

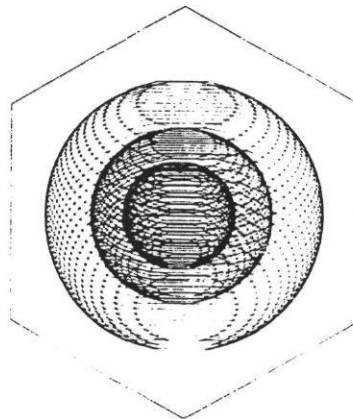
LoanSTAR Monitoring and Analysis Program

Presentation Summary of the State Capitol Complex Building Operation and Maintenance Field Test

Presented to the
State Purchasing and General Services Commission
By the
Monitoring Analysis Task E

Dr. W. D. Turner
Mr. John K. Houcek
Dr. Mingsheng Liu
Dr. David E. Claridge, Principal Investigator

June 9, 1993



**ENERGY SYSTEMS
LABORATORY**

Department of Mechanical Engineering
Texas Engineering Experiment Station
Texas A&M University System

SUMMARY REPORT

During the Fall of 1992 a comprehensive survey was conducted on eight buildings at the State Capitol Complex to determine potential operations and maintenance (O&M) savings opportunities. A verbal report of the findings was presented to General Services Commission and Governor's Energy Office personnel in October, 1992. In January, 1993, a formal written report titled "Potential Operation and Maintenance (O&M) Savings at the State Capitol Complex" was transmitted to the same GSC and GEO personnel.¹

The O&M cost saving opportunities, identified in the previous report, are summarized in the following table. The largest savings opportunities identified are the unoccupied period shut down of the central air handling units. Four buildings (SFA, LBJ, WBT, and JER) can have all or some of their air handlers turned off during unoccupied hours, while three buildings (SFA, LBJ, and WBT) can have all or some of their exhaust fans turned off during unoccupied hours. Turning off PCs and office equipment during unoccupied periods represents the second largest savings opportunities, followed by the turning-off of lights as the third.

Table A
Potential O&M Opportunities and Savings

Building	Air Handler Units	Exhaust Fan	PC and Machines	Lights	Savings \$/year
SFA	\$138,500	\$1,500	\$15,500	\$6,900	\$162,400
LBJ	94,800	1,300	28,300	10,900	\$135,300
WBT	69,700	3,800	17,900	10,900	\$102,300
JER	24,900	-0-	2,900	3,500	\$31,300
JHR	-0-	-0-	6,100	8,200	\$26,000
INS	-0-	-0-	3,700	4,300	\$14,300
ARC	-0-	-0-	4,300	2,400	\$8,000
JHW	-0-	-0-	18,100	7,900	\$6,700
Savings \$/year	\$327,900	\$6,600	\$96,800	\$55,000	\$486,300

¹Houcek, J.K., Liu, Mingsheng, 1993, "Potential Operation and Maintenance (O&M) Savings at the State Capitol Complex," Technical Report # ESL-PA-93/0/-07, Energy Systems Lab, Texas A&M University, (February).

The savings estimated for each O&M measure are shown in Table A. The results show potential annual savings of \$486,300 (11.5% of current total energy cost) for these eight buildings. The savings due to air handler and exhaust fan shutdown (including reduced heating and cooling expense) account for 69% of the total savings. This can be achieved by the building operators with minimum extra cost. The savings from turning off lights and office machines account for 31% of the total savings.

Three buildings (SFA, LBJ, and WBT) account for 83% of the potential savings for the eight buildings. It was thus suggested that the highest priority be given to O&M modification in these three buildings. Subsequently, a field test was conducted in the Lyndon B. Johnson, William B. Travis and Stephen F. Austin buildings to verify the potential savings identified in the earlier report¹. This report presents the results of that field test.

The test procedure allowed for the fact that all of the originally reported quantities of equipment could not be turned off due to special agency requests to leave systems on.

The original potential savings compared to the savings of the O&M Field Test are presented in Table B.

Table B
Original Potential Savings Compared To Field Test Savings

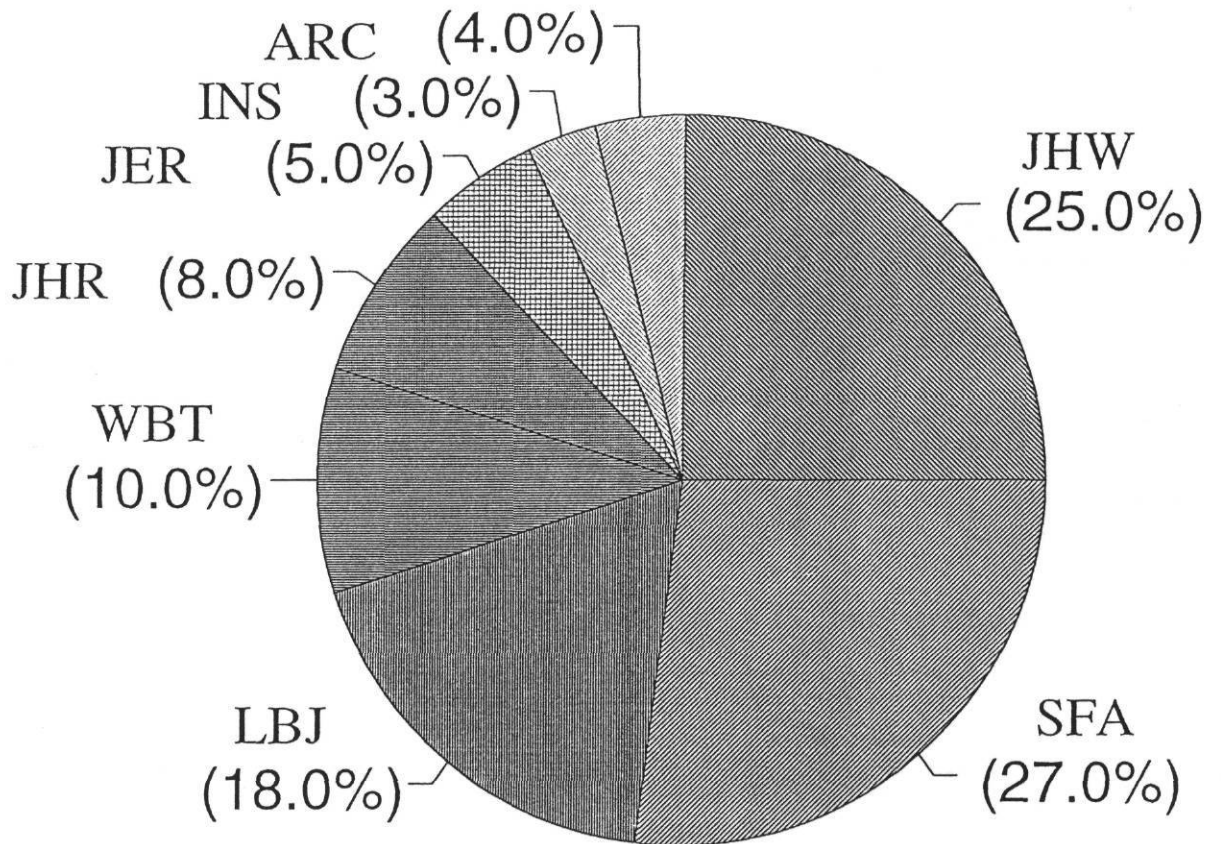
Building Name	AHU Test Savings	Percent of Potential Savings	Exhaust Fans	PCs and Machines	Lights	Total Potential Savings	Total Test Savings
SFA	\$138,500	95%	\$1,500	\$15,500	\$6,900	\$162,400	\$156,902
LBJ	94,800	58%	1,300	28,300	10,900	135,300	114,958
WBT	69,700	78%	3,800	17,900	10,900	102,300	73,084
TOTAL	\$303,000	83%	\$6,600	\$61,700	\$28,700	\$400,000	\$344,944

The original savings calculations due to air handler shut-off was based on the assumption that a total of 1692 hp or 819 kW could be turned off in the LBJ, WBT, and SFA buildings. This would have resulted in total annual AHU savings in the three buildings of \$ 303,000.

Due to special requests by agency personnel in each of the three buildings, certain air handlers were not turned off. The AHUs turned off in the three buildings during the test were rated at 1397 hp or 677 kW. This would result in total annual AHU savings in the three buildings of \$247,944.

Based on the test results, the potential savings from exhaust fans, PCs and office equipment, and lighting would not change. However, a continuing effort in promoting an educational program addressing the importance of energy conservation and environmental protection is needed to allow these savings to be realized.

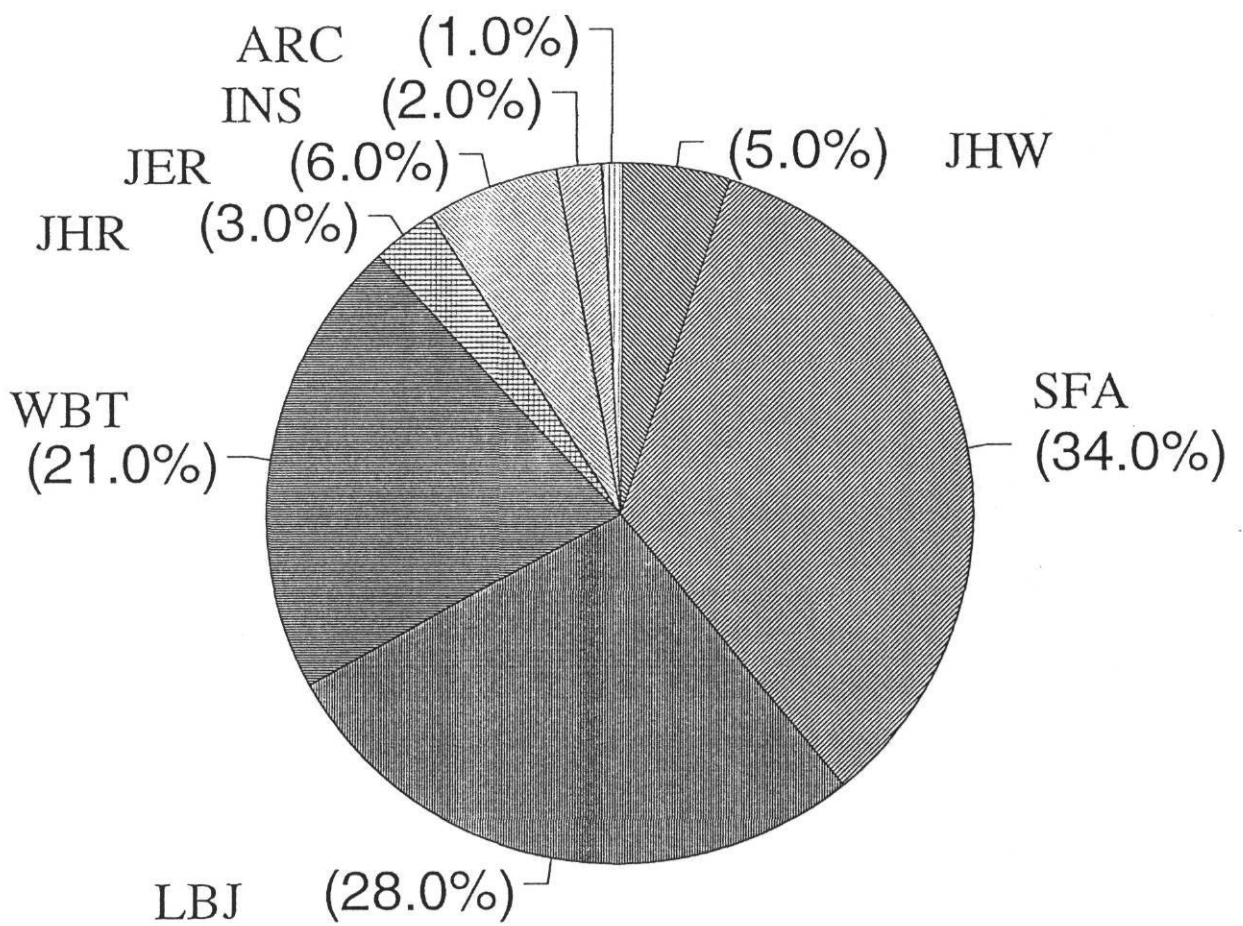
Annual Energy Cost for the State Capitol Complex (8 Buildings) (Total = \$4.2 million)



State Capitol Complex O&M Measures Investigated

- 1a. Turn fans (air handling units or AHUs) off in non-essential areas from 10:00 p.m. - 5:00 a.m. Monday through Friday, and off on weekends and holidays.**
- 1b. The thermal effect of turning off AHUs during unoccupied hours (1a).**
- 2. Turn exhaust fans off during unoccupied hours.**
- 3. Turn lighting off during unoccupied hours.**
- 4. Turn PCs, computer screens, printers, and copying machines off during unoccupied hours.**

Annual O&M Potential Savings for Eight Buildings at the Capitol Complex (Estimated Total =\$486,300)



O&M Field Test

Purpose: To verify savings from air-conditioning and lighting in SFA, LBJ & WBT buildings

- Approach:*
1. Met with SP&GSC contact (Indunil Netthikumara)
 2. Notices had been sent the previous week to the agencies requesting turn-off PCs & lights
 3. Revision of AHU & lighting off list to allow for agency requests
 4. Count of all PCs & office equipment in LBJ building to verify percent off right before the test
 5. Sequencing of test to allow maximum off time and distinguish the impacts of lights turned-off and AHUs shut down

Note: Six SP&GSC staff and two LoanSTAR staff conducted this all-night test

PC and Office Machine Count in LBJ Building

FLOOR	TOTAL PCs	OBSERVED ON	TOTAL PRINTERS	OBSERVED ON	TOTAL COPIERS	OBSERVED ON
11	262	115	51	38	8	8
10	279	16	44	16	9	4
9	174	15	45	15	5	4
8	176	28	42	19	10	7
7	217	182	15	11	4	3
6	216	5	42	39	11	11
5	0	0	0	0	0	0
4	89	31	6	5	1	1
3	170	67	28	17	4	3
2	150	17	34	8	13	7
1	32	6	11	9	3	3
TOTAL	1765	482(27%)	318	177(56%)	68	51(75%)

Following Notices Requesting PC and Office Equipment Shut-off:

- **84% of PCs on the 7th floor on**
- **19% of PCs on other floors on**
- **50% - 55% of PCs on during Fall, 1992 walk-throughs**
- **Responsibility for copier/printer shut-off needs to be assigned**

Equipment Turn-off/Turn-on Sequencing

BUILDING	EQUIPMENT	TIME OFF	TIME ON	DURATION
S.F. Austin	AHU	10:00p.m.	1:00a.m.	3.0 hours
	LIGHTS	11:00p.m.	1:30a.m.	2.5 hours
W.B. Travis	AHU	10:30p.m.	2:00a.m.	3.5 hours
	LIGHTS	11:30p.m.	2:30a.m.	3.0 hours
L.B. Johnson	AHU	12:00a.m.	3:00a.m.	3.0 hours
	LIGHTS	12:30a.m.	3:30a.m.	3.0 hours

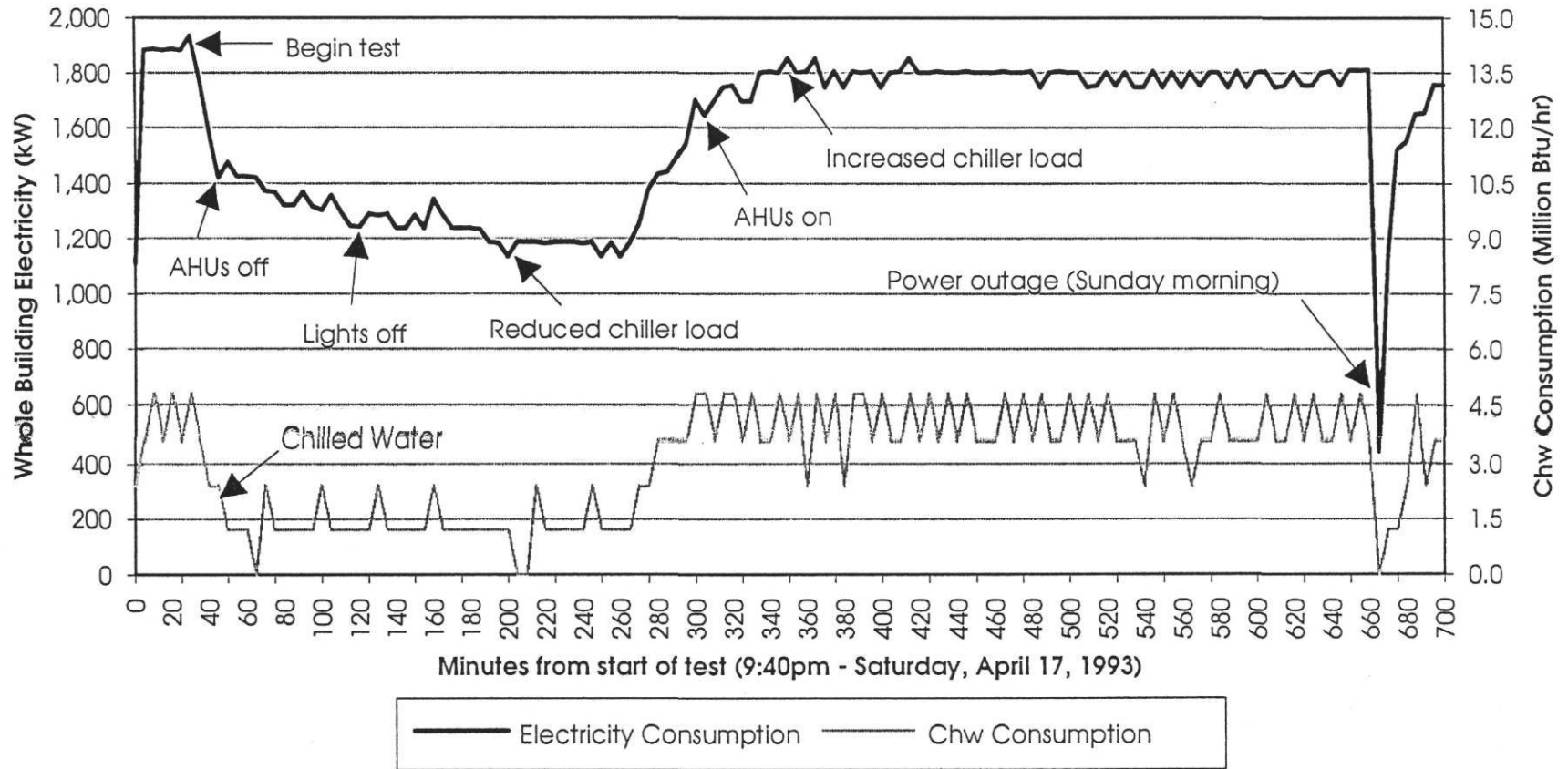
- **Used LoanSTAR recorders to measure test results**
- **Test designed to separately measure savings from:**
 - **Air handler shut-off**
 - **Lighting shut-off**
 - **Reduced air conditioning**

Actual Test kW Compared To Reported Potential kW

BUILDING	REPORTED POTENTIAL KW	ACTUAL TEST KW	% of POTENTIAL
S.F. Austin	405	386	95
W.B. Travis	167	97	58
L.B. Johnson	247	194	78
TOTAL	819	677	83

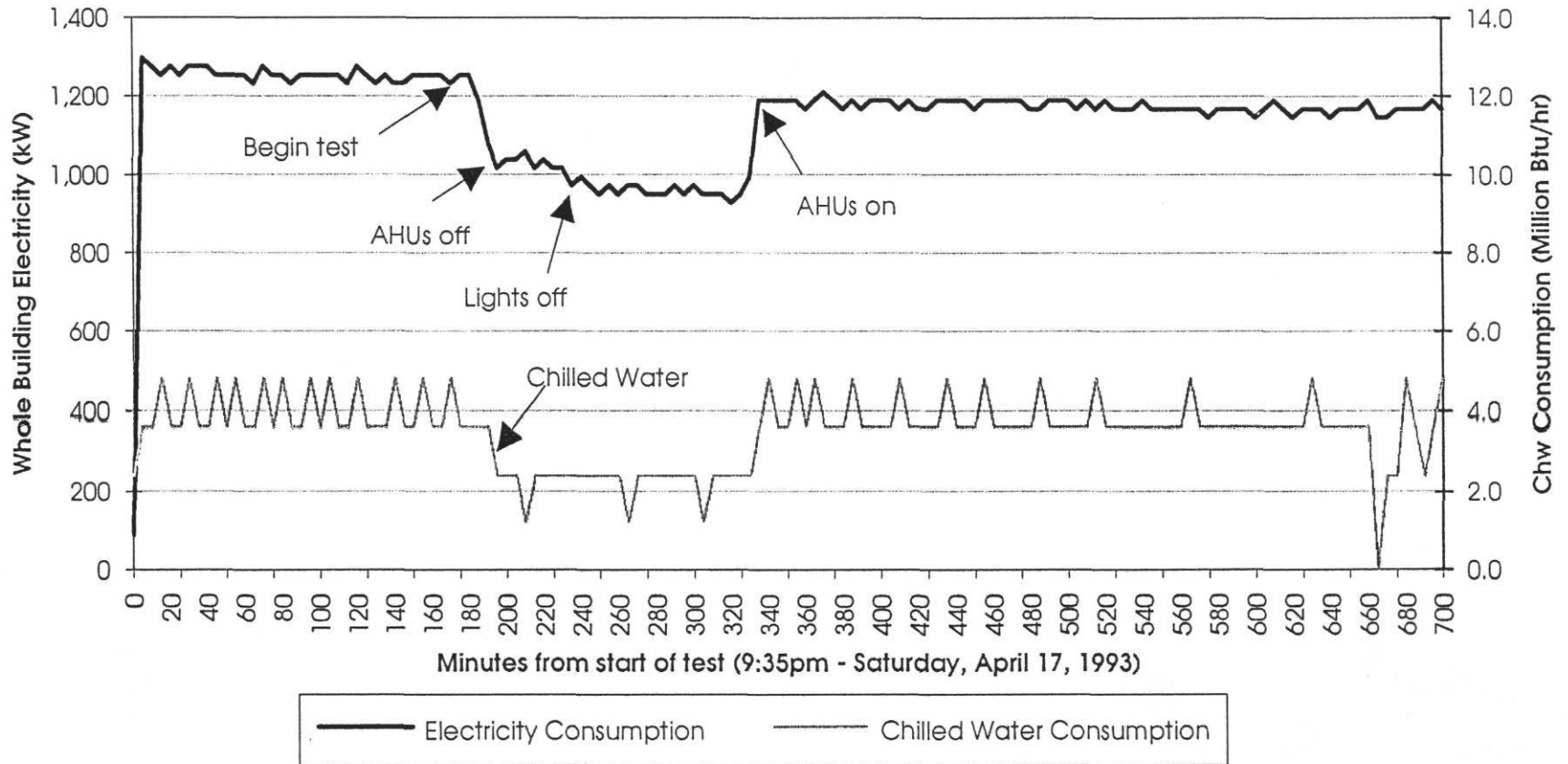
- . Due to special agency requests, only 58% to 95% of AHUs identified in earlier report were shut off**

S. F. Austin Whole Building Electricity & Chilled Water Consumption

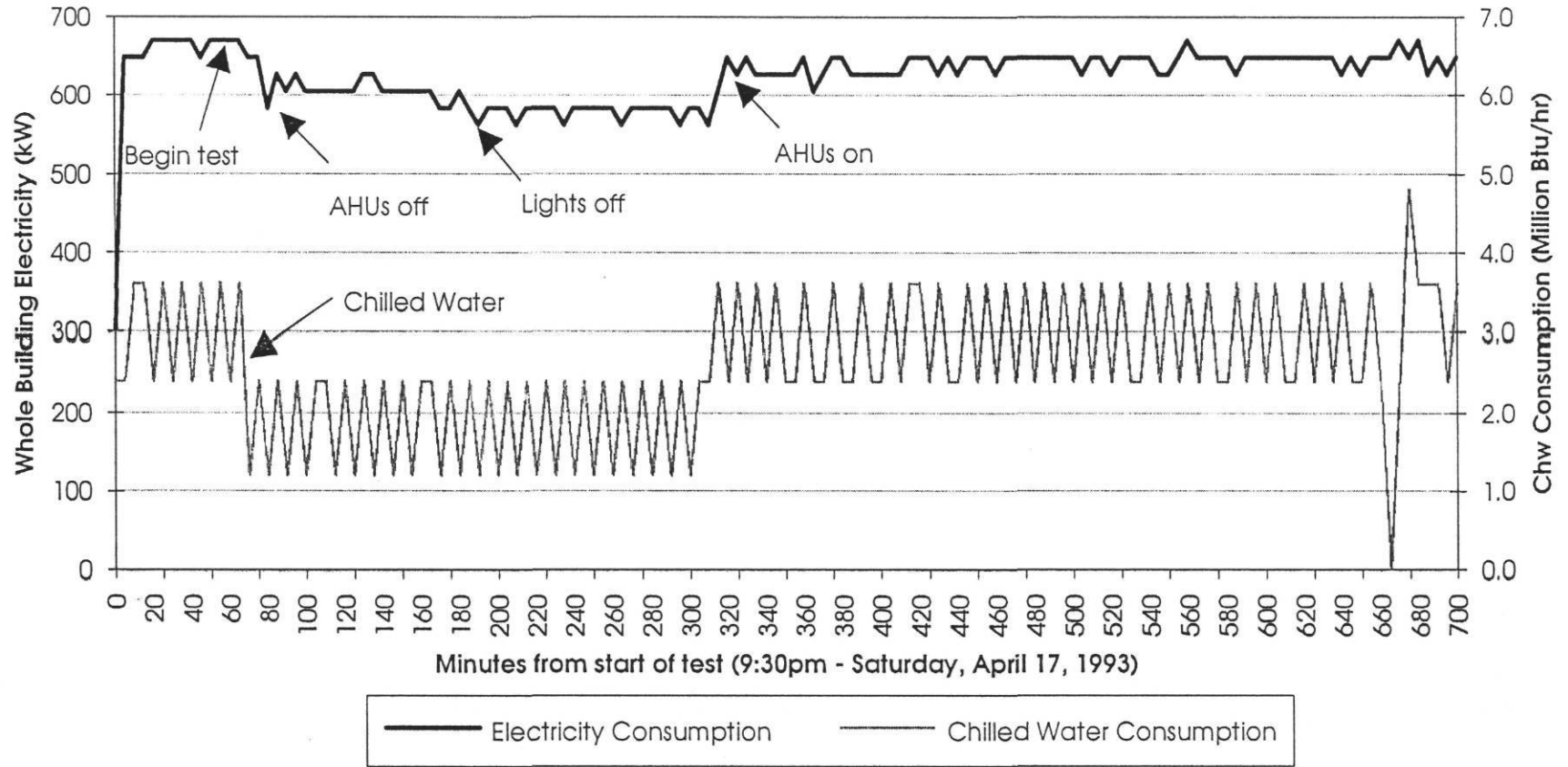


* Over 600 kW reduction when AHUs and lights turned off

L.B. Johnson Whole Building Electricity & Chilled Water Consumption



W. B. Travis Whole Building Electricity & Chilled Water Consumption



Original Potential Savings Compared To Field Test Savings

Building Name	AHU Potential savings	AHU Test Savings	Exhaust Fans	PCs and Machines	Lights	Total Potential Savings	Total Test Savings
SFA	\$138,500	\$133,002	\$1,500	\$15,500	\$6,900	\$162,400	\$156,902
LBJ	94,800	74,458	1,300	28,300	10,900	135,300	114,958
WBT	69,700	40,484	3,800	17,900	10,900	102,300	73,084
TOTAL	\$303,000	\$247,944	\$6,600	\$61,700	\$28,700	\$400,000	\$344,944

- **Note: the \$344,944 in test savings are 83% of the original \$400,000 savings potential due to air conditioning left on by agency request**

Recommendations

- . **Have operators manually turn off AHUs**
- . **Install time clocks**
- . **Remind employees to turn off lights, PCs and computer screens**
- . **Continue to educate employees on the subject of energy conservation**
- . **Discuss optimized scheduling with custodial staff**
- . **Continue turn-off testing by gradually increasing the off time**
- . **Assign responsibilities for copier/printer turn-offs**