new and existing family housing in Hawaii is air-conditioned. We made our review at various military commands and installations in Hawaii and at headquarters offices in Washington, D.C.

CHAPTER 2

REQUIREMENTS FOR AIR-CONDITIONING

The Department of Defense's Construction Criteria Manual 4270.1-M provides that air-conditioning may be installed in new family quarters where the 67°F. wet bulb temperature exists for at least 1,000 hours for the 6 warmest months. OASD (I&L) officials maintain that all of the areas on the Island of Oahu, where most military housing is located, meet this wet bulb criteria.

The Department's criteria is inappropriate for Hawaii since it does not consider the cooling effect of the trade winds and the consistently moderate temperature and humidity conditions. Wet bulb readings ignore wind velocity. The National Oceanic and Atmospheric Administration, Department of Commerce, describes the Hawaiian climate as follows:

> "The mild temperatures are an asset as are the low rainfall and generally sunny conditions in such leeward locations as Waikiki and Kona. The trade wind breeze is also an important element because on the warmer days it often lowers the sensible temperature very appreciably, making conditions far more pleasant than the temperature and humidity values alone would indicate. In the Honolulu area for example, temperatures of 80°F. or above occur less than one-half of one percent of the time under conditions when the humidity is as high as 70 percent and there are not at least moderate trade winds. August, September, October and November are the only months when such conditions occur more than 1 percent of the time."

To summarize the National Oceanic and Atmospheric Administration notes that the "summers are warm but not hot, so that air-conditioning is a luxury rather than a necessity."

JUNE 17, 1971, MEMORANDUM

The Department's air-conditioning criteria has existed for about 20 years. However, it wasn't until the June 17, 1971, memorandum that the Department required military family housing in Hawaii to be air-conditioned.

We discussed this timelag in air-conditioning with OASD (I&L) officials who stated that, in the past, central air-conditioning was not considered for family housing in Hawaii because of an "administrative prohibition" placed on the Department by a former Chairman of the House Armed Services Committee. This prohibition no longer exists, therefore the Department is now free to follow its published policy.

The officials were asked what events prompted the Department to issue the June 1971 memorandum, since the committee chairman who had opposed air-conditioning in Hawaii had departed long before 1971. They were unable to cite any specific events.

Use of window units

In justifying central air-conditioning, the June 17, 1971, OASD (I&L) memorandum stated:

> "Because of the magnitude of rainfall and extended periods of high humidity, there has been an increasing growth in the number of occupant-owned window air-conditioners being installed in family quarters, varying in capacity from 5,000 BTU to 18,000 BTU, and often with three or four such units in one set of quarters. The window units generally maintain a high noise level, are not fully effective, and in many instances utilize more electrical energy than if a central system were installed."

OASD (I&L) officials informed us that the above statement was based on observations they made during trips to Hawaii, not on detailed data or documentary evidence.

EXISTING FAMILY HOUSING

In its memorandum, OASD (I&L) instructed the military services to centrally air-condition the existing family housing in Hawaii "through orderly increments in the annual Improvements to Existing Public Quarters Program." In the past, the Department has justified this practice on the basis that:

> "When air conditioning or evaporative cooling is included in the construction of new personnel living space of any type on an installation, consideration shall be given to the addition of air conditioning

or evaporative cooling in all existing personnel living spaces on the installation in order to provide equal facilities and to prevent morale problems."

At the time of our fieldwork about 13,600 military family housing units were on the Island of Oahu that were not centrally air-conditioned.

ACROSS-THE-BOARD AIR-CONDITIONING

OASD (I&L) officials said they required across-the-board central air-conditioning in all military family housing in Hawaii to promote uniformity among the services as well as within the services and because "the people in Hawaii wanted it" (apparently referring to local military officials). The letter is not supported; none of the services favors across-the-board central air-conditioning of new and existing family housing.

CHAPTER 3

POSITIONS OF MILITARY AND CIVILIAN OFFICIALS ON CENTRAL AIR-CONDITIONING

We discussed the need for central air-conditioning in Hawaii with officials of (1) the three military services in Hawaii--Army, Navy, and Air Force, (2) the Federal Housing Administration (FHA), (3) the U.S. Coast Guard, and (4) two large commercial developers of housing projects in Hawaii.

Each of the three military services does not favor across-the-board air-conditioning of military family housing in Hawaii. Also, the officials from the Coast Guard, FHA, and private industry do not believe that air-conditioning is needed throughout Hawaii, although they feel it might be desirable in certain locations.

On the basis of information from people living in Hawaii, it is our opinion that the OASD (I&L) decision to require central air-conditioning is not justified. It would be better to judge each housing site separately since Hawaii is not a one climate area. One of the guides that should be used in determining whether a particular location needs air-conditioning would be the practice of people already living in that vicinity.

MILITARY POSITIONS CONCERNING AIR-CONDITIONING

Navy

The Navy commands in Hawaii have consistently been against across-the-board air-conditioning of family housing. Three days after the OASD (I&L) memorandum, the Pacific Division, Naval Facilities Engineering Command, speaking for all the Navy commands in Hawaii, advised its Washington headquarters of its position on central air-conditioning as follows:

--The wet bulb criteria used by the Department of Defense to justify air-conditioning does not consider the cooling effect of the trade winds. The combination of cooling trade winds with consistently moderate temperature and humidity conditions is highly conducive to outdoor living. Year-round

outdoor living is a fundamental factor making Hawaii a sought-after duty station.

--Air-conditioning is secondary and other amenities, such as community recreation facilities, should be provided first.

--FHA and commercial builders indicate that central air-conditioning is rare in commercial housing in Hawaii. It is becoming common practice to provide outlets for window air-conditioning units in multi-story, multiple-family units for flexibility in catering to individual owner or occupant desires. The provision of outlets for air-conditioning units in military housing would accommodate the few families that desire air-conditioning.

--Any substantial air-conditioning program will be affected by ecological considerations. Increased power consumption ultimately leads to more or larger power generation facilities with attendant higher plant costs because of air and thermal pollution controls. This in turn leads to increased power costs.

--The costs of central air-conditioning are extensive. The Navy estimates that it will cost $30 million to $40 million for 8,000 Navy and Marine new and existing housing units. In addition, this would increase power costs approximately $3.2 million annually based on fiscal year 1972 rates and increase maintenance costs by approximately $600,000.

The Navy recognizes that multiple window air-conditioning units are less efficient and thus more costly to operate than central systems; however, the Navy also recognizes that the higher cost to support a few families operating window units is negligible in comparison to the costs to be incurred if every family is provided with central air-conditioning systems.

Army

The Army in Hawaii has not been as opposed to central air-conditioning as the Navy. The Army believes central air-conditioning should be evaluated on a site-by-site basis.

For example, the Army housing officer for Hawaii stated that for the fiscal year 1971 program the Army wanted air-conditioning at the Ridge and Park sites of Fort Shafter (35 units) but did not want air-conditioning at the Schofield Barracks and Tripler Army Medical Center sites (265 units). The official said the Army would be willing to support the Navy position of no air-conditioning rather than the OASD (I&L) position of across-the-board air-conditioning.

Air Force

The Air Force officially supported the OASD (I&L) decision to require central air-conditioning in the fiscal year 1971 military housing program. The Air Force's housing units being constructed under the fiscal year 1971 program are located at Hickam Air Force Base, and air-conditioning will help reduce the noise from jet aircraft. The Air Force will continue to support central air-conditioning because (1) all its future housing will be constructed at Hickam and (2) it wants to centrally air-condition the existing housing at Hickam.

The Air Force also has existing housing at Wheeler Air Force Base which is adjacent to the Army's Schofield Barracks. We were informed that the Air Force is opposed to air-conditioning these houses because it isn't necessary, either from the standpoint of noise or climate. Thus, the Air Force also believes that the need for air-conditioning depends on the location of the housing.

U.S. COAST GUARD

The U.S. Coast Guard completed 164 housing units in 1967 and is in the process of building an additional 120 units. None of these units is air-conditioned. Coast Guard officials stated that they did not consider air-conditioning these units because their location is exposed to cooling trade winds. These officials agreed with Army and Navy officials that across-the-board air-conditioning is not justified, although there may be locations where it would be desirable.

FHA AND COMMERCIAL BUILDERS

In fiscal year 1972 the Surveys and Investigations Staff of the House Appropriations Committee requested opinions on central air-conditioning of family housing in Hawaii from FHA and the three largest commercial home builders in the State. FHA officials informed the Staff that less than 1 percent of the residences in Hawaii had central air-conditioning. FHA said none of the apartment houses sponsored by the Housing and Urban Development agency were air-conditioned and that there was no intention to add what FHA considered to be an unnecessary and expensive feature.

FHA considered it "ludicrous" to air-condition townhouses or single houses and stated that "no one will suffer in Hawaii because of a lack of air-conditioning." The three home builders said none of the homes they built in 1971 were centrally air-conditioned, nor was there any demand for such a feature.

We contacted the FHA in Hawaii and two large home builders to determine their current feelings on the need for central air-conditioning. The FHA official said FHA's comments to the Surveys and Investigations Staff were still valid--air-conditioning is not required in Hawaii.

The two builders contacted had constructed about 1,350 houses during 1972. One builder said he had offered central air-conditioning in one of his past developments but that there were so few takers that he no longer offered it as an option. The other builder said he gets more requests for fireplaces than he does for air-conditioning in his development near Schofield Barracks and that he will be offering central air-conditioning as an option only in his "luxury" homes--those costing $80,000 to $90,000.

According to one of the two builders, there is no need at all for air-conditioning in Hawaii. The other builder thought there might be some locations where air-conditioning would be desirable.

CHAPTER 4

COSTS AND RELATED ENERGY EFFECTS OF INSTALLING CENTRAL AIR-CONDITIONING

We estimate that the cost of installing central air-conditioning in new and existing military housing in Hawaii could reach $100 million. An estimated $9.8 million would be needed to centrally air-condition the new houses needed to meet the military housing deficit, and from $46 to $95 million would be needed to air-condition existing houses (based on the most current cost estimating information available).

Air-conditioning would add many millions of dollars annually to military operating and maintenance costs. It would also significantly increase power demand and consumption during a time of growing concern about energy shortages in the United States in general and the State of Hawaii in particular.

NEW HOUSING

The first military houses in Hawaii to be equipped with central air-conditioning at the time of construction were those in the fiscal year 1971 housing program. The Navy estimated the cost of this air-conditioning to be about $3.18 million--or about $2,900 for each of the 1,080 housing units constructed.

Recently, a contract was awarded for constructing 716 housing units for the fiscal year 1972 program. The Navy estimates the cost of air-conditioning these houses at about $1.07 million, or about $1,500 per unit. The wide variance in unit cost for air-conditioning between the fiscal year 1971 and fiscal year 1972 housing programs may be due to (1) adding air-conditioning after the contract was awarded in 1971, while in 1972 it was included in the basic contract, and (2) the relative ease in determining the costs in the 1971 program because the contract for air-conditioning was negotiated separately, while in the 1972 program it was part of the overall housing contract for all 716 units.

The long-range military housing deficit in Hawaii as of April 1973 was 6,518 units. Using the lower 1972 figure of $1,500 per air-conditioning unit, we estimate the air-conditioning costs related to the construction of houses to meet the deficit will be about $9.8 million.

EXISTING HOUSING

At the time of our fieldwork there were 13,600 existing family housing units on the Island of Oahu that were not centrally air-conditioned. Although there have been studies on the cost to install central air-conditioning in some existing houses, there has not been a study to determine if air-conditioning is economically feasible for all existing houses.

An August 1971 Navy study of 250 units at Camp Smith estimated the cost to be about $6,000 per unit for central air-conditioning. In April 1972 the Army requested an architect-engineer to prepare a cost estimate to centrally air-condition 2,290 housing units at Schofield Barracks and Fort Shafter. The estimate totaled about $7.9 million, or about $3,400 per unit. The Air Force has an approved project to centrally air-condition 400 houses constructed as part of the fiscal year 1968 housing program. The approved cost for central air-conditioning amounts to about $1.48 million, or about $3,700 per unit.

Currently there is only one ongoing project involving the central air-conditioning of existing family houses. This involves four houses at Barbers Point Naval Air Station, which are adjacent to newly constructed military houses having central air-conditioning. The actual expenditures, as of March 24, 1973, for air-conditioning these four houses was about $28,000, or about $7,000 per unit.

On the basis of these per unit costs, the military services could conceivably spend from $46 million to $95 million if all 13,600 existing housing in Hawaii were centrally air-conditioned.

UTILITY, REPAIRS AND MAINTENANCE, AND REPLACEMENT COSTS

None of the above projections includes costs for increased utility consumption and repairs and maintenance, which would be considerable according to Navy estimates. The Navy estimated that, at 1972 rates, the annual power consumption and maintenance costs for 8,000 newly constructed and existing housing units would be increased by about $3.2 million and about $600,000, respectively, if the houses were centrally air-conditioned. Projecting the Navy estimate to all existing houses and to the long-range deficit (about 20,000 units), annual power consumption and maintenance costs would be increased by about $8 million and about $1.5 million, respectively.

In addition to increased costs for utility consumption and repairs and maintenance, costs would be incurred for periodic replacements of defective or wornout units. No estimates were available on the costs of replacements.

The decision to centrally air-condition will also increase the construction cost of houses. A higher degree of insulation and a more closed type of house construction would be required to facilitate efficient use of the air-conditioning than would be required for houses built to take advantage of the existing tradewinds.

ENERGY CONSUMPTION

Presently, there is growing concern in the United States over shortages, increased costs, and unnecessary use of energy. Hawaii has been one of the States most affected by the supply and cost problems related to oil consumption. Almost all of Hawaii's electric power is produced from imported oil.

The Department's decision to air-condition all new and existing housing will further aggravate Hawaii's energy problems. In our opinion, central air-conditioning for all military family housing is a luxury that Hawaii's energy sources, at this point in time, can not afford.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

We believe that the Department's blanket policy of centrally air-conditioning all military family housing units in Hawaii is unwarranted because:

--The military criterion for air-conditioning does not consider the cooling effect of trade winds and the consistently moderate temperature and humidity conditions which gives Hawaii one of the most pleasant climates in the world and makes it one of the most sought-after states to live in and visit.

--Central air-conditioning is not common in Hawaiian townhouses and private homes, including those in the luxury category. In our opinion, air-conditioning is generally not essential to the heatlh, welfare, or morale of persons living in Hawaii.

--The military services in Hawaii have gone on record as concluding that air-conditioning is not needed, except on a site-by-site basis at some locations having unusual weather or noise problems.

--Other agencies, such as FHA and the U.S. Coast Guard, do not believe that air-conditioning is needed throughout Hawaii, although it might be desirable in certain locations. In fact, the Coast Guard did not air-condition the 164 family housing units it completed in 1967 and is not air-conditioning the 120 units it now has under construction.

--Installing central air-conditioning in new and existing military family housing could cost as much as $100 million.

--Central air-conditioning will add millions of dollars annually to utility and operation and maintenance costs. The military will also incur costs for replacing defective and wornout units.

--Across-the-board installation of central air-conditioning will aggravate Hawaii's existing energy problems.

--Central air-conditioning will add to construction costs because of additional insulation and a more closed type of building design.

At present there is a significant shortage of housing units available to families at various military posts. During the fiscal year 1974 military construction appropriations hearings, the military services estimated the housing deficit for eligible military personnel to be about 98,600 units. Additionally, the services estimated that their backlog of improvements to existing military family housing was about $633 million.

In our opinion, air-conditioning of family housing in Hawaii is unnecessary. It is more important to build new houses to reduce the current housing deficit and to close the gap between the quality of existing housing and present-day standards.

RECOMMENDATIONS

To prevent further unnecessary expenditures for central air-conditioning in Hawaii, we recommend that the Secretary of Defense:

--Rescind the June 17, 1971, OASD (I&L) memorandum requiring the air-conditioning of all military family housing in Hawaii.

--Develop new criteria for areas that are subject to cooling trade winds that will allow central air-conditioning of military family housing only when it is determined essential because of unusual weather or excessive noise.

--Direct the military services in Hawaii to review existing or proposed air-conditioning projects and contracts to minimize expenditures that cannot be fully justified. This action is necessary if expenditures are to be avoided or minimized on contracts entered into for the 1972 housing program.

CHAPTER 6

AGENCY COMMENTS AND OUR EVALUATION

The Department of Defense disagrees with our conclusions and recommendations. In commenting on matters discussed in this report (app. I), the Acting Assistant Secretary of Defense (Installations and Logistics) stated unequivocally that air-conditioning is needed for military family housing in Hawaii. He specifically noted:

--The uncomfortable climate of Hawaii.

--That its criteria of 67°F. wet bulb represents the upper limit of human comfort (80°F. dry bulb and 50 percent relative humidity).

--The widespread use of private air-conditioning units in Hawaii.

--That air-conditioning is rapidly becoming the accepted way of life throughout the United States.

--That our cost figures were excessive.

--The energy usage question was irrelevant.

--That air-conditioning is needed to control excessive noise.

--That selected use of air-conditioning could seriously affect the morale of those that don't have air-conditioning.

--That the military services now want air-conditioning.

UNCOMFORTABLE CLIMATE AND HUMAN COMFORT

A large portion of the Department's comments seek to prove that Hawaii's climate is uncomfortable because of its high humidity. The Department uses its wet bulb criteria to show that Hawaii is more uncomfortable than Jacksonville, Florida; San Antonio, Texas; and Washington, D.C.

The Department's classification of Hawaii's climate conflicts with the positions of the National Oceanic and Atmospheric Administration and the National Weather Service. Both of these organizations have constantly cited Hawaii as having moderate temperature and humidity conditions.

The Department bases its comparison of various locations on its wet bulb criteria. As discussed in the report, wet bulb criteria is not applicable since it does not consider the moderating effect of trade winds, a position supported by the National Weather Service. On Hawaii, trade winds blow 80 percent to 95 percent of the time and exceed 12 miles an hour 50 percent of the time during May through September.

A National Weather Service official stated that the Department's comparison of selected installations to Hawaii, to show the need for air-conditioning, is not valid. He noted that the Department ignores the fact that some of the locations outside of Hawaii have extremely high temperature and humidity conditions which make air-conditioning a necessity in summer, while Hawaii has moderate temperatures year round. The average daily maximum temperature for the Honolulu International Airport over a 30-year period (1931 to 1960) only varied 7 degrees.

The National Weather Service also disagrees with the Department's contention that the upper limit of human comfort is 80°F. dry bulb and 50 percent relative humidity. An official stated that the Department's statement on physiological studies may be true in some locations, but it is not valid in Hawaii. He noted that very few people in Hawaii would be uncomfortable under these conditions since the trade winds temper the discomfort experienced when the temperature and humidity conditions reach or exceed this level.

PRIVATE AIR-CONDITIONING UNITS

The Department maintains that privately owned air-conditioning units in Hawaii are "believed" to be much more widespread than our report indicated. The Department noted that at Hickam Air Force Base, approximately 2,030 out of a total of 2,401 existing homes had at least one occupant-owned air-conditioner. The Department added that detailed surveys had not been conducted at other military installations in Hawaii.

We do not know how the Department supports its statement about widespread use of air-conditioning. As detailed in the report, there is no widespread use of air-conditioning in the private housing sector. Our position is supported by FHA, the Surveys and Investigations Staff, House Appropriations Committee, private developers, and the U.S. Coast Guard.

The example cited by the Department--Hickam Air Force Base--is also inappropriate. Our report already cited the Air Force's desire for air-conditioning at this location because of the excessive noise.

AIR-CONDITIONING IN THE UNITED STATES

The Department maintains that air-conditioned housing is becoming the accepted way of life throughout the United States and believes it is more economical to install air-conditioning in Hawaii now.

It is hard for us to see the relevancy of the Department citing the alleged situation in continental United States as the basis for requiring air-conditioning in Hawaii. We are unaware of any locations in the continental United States that are subject to the same trade winds that Hawaii experiences.

We disagree with the Department's position that, since eventually it will be necessary to air-condition military housing in Hawaii, doing it now is the economical course of action. Our report describes quite clearly that there is no trend toward air-conditioning private housing in Hawaii. Further, the probability of increasing scarcity and cost of energy would tend to discourage any trend in that direction.

COST ESTIMATES

The Department said our maximum cost figures for installing air-conditioning gives an impression of excessive cost. The Department feels that $1,500 per unit cost is realistic.

The report divides the cost into two categories--new houses and existing houses. For estimating the cost of air-conditioning new homes, we used only one figure--$1,500 per unit. This figure was used even though the cost for units in the 1971 housing program was about $2,900 each.

We based our projected cost of air-conditioning existing family housing on the experiences and estimates of the Navy, the Army, and the Air Force--which ranged from $3,400 to $7,000 per unit. The projections we used gave consideration to these variances.

ENERGY USAGE

The Department maintains that the energy usage question is irrelevant because:

--Of the number of privately owned window units.

--Use of air-conditioning is growing.

--Privately owned units will consume as much or more electricity than the more efficient central units.

The Department's position would be valid only if there were enough inefficient window units to equal the total energy consumption that would occur if all houses were centrally air-conditioned. However, the Department was unable to provide any data on:

--How many of the existing military family houses had window units.

--How many total window units there were for all military family houses in Hawaii.

--How much total energy was being consumed by these units.

--How much energy would be consumed if all houses were centrally air-conditioned.

The Department was unable to provide, upon request, any documentation or quantitative data supporting widespread use of window units. Only at Hickam Air Force Base, which is subject to excessive noise, did our fieldwork show widespread use of window units. In our opinion, it would take many times the existing number of window units in military family houses to approach the energy consumption that would occur if all such houses were centrally air-conditioned.

NOISE CONTROL

The Department stated that air-conditioning is needed to reduce noise, particularly for military personnel who have to work nights and sleep during the day.

We believe noise pollution is an insignificant matter other than at Hickam Air Force Base. The report recognizes the noise problem at Hickam and the Air Force's desire for air-conditioning at that location.

EFFECT ON MORALE

The Department stated that providing air-conditioning at only selected locations in Hawaii could seriously affect the morale of those that don't have such air-conditioning.

Our report shows that all three military services believe that the need for air-conditioning in Hawaii depends on the location of the housing. None of the services noted problems in attracting or retaining personnel for a tour of duty in Hawaii because of the lack of central air-conditioning.

The services were able to provide central air-conditioning for new housing constructed under fiscal years 1971 and 1972 housing programs because they were able to remain within the congressional limitations on housing unit costs. However, a Navy official told us that, based on estimates received for the fiscal years 1973 and 1974 programs, the unit cost may exceed present congressional ceilings. Military officials in Hawaii stated that, should this become a reality, central air-conditioning would be the first amenity they would recommend deleting. They said upgrading the quality of existing housing to present-day standards would have a higher priority than providing central air-conditioning.

The Army recently conducted a survey to determine occupants' desires for air-conditioning over other improvements. In August 1973, 3,260 questionnaires were sent to occupants of all Army family housing in Hawaii who did not have central air-conditioning. As of September 12, 1973, a total of 1,519 questionnaires, or 47 percent, had been returned. The responses showed that only 29 percent considered air-conditioning a necessity.

SERVICES WANT AIR-CONDITIONING

The Department said that, subsequent to our report, it requested the current positions of the three military services on the use of air-conditioning in Hawaii; they considered the use of air-conditioning reasonable and necessary in most instances. The Department then cited the positions of the Air Force and the Navy supporting the need for air-conditioning. It should be noted that Navy's position, as shown in the Department's response, contained the statement that "the need for air-conditioning varies from site to site."

The Department was unable to claim support from the Army for across-the-board central air-conditioning:

> "Notwithstanding the above, this office will enter into discussions with the Army with regard to those reasons for not using air conditioning at specific locations in Hawaii. In the event that the Army, or other military service, can clearly demonstrate that the installation of central air conditioning is not in the best long-term interest of the Department of Defense, then consideration may be given to the granting of individual exceptions to our existing policy. Such exceptions would be made only after a detailed review of the unique situation involved in each case. If it is determined that Government furnished air conditioning is not required at a specific location, then it would logically follow that occupant-furnished air conditioning would not be required, and a strict prohibition of occupant-owned units would be necessary * * *."

It is obvious from the above that the Department was unable to convince the Army that it needed air-conditioning in Hawaii. It is also obvious that the Department's statement relating exceptions to central air-conditioning to the prohibition against window units is an effort to convince the services not to seek such exceptions.

After receiving the Department's response, we asked all three services in Hawaii their current positions on central air-conditioning. As detailed below, we found that they still do not support across-the-board air-conditioning in Hawaii.

Army

The Army in Hawaii is considering formally requesting the Department of the Army for a waiver from the mandatory air-conditioning policy for certain areas, such as Schofield Barracks. Local Army officials are strongly opposed to central air-conditioning for housing in the Schofield area because of the cooling trade winds.

On May 1, 1973, it was announced that the fiscal year 1974 family housing improvement program approved by the Department for proposal to the Congress included $2.3 million for installing central air-conditioning in 580 quarters at Fort Shafter and $301,500 for exterior electrical upgrade in preparing for central air-conditioning at Schofield Barracks in subsequent fiscal years. This was unexpected since Headquarters, United States Army, Pacific, did not request either of the projects and has exerted no real pressure for air-conditioning Army housing in Hawaii.

Air Force

A Hickam Air Force Base official stated that the Air Force in Hawaii is opposed to centrally air-conditioning all Air Force housing in Hawaii. The Air Force does intend, however, to centrally air-condition new and existing housing at Hickam if funds are available. The primary reason for air-conditioning housing at Hickam is to reduce jet aircraft noise. The official told us the Air Force is opposed to centrally air-conditioning the existing housing at Wheeler and Bellows because it isn't necessary, either from the standpoint of noise or climate.

Navy

The local Navy position on across-the-board air-conditioning is the same now as it was in June 1971. A local Navy official stated that the Navy in Hawaii was not asked to comment before the issuance of the Assistant Secretary of the Navy's statement on August 29, 1973, that "the Navy recommends air-conditioning remain a requirement for family housing in Hawaii."

SUMMARY

Despite the Department's comments on the matters discussed in our report, we believe it has failed to raise any points that refute our findings, conclusions, and recommendations. We discussed the Department's comments with its officials on several occasions, but they did not provide any additional documentation or quantitative data. In our opinion the Department's comments have questionable validity; its position favoring continued across-the-board air-conditioning in Hawaii is unsupported.

MATTER FOR CONSIDERATION BY THE CONGRESS

This report brings to the attention of the Congress the potential unnecessary expenditure of as much as $100 million unless the Department of Defense takes action to modify its plans to air-condition all military family housing in Hawaii.

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

ID
INSTALLATIONS AND LOGISTICS

24 OCT 1973

Mr. V. L. Hill
Assistant Director in Charge
Logistics and Communications Division
United States General Accounting Office
Washington, D. C. 20548

Dear Mr. Hill:

Reference is made to your letter of July 9, 1973 to the Secretary of Defense regarding your draft report on the need for revising the criteria for air conditioning in military family housing in Hawaii (OSD Case No. 3666).

This office does not agree with the climatic description used in the referenced report which identifies Hawaii as having "moderate [p. 17] temperature-humidity conditions." Weather data for Hawaii does not support such a description. While it is acknowledged that Hawaii does not have the very high temperatures experienced in many areas of the conterminous United States, the humidity in Hawaii is extremely high. [p. 17] Furthermore, the number of hours during the year in which uncomfortable temperatures are experienced are also high. In support of this position, the attached analysis of high humidity conditions at selected DoD installations deserves careful study. This list includes locations in the south- [p. 17] eastern and southwestern United States which are uniformly acknowledged to be hot, humid and very uncomfortable during the summer. It is to be noted, however, that locations such as Jacksonville, Florida and San Antonio, Texas have only 50 to 60 percent of the 80 to 84° temperature experienced in Hawaii and that the mean coincident wet bulb is never higher than that at Pearl Harbor and usually less. This office would classify San Diego as having moderate temperature-humidity conditions and the great contrast with Hawaii can be noted from the attached weather data summary.

[p. 17] The consensus of physiological studies indicates the upper limit of human comfort is 80°F dry bulb and 50 percent relative humidity (about 66.8°F wet bulb). For this reason, the DoD selected the 67°F wet bulb as the base line to measure uncomfortable conditions. The use of the wet bulb

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is also sound from the engineering standpoint since it is a measure of total heat. This criteria has been in use for 19 years and has proven to be an accurate determination of discomfort. Accordingly, it is essential to realize that Pearl Harbor, with approximately 4,000 hours
[p. 17] of 67°F wet bulb conditions, has more hours of uncomfortable weather than any of the acknowledged hot and humid locations noted on the
[p. 17] attached analysis. Pearl Harbor has considerably more than twice the uncomfortable hours of Washington, D. C., and yet none would deny that air conditioning in Washington is reasonable.

It is acknowledged that the trade winds that reach much of Hawaii during the greater part of the year tend to ameliorate the effects of the high humidity conditions when an individual is outdoors in the shade and in a position where the full breeze prevails without any shielding. This situation, however, does not exist indoors for a great many reasons. Factors such as the number and location of windows, orientation of the building, shielding by nearby structures, location as to the windward or leeward side of the Island, doors closed to achieve privacy, internal heat loads such as lighting and cooking, solar loads, and the stored heat effect of buildings can cancel it entirely. It is significant to note that the recommended indoor design conditions for air conditioning, as specified by the
[p. 17] American Society of Heating, Refrigerating and Air Conditioning Engineers, are exceeded by approximately 4,000 hours at Hickam Air Force Base and
[p. 22] by approximately 3,200 hours at Wheeler Air Force Base during the six warmest months (4,320 hours) of the year.

[p. 19] With regard to the use of privately-owned air conditioning units in Hawaii, it is believed to be much more widespread than indicated in your report.
[p. 17] For example, at Hickam AFB the Air Force has determined that approximately 2,030 out of a total of 2,401 existing homes have at least one occupant-owned air conditioner. While detailed surveys have not been conducted at other military installations in Hawaii, it is our understanding that the use of privately-owned air conditioning units is quite widespread, especially on the leeward side of the Island.

This office has been studying the use of air conditioning by the private sector in the United States for the past 19 years. One of the conclusions reached is that air conditioning is dependent not only on weather conditions but also on internal heat loads which, in turn, are greatly influenced by living habits, decorating schemes, traditional comfort experience, and other physiological and psychological reasons. It has been noted that when the military transient family is moved to a new area after living in air

conditioned comfort that it is difficult for the family to make the necessary dramatic switch to non-air conditioned space. While local climatic conditions in many parts of the United States may be considered quite satisfactory to the lifelong inhabitant, this opinion is not necessarily shared by the new arrival. Our experience in the arid southwestern part of the United States with evaporative cooling has very clearly demonstrated this situation. While natives of the Southwest accustomed to evaporative cooling considered it quite satisfactory, we have found that almost universally, new arrivals in military installations in the Southwest consider evaporative cooling too warm and too humid. This is true in spite of the fact that evaporative cooling in the Southwest can produce comfort conditions equal to air conditioning almost 90 percent of the time. It has been very interesting to note that evaporative cooling in the past 10 years in the southwestern United States has essentially disappeared and now even the natives are fully committed to air conditioning.

[p. 18] Air conditioning is rapidly becoming the accepted way of life throughout the United States, even in mild climates such as Maine, Minnesota, and Southern California. For this reason, the Department of Defense, in establishing criteria for air conditioning in new facilities, is constantly faced with the predicament of deciding whether to exclude air conditioning in a particular locale and risk planned obsolescence in a very short period of time, plus the always higher cost of installing air conditioning in an existing facility, or to air condition initially and achieve the lowest total cost over the life of the structure. This office is of the opinion that the

[p. 18] use of air conditioning in Hawaii is not only needed, but in a very short time will become widely accepted. If the Department of Defense does not install air conditioning at this time, two major problems are created. First, installation of air conditioning in these same facilities at later dates will cost significantly more than at the time of the initial construction. Second, the use of occupant-owned air conditioning units in houses not designed for air conditioning with little or no insulation, without vapor barriers and with no control of air infiltration, will result in operating costs far in excess of that which could be reasonably expected in a house designed initially for air conditioning. Furthermore, when an occupant installs several window type air conditioning units in a single house, the overall efficiency is much lower than that from a central system and, again, this results in larger electric power costs than for houses properly constructed initially for air conditioning.

[p. 18] With regard to the possible costs of installing air conditioning, it is our opinion that the maximum cost figures utilized in your report create an

[p. 18] impression of excessive cost. It is considered that with proper attention
[p. 19] to design and the advantage of large volume construction, that the cost experienced by the Air Force of approximately $1,500 per unit is much more realistic and is a reasonable cost level, rather than the higher costs noted in your report.

[p. 19] With regard to the possible increase in operation and maintenance costs due to the installation of central air conditioning units, it is the position of this office that a realistic view of the number of privately-owned units
[p. 18] in military housing must be taken, and it must also be realized that the use
[p. 18] of air conditioning is growing. Accordingly, the amount of energy being used for air conditioning appears to be irrelevant, since privately-owned units will consume as much or more electricity than the more efficient central type Government-owned units. Furthermore, if buildings are not built for air conditioning, there will be a considerable added cost for electric power for air conditioning due to lack of insulation, vapor barrier, and the factors noted above.

This office, in responding to your report, requested the current position of the three Military Departments regarding the use of air conditioning in Hawaii, and we have been informed that the use of air conditioning in
[p. 21] Hawaii is considered reasonable and necessary in most instances. The
[p. 21] Air Force now states its desire and intention to air condition all existing Air Force housing in Hawaii. While the Navy position as stated in your
[p. 22] report, prevailed two years ago, it is not correct today. On August 29, 1973, the Assistant Secretary of the Navy commented that "The great
[p. 21] majority of the family housing being constructed by the Navy is comprised of small, multiplex units sited at relatively high densities to satisfy land
[p. 23] use criteria. Its multiunit configuration does not lend itself to natural ventilation for various wind and weather conditions and site conditions frequently prevent full utilization of prevailing breezes. Further, the majority of Navy family houses on Oahu are located on the leeward side of the island. Notwithstanding the fact that the need for air conditioning varies from site to site, the Navy believes that air conditioning will generally be necessary in the future due to the aforesaid unit size, multiplex configuration, density, site condition, and location considerations. Accordingly, the Navy recommends that air conditioning remain a requirement for family housing in Hawaii."

[p. 20] The matter of noise control is extremely important and the use of air conditioning to abate noise pollution is achieving wide use and is necessary in most cases, particularly in high density housing areas. Because many military personnel work nights and attempt to sleep days, air conditioning can be classified as essential for those personnel, not only for comfort but for noise abatement reasons. Since night work is usually rotated,

varies for different assignments, and is different for each successive occupant of the housing, it would be impractical to designate certain housing for this purpose.

[p. 20] The question of morale is extremely important at this time when attempts are being made to attract new personnel into the Armed Forces and to retain those with experience and skills. Therefore, the suggestion that some areas of Hawaii may need air conditioning, while others only a few miles away may not, would cause a very difficult decision and one which we cannot envision could be made without seriously affecting morale.

[p. 18] In considering all factors and particularly the long range growing use
[p. 18] of air conditioning and the economical utilization of energy, it is the position of the Department of Defense that our current air conditioning policy in Hawaii is sound, will result in the lowest long term cost to the Government and will provide numerous intangible benefits relating to the morale and welfare of military personnel stationed in this area.

[p. 21] Notwithstanding the above, this office will enter into discussions with the Army with regard to those reasons for not using air conditioning at
[p. 21] specific locations in Hawaii. In the event that the Army, or other military
[p. 21] service, can clearly demonstrate that the installation of central air conditioning is not in the best long-term interest of the Department of Defense, then consideration may be given to the granting of individual exceptions to our existing policy. Such exceptions would be made only after a detailed review of the unique situation involved in each case. If it is determined that Government furnished air conditioning is not required at a specific location, then it would logically follow that occupant-furnished air conditioning would not be required, and a strict prohibition of occupant-owned units would be necessary. Such a prohibition of privately-owned window units would be essential to eliminate the cost of the addition of special electrical outlets, the augmentation and increase in capacity of the electrical distribution system, and the very costly practice of operating air conditioning units in open housing not properly constructed to prevent excessive air infiltration and heat gain.

Sincerely,

Hugh E. Witt

HUGH E. WITT
Acting Assistant Secretary of Defense
(Installations & Logistics)

Enclosure

GAO note: Numbers in brackets are page numbers to this final report.

APPENDIX I

ANALYSIS OF HIGH HUMIDITY CONDITIONS AT SELECTED DOD INSTALLATIONS

	Annual No. of Hrs. 80 to 84°F DB	Mean Coincident Wet Bulb (°F) at 80 to 84°F DB	Total Hrs. Above 67°F WI
Pearl Harbor	1834	71	3999
Robins AFB, Ga.	651	69	3069
McCoy AFB, Fla.	1022	71	3958
Jacksonville NAS, Fla.	1070	71	3646
Andrews AFB, Md.	425	68	1682
Columbus AFB, Miss.	660	69	2873
Ft. Rucker, Ala.	709	70	3324
Barksdale AFB, La.	738	70	3198
Cherry Point MCAS, N.C.	671	70	2949
Brooks AFB, Tex.	956	69	3524
San Diego NAVSTA, Cal.	51	63	317

PRINCIPAL OFFICIALS RESPONSIBLE FOR ADMINISTERING ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
James R. Schlesinger	July 1973	Present
William P. Clements, Jr. (acting)	Apr. 1973	July 1973
Elliot L. Richardson	Jan. 1973	Apr. 1973
Melvin R. Laird	Jan. 1969	Jan. 1973
DEPARTMENT OF THE ARMY		
SECRETARY OF THE ARMY:		
Howard H. Callaway	June 1973	Present
Robert F. Froehlke	July 1971	June 1973
Stanley R. Resor	July 1965	June 1971
CHIEF OF ENGINEERS:		
Lt. Gen. W. C. Gribble, Jr.	Aug. 1973	Present
Lt. Gen. Frederick J. Clarke	Aug. 1969	July 1973
DEPARTMENT OF THE NAVY		
SECRETARY OF THE NAVY:		
John W. Warner	May 1972	Present
John H. Chafee	Jan. 1969	May 1972
COMMANDER, NAVAL FACILITIES ENGINEERING COMMAND:		
Rear Adm. A. R. Marschall	June 1973	Present
Rear Adm. Walter M. Enger	Aug. 1969	June 1973

APPENDIX II

	Tenure of office	
	From	To
DEPARTMENT OF THE AIR FORCE		
SECRETARY OF THE AIR FORCE:		
Dr. John L. McLucas	July 1973	Present
Dr. John L. McLucas (acting)	June 1973	July 1973
Dr. Robert C. Seamans, Jr.	Jan. 1969	May 1973
DEPUTY CHIEF OF STAFF, SYSTEMS AND LOGISTICS:		
Lt. Gen. William W. Snavely	Jan. 1973	Present
Lt. Gen. Harry E. Goldsworthy	Aug. 1969	Dec. 1972

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