INTERTECHNOLOGY CORPORATION

100 MAIN STREET, WARRENTON, VIRGINIA 22186, U.S.A., TELEPHONE 703-347-7900

SOLAR HEATING AND COOLING OF BUILDINGS - PHASE 1 (Non-Residential)

Recommendation for Solar Heating and Cooling
Demonstrations as an Integrated Package

Summary Report

MASTER

ITC No. 021276

12 February 1976

NOTICE

PORTIONS OF THIS REPORT ARE ILLEGIBLE. It
has been reproduced from the best available
copy to permit the broadest possible avail-
ability.

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

INTERTECHNOLOGY CORPORATION

100 MAIN STREET, WARRENTON, VIRGINIA 22186, U.S.A., TELEPHONE 703-347-7900

11 February 1976

Energy Research and Development Administration
Washington, D. C. 20545

Attention: Division of Solar Energy
Mr. Eugene R. Doering

Reference: Contract E(11-1) 2688

Gentlemen:

Subject: Recommendations for Selection and Construction of
Solar Demonstration Projects as an Integrated Package

The enclosed package of preliminary solar system designs provides a highly cost effective combination of real buildings, locations, and solar systems carefully selected to offer ERDA, and the United States Congress, the greatest total impact for the dollars invested. It is our strong contention that the number of meaningful demonstrations must be allowed to reach a maximum within the funds available. The ITC Task 0 Cost/Benefit Analysis Report, ERDA No. C00-2688-1, recommends that "ERDA should, with few exceptions, support projects involving less than 5,000 square feet of collector or, alternatively, projects which cost ERDA less than 75 percent of \$200,000 in first cost". The average size of collector area for solar systems contained in this package is approximately 2800 square feet. ITC has matched climatic region and building type, along with other parameters such as economics, need, innovative design, and performance, into four desirable site demonstrations. The total construction cost of the four sites should not exceed \$400,000.

The climatic regions and sub areas selected in three cases are located in areas where solar energy is already emerging as an industry (Phoenix, Omaha, and Miami). Successful demonstrations in these areas would provide the much needed stimulation necessary to create a local solar industry. The other location, Washington, D.C./New York, is in an area where many decision makers reside and conventional fuel costs are relatively high, \$11.25 per million Btu for electricity. In addition to the fact that each recommended demonstration is in a separate climatic region, each demonstration involves a totally different type of solar system design to be installed on four different types of buildings which are owned and operated by different representatives of the business economy.

The four selected sites have solar system designs which cover the near term uses of solar energy. The timely execution of the construction of these demonstrations could provide technological benefits to ERDA PON programs. The

Mr. Eugene R. Doering

11 February 1976

commercial systems proposed, heat pump, domestic hot water, heating and cooling, hydronic space heating will provide much needed information before more expensive PON projects are funded. In addition to the variety of solar system designs, each project will employ energy conservation techniques matched to the basic solar system design provided to insure greatest energy savings and the best opportunity for near term economic viability. The heat pump system utilizes waste heat. The domestic hot water system design involves the use of lower supply temperature and the addition of storage to the existing "instantaneous" boilers that provide for much lower operating cost or smaller required collector areas. The heating and cooling system design utilizes outside air for cooling when temperatures permit and in the case of the hydronic space heating system, energy conservation is achieved by the effective use of manufacturing process waste heat. The types of buildings represented in the package of four demonstration sites are as follows: (1) a privately owned office space and warehouse; (2) motel/hotel; (3) municipally owned office space; (4) commercial/industrial, metal building. With the exception of the motel/hotel building selected, which is a domestic hot water demonstration only, the average size of the other three buildings is less than 17,000 square feet. From our discussions with our solar committees and building owners around the country, we have found that it is generally agreed that a larger number of carefully selected smaller demonstrations would have greater impact than larger and correspondingly fewer demonstrations. We would also like to point out that the involvement by ITC in the design and construction of a variety of projects such as that proposed herein would be extremely helpful in the preparation of various types of design construction and operation manuals contemplated by ERDA.

In each case the particular area was carefully considered before selecting the type of building considered to be most suitable. The combination of available insolation and cost of conventional energy, both present and projected in near term, were major factors in the selection of the particular area involved. The selection of a demonstration in the Phoenix area was considered to be extremely important because as indicated in the Task 0, Cost/Benefit Analysis Report, referred to earlier, the area most likely to respond to the market stimulation with an active local solar industry is the general Phoenix area. An added benefit from the selection of the Bell Telephone Company of Pennsylvania building in Philadelphia is the fact that a large company is involved. As in the case of the motel/hotel project selected, a Howard Johnson's, Inc. owned facility located in North Miami, Florida, the impact upon the particular large company involved could be significant if the concept of solar heating and cooling became accepted and commonly used by the particular company.

ITC has also given careful thought to the management plan which should be applied to these four projects in order to derive the greatest possible overall benefit. We believe the management plan should be one that educates and interacts with

Mr. Eugene R. Doering

11 February 1976

the existing HVAC industry infrastructure, as well as monitors the construction of the project. ITC proposes to serve as the overall program manager using qualified local consulting engineering firms to serve as the on-site construction managers. ITC will provide the overall management and solar energy engineering technology which, when teamed with local Consulting Engineering HVAC firms, offers the complete management and engineering capability necessary to insure that highly reliable projects are constructed the first time without the requirement for revision or major redesign. The experience of ITC in solar system design and construction will serve to augment and compensate for any lack of experience in actual solar system installation or construction on the part of the Consulting Engineering firms selected. The area or local managers would "run the job" providing the day to day monitoring of the construction site operations, which is a task that they are well qualified to perform. ITC, providing the overall program management, would offer the initial technical guidance necessary and make periodic visits to construction sites to verify subcontractor reports and to continue with the training of the area or local site managers in the technical area of solar HVAC.

We believe the program package described above with the variety of building types, locations, and solar system designs, combined with a program management plan that in itself will assist in meeting the overall goals of the Solar Heating and Cooling Demonstration Program offers ERDA a simple, cost effective, easily managed step toward meeting the requirements of the Solar Heating and Cooling Act of 1974. A cost breakdown of the management portion of this proposed project is not enclosed. We suggest that the detailed cost estimate for the management portion of this project be deferred and prepared during the final design phase of these projects during which a more accurate assessment of the construction costs and schedules will be prepared, also allowing time to obtain cost estimates from potential Consulting Engineering firms as site construction managers.

ITC will be pleased to provide any additional information required.

Sincerely,

A handwritten signature in cursive script, reading 'Norris L. Beard', is written over the typed name.

Norris L. Beard
Project Manager

NLB:mem
Enclosures

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

SUMMARY DESCRIPTION

BELL TELEPHONE COMPANY OF PENNSYLVANIA

The Bell Telephone Company of Pennsylvania has suggested using their future Westchester Work Center Building as a facility for a solar heating demonstration. The proposed building, a combined office and warehouse, has been evaluated and found to be typical of many such buildings used throughout the United States. The building size, type of construction, and location make it an excellent choice. Construction of the building is scheduled to begin in early May 1976 with completion estimated by late November 1976. The building will contain approximately 7500 square feet of usable space on one floor and will be located in West Chester, Pennsylvania, a suburb of Philadelphia. The economic analysis of the United States prepared by ITC ranks the Philadelphia area as one of the better areas for solar heating demonstrations. The estimated payback period of twenty years for the solar heating system design proposed for this building is reasonably attractive considering today's costs for solar systems.

COUNTY COURTS BUILDING, SCOTTSDALE, ARIZONA

The Phoenix climatic region and in particular the Phoenix metropolitan area, offers the greatest overall opportunity for maximum solar HVAC system impact. The Task 0 Cost/Benefit analysis, performed by ITC, clearly identifies the Phoenix area as the most promising starting point for a solar industry. The building selected for this solar heating and cooling demonstration, Scottsdale County Courts, is owned by the City of Scottsdale, Arizona and occupied by Maricopa County personnel. The building fits the ITC System Level Plan matrix under the classification of office building.

A collector area of 2,850 square feet can be easily installed on the flat roof of this single story building. According to our preliminary

analysis, the hydronic, flat plate collector with an absorption cooling sub-system will provide approximately 70% of the cooling load and 100% of the heating load.

HOWARD JOHNSON'S INC., HOTEL, NORTH MIAMI, FLORIDA

A 150 room motor lodge, located in North Miami, Florida has been selected for a domestic hot water demonstration. The motor lodge, owned by Howard Johnson's Inc., uses approximately 5000 gallons per day of hot water for guest room showers, baths, etc. This continuous, year-round requirement for domestic hot water in an area of exceptional annual insolation provides an excellent opportunity to demonstrate near term economic viability.

In addition to the basic economic advantages, the impact upon hotel owners, particularly Howard Johnson's Inc., and the public in general will be favorable. The 2000 square foot solar collector to be installed on the roof of one of the highest buildings in the motor lodge complex, see architectural rendering, will be visible from two major highways (U.S. 95 and the Florida State Turnpike). This relatively small demonstration, producing domestic hot water only, could be one of the most cost effective demonstrations in terms of funds invested by ERDA versus overall benefits received. Energy savings in barrels of oil for solar hot water systems applied to motel/hotels only could exceed 15,000 barrels daily. The "payback" time for the solar system has been estimated to be eight (8) years.

ROCKY MOUNTAIN MANUFACTURING AND WIRE BUILDING

The combination warehouse, manufacturing facility offered by Mr. John I. Ladd of Ladd Brothers, Pueblo, Colorado, is an excellent example of metal building construction and use. This demonstration, using metal building construction techniques, will have a significant impact on users of metal buildings throughout the country. The economic analysis performed by ITC ranks this particular area as one of the best locations for early demonstrations of economic viability. The type of fuel used to heat this building, propane, was a factor in selecting this particular building. It is generally agreed that propane, as a fuel for space heating, will escalate in price and even cease to be available for this use in the near future. The only alternatives open to businesses such as this, an expensive modification to switch to oil followed by a probable requirement to modify again to accept all electric heat, are typical of the problems faced by users of propane and natural gas in this selected region.

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

NAME OF PROJECT		DATE		DRAWN BY		DATE		DATE		DATE	
BELL TELEPHONE CO.		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976		J. C.		JAN 1976		JAN 1976		JAN 1976	
		JAN 1976									

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

PROPOSED SOLAR SYSTEM FACT SHEET

BELL TELEPHONE COMPANY OF PENNSYLVANIA

CLIMATE REGION: Washington, D.C./New York
TYPE OF BUILDINGS: Office/Warehouse
BUILDING STATUS: New
TOTAL FLOOR AREA: 10,324 sq. ft.
ESTIMATED COMPLETION DATE: November 1976
SYSTEM TYPE: Heating only, solar assisted heat pump
AUXILIARY ENERGY SOURCE: Electric boiler
TOTAL COLLECTOR SQUARE FOOTAGE: 2000 sq. ft.
FRACTION OF LOAD CARRIED BY SOLAR: 62%
TOTAL COST OF SYSTEM: \$66,000
COST OF SOLAR PORTION: \$48,000
COST PER SQUARE FOOT OF COLLECTOR: \$24.00
COST PER SQUARE FOOT OF BUILDING: \$4.65

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

NAME OF PROJECT JULIAN HEADING & COMPANY FOR COUNTY COURT MODERN CIVIC CENTER - 901 EAST TUCUMCARI RD - TUCUMCARI, ARIZONA	REV. DESCRIPTION DATE	SHEET TITLE LOOK PLAN & PERSPECTIVE VIEW	THIS STRUCTURE HAS BEEN DESIGNED TO MEET ALL NATIONAL APPLICABLE CODES & ORDINANCES	DATE 1970 SCALE 1/4" = 1'-0"	ITC	INTERTECHNOLOGY CORPORATION 1000 Martinez, Virginia 22061, U.S.A.	SHEET NO. JOB NO.
---	-----------------------	---	--	---------------------------------------	-----	---	----------------------

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

PROPOSED SOLAR SYSTEM FACT SHEET

COUNTY COURTS BUILDING

CLIMATE REGION: Phoenix

TYPE OF BUILDING: Office

BUILDING STATUS: Existing

TOTAL FLOOR AREA: 7,000 Sq. Ft.

ESTIMATED COMPLETION DATE: November 1976

SYSTEM TYPE: Heating and cooling, flat-plate collectors

AUXILIARY ENERGY SOURCE: Electricity

TOTAL COLLECTOR SQUARE FOOTAGE: 2,850 Sq. Ft.

FRACTION OF LOAD CARRIED BY SOLAR: Cooling 70%, Heating 100%

TOTAL COST OF SYSTEM: \$93,911

COST PER SQUARE FOOT OF COLLECTOR: \$32.95

COST PER SQUARE FOOT OF BUILDING: \$13.42

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

SITE PLAN - PART
Scale: 1" = 40'

NAME OF PROJECT
HOWARD JOHNSON NORTH MIAMI MOTOR LODGE

REV.	DESCRIPTION	DATE

SHEET TITLE
PERSPECTIVE VIEW, SITE PLAN

THIS STRUCTURE HAS BEEN
DESIGNED IN ACCORDANCE
WITH ALL APPLICABLE CODES
& ORDINANCES

DATE
JAN 1976
SCALE
AS NOTED
DRAWN BY
J.G.

INTERTECHNOLOGY CORPORATION

Box 100
Worthington, Virginia 22191, U.S.A.

SHEET NO

JOB NO

PROPOSED SOLAR SYSTEM FACT SHEET

HOWARD JOHNSON'S INC., HOTEL

CLIMATE REGION: Miami

TYPE OF BUILDING: Hotel

BUILDING STATUS: Existing

TOTAL FLOOR AREA/ROOF AREA: 84,250/10,680 Sq. Ft.

ESTIMATED COMPLETION DATE: November 1976

SYSTEM TYPE: Hot water only, flat plate collectors, hydronic

AUXILIARY ENERGY SOURCE: Existing natural gas

TOTAL COLLECTOR SQUARE FOOTAGE: 2,000 Sq. Ft.

FRACTION OF LOAD CARRIED BY SOLAR: 88%

TOTAL COST OF SYSTEM: \$54,000

COST PER SQUARE FOOT OF COLLECTOR: \$27.00

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

PERSPECTIVE VIEW

ROW #	COLLECTOR AREA	COLLECTOR TYPE
1	26	
2	26	
3	31	
4	30	
5	19	
6	70	
TOTAL:		183 units = 4,424 sq. ft.

SECTION A-A

SITE PLAN

NAME OF PROJECT LADD BROTHERS PUEBLO, COLORADO		NO.	DESCRIPTION	DATE	SHEET TITLE SITE PLAN COLLECTOR PLAN & SECTION PERSPECTIVE VIEW	THIS STRUCTURE HAS BEEN DESIGNED IN ACCORDANCE WITH ALL APPLICABLE CODES & ORDINANCES	DATE SCALE DRAWN BY J.C.		INTERTECHNOLOGY CORPORATION Box 208 Warrenton, Oregon 97146, U.S.A.	SHEET NO.
							JOB NO.			

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

PROPOSED SOLAR SYSTEM FACT SHEET

ROCKY MOUNTAIN MANUFACTURING AND WIRE BUILDING

CLIMATE REGION: Omaha

TYPE OF BUILDING: Light Manufacturing

BUILDING STATUS: Existing

TOTAL FLOOR AREA: 32,040 Sq. Ft.

ESTIMATED TIME FOR COMPLETION: November 1976

SYSTEM TYPE: Heating only, flat plate collector, hydronic

AUXILIARY ENERGY SOURCE: Existing propane system

TOTAL COLLECTOR SQUARE FOOTAGE: 4200 Sq. Ft.

FRACTION OF LOAD CARRIED BY SOLAR: 65%

TOTAL COST OF SOLAR SYSTEM: \$127,893

COST PER SQUARE FOOT OF COLLECTOR: \$30.45

COST PER SQUARE FOOT OF BUILDING: \$3.76

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

FUNDING SUMMARY

TOTAL ESTIMATED COST

Bell Telephone Company of Pennsylvania.....\$ 58,400

County Courts Building.....\$ 93,911

Howard Johnson's Hotel.....\$ 54,382

Rocky Mountain Manufacturing & Wire Building.....\$127,893

Total.....\$334,586