West Virginia State University

Wallace Hall Project

Institute, West Virginia

West Virginia State University (WVSU) was founded as the West Virginia Colored Institute in 1891 under the provisions of the Second Morrill Act passed by Congress in 1862. During the turmoil of the American Civil War, it was one of the 17 original land-grant institutions authorized by Congress and designated to educating black citizens in agriculture and the mechanical arts. Today, WVSU has evolved to serve a 2600+ student population that is richly diverse in ethnicity, geography and age with numerous adult students. The University offers 21 undergraduate degrees, three graduate degrees and boasts an enviable 17 to 1 student/faculty ratio. It is the smallest of the nation's land-grant institutions.

WVSU is located in Institute, WV near Charleston, the largest and capital city of the state, and competes in athletics at the NCAA Division II level in five men's sports and five women's sports. It consists of 41 buildings on a 100-acre campus and has recently completed a major gymnasium renovation/addition and is building new student housing.

Project Highlights

Higher Education Classroom Facility

Name: West Virginia State University
Location: Institute, WV
Owner: State of West Virginia
Facility: Nine Story Classroom, Office and Auditorium Building - 85,000sf
Solution: Daikin Magnitude 250-ton Chiller

Issues: Since its construction in 1970, Wallace Hall has functioned as a major classroom facility for the University. The facility houses 35+ classrooms, an auditorium and numerous professorial/staff offices. It is the highest profile, signature building on the WVSU campus. When service of their antiquated centrifugal chiller became questionable, facility managers met with Daikin representatives from Mason & Barry Inc. seeking an opportunity to reduce their energy costs and eliminate the distracting noise levels in their academic and auditorium spaces. They chose to specify Daikin's innovative magnetic bearing technology for their replacement unit. Additionally, the magnetic bearing compressor in Daikin's "Magnitude" chiller eliminated the need for a lubricant, thereby eliminating the need for the costly and maintenance demanding oil management system of their previous unit. Marvin Smith, Assistant Director of the Physical Plant at WVSU, indicated that the cost of operation and maintenance as well as

performance reliability had become major issues in choosing the best alternative. After due diligence in the marketplace, Physical Plant Manger, Dayton Wilson shared that he was attracted to the Daikin "Magnitude" because of its ultra-quiet operation, which was especially important to the educational setting of Wallace Hall, and the frictionless magnetic bearing compressor which features variable speed drives, yields a greater reduction in energy usage and is less maintenance intensive.

Results:

A certified Daikin Technician fine tunes the unit's controls during installation.

Energy Consumption/Savings - The installation of a new 250 ton Daikin "Magnitude" chiller was completed on the second floor of Wallace Hall's 9 story layout in March 2013. Start-up and commission was completed by Daikin technicians and the unit went on-line in April. Actual energy consumption and savings have proven to meet and/exceed the expectations of the WVSU facility staff. As can be observed in the report submitted by WVSU's independent energy contractor, the consumption of kBtus and resulting billed cost avoidance during the Magnitude's first season of operation in 2013 provided a significant budget savings. Additionally, when normalized for weather differentiation, the new chiller accounted for a kBtus savings greater 40% over the base year resulting in significant normalized utility cost reduction approaching $13,000. Because of the high efficiency of the new chiller, WVSU is eligible, and has applied for a $20,000 energy grant from Appalachian Electric Power Company, the University's electrical provider. The grant will be applied toward the purchase of the equipment and will further reduce the University's investment.

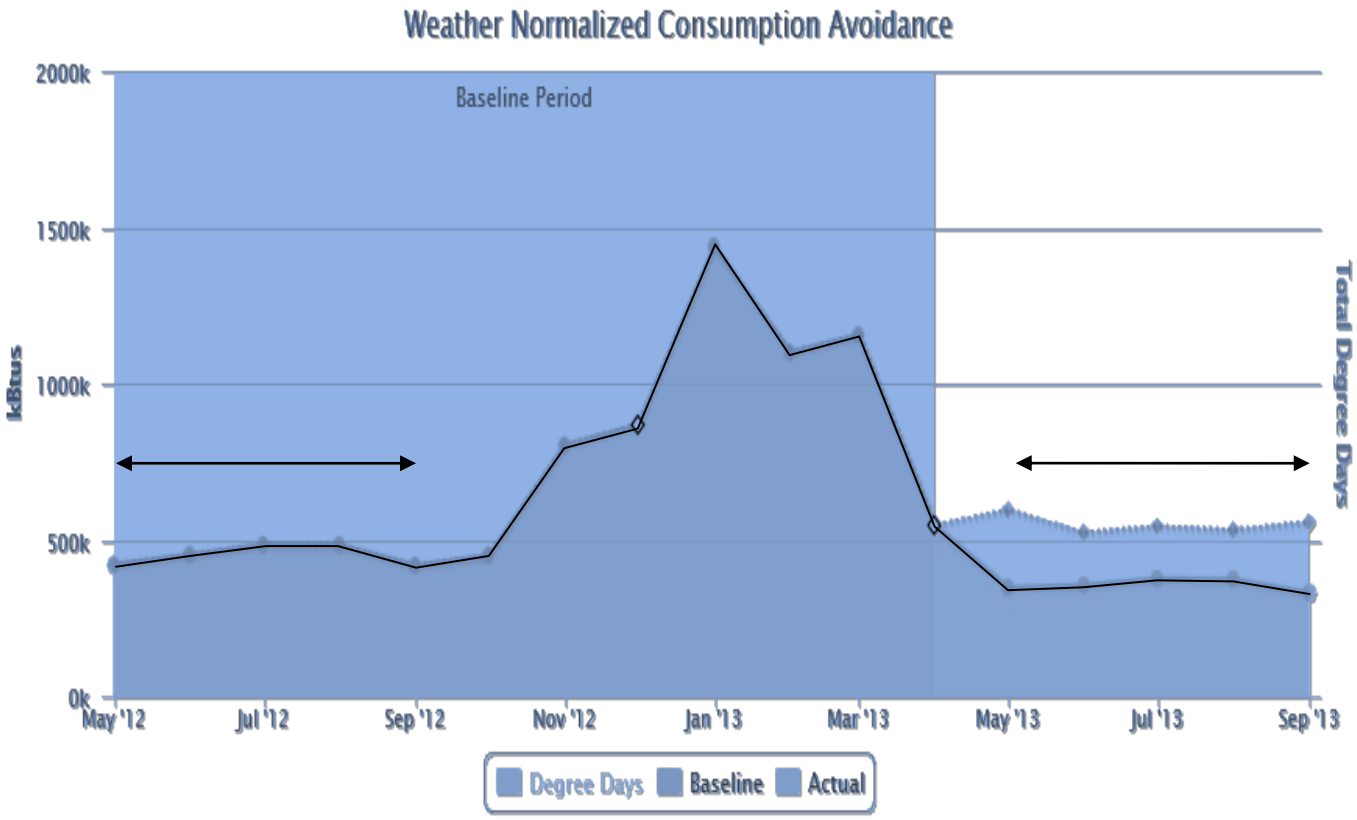
Noise Reduction – The Occupational Safety and Health Administration (OSHA) has determined that "an 8-hour time-weighted average of 85 decibels or a dose of fifty percent shall be referred to as the action level". With sound pressure ratings as low as 76 dBA tested per AHRI Standard 575, Daikin's Magnitude is the quietest chiller on the market in its size range. By comparison, the sound of a telephone dial tone is 80dB. As a further enhancement, sound levels are further reduced when demand lowers the load on the unit. Consequently, this is the only chiller mechanical room on the WVSU campus without

OSHA issues and notifications. As result, these sound improvements have reduced the noise in the facilities classrooms to a non-existent level which is conducive to the educational/instructional intent of the building.

Energy Cost Avoidance Snapshot

New Magnitude Chiller - West Virginia State University

Base year kBtus are Actual - No adjustments were made



Month	Actual kBtus	Base Year Month	Baseline kBtus	Billed Consumption Avoidance kBtus	Billed Cost Avoidance	Weather Normalized Baseline kBtus	Weather Normalized Consumption kBtus	Weather Normalized Cost Avoidance
May-13	346,760	May-12	420,405	73,645	$1,761.21	594,764	248,003	$2,850.13
Jun-13	353,602	Jun-12	451, 802	98,200	$2,187.64	522,821	169,219	$2,766.91
Jul-13	375,392	Jul-12	483,267	107,874	$2,400.23	542,929	167,537	$2,484.36
Aug-13	373,592	Aug-12	483,031	109,439	$2,495.40	531,696	158,103	$2,101.67
Sep-13	329,976	Sep-12	417,262	87,286	$1,943.86	556,959	226,982	$2,377.82
				Total	**$10,788.35**			**$12,580.89**

Energy Consumption and Cost Avoidance Documentation Provided Courtesy of WVSU

Maintenance Cost Reduction – Because the impeller in a magnetic centrifugal chiller's compressor is suspended in a magnetic field instead of riding on bearings, it eliminates the efficiency-robbing friction inherent in traditional centrifugal chillers as well as the need for an oil lubrication system, purge system, and shaft seals. The chart of manufacturer's estimated maintenance costs over a 25 year period of ownership reflects the investment of significant dollars in the routine maintenance and up-keep of the traditional centrifugal chiller.

WVSU's Dayton Wilson conducts an operational inspection

Additionally, without proper maintenance, oil systems typically allow concentrations of oil in the refrigerant to be surprisingly high. With as little as 3.5% oil concentration, efficiency loss approaches 8 percent which, over a 30 year life cycle, equates to almost $350,000, more than twice the cost of the initial investment in energy usage alone.

Not only does the frictionless chiller increase operational efficiency, but the maintenance cost and personnel attention needed to maintain and operate it approaches a 60% reduction when compared to the average cost of the previous unit.

Return on Investment – Base on the cost savings achieved in the first year of operation, WVSU will regain their initial cost differential in the purchase of the magnetic centrifugal chiller in third month of its second operational season. The savings in energy for the remainder of the unit's life cycle will yield real dollars for the University's utility budge. The additional savings gleaned in purchase of supplies, materials, parts maintenance contracts and investment of personnel will generate operational budget reductions and provide funds for other needed projects at the University.

WVSU officials are quick to express their satisfaction with the performance, the ease of operation, and energy savings they are experiencing with the Daikin "Magnitude" chiller. Additionally, the reduction in operational noise has greatly enhanced the peaceful environment of the WVSU campus as well as the educational functionality of Wallace Hall for the students at West Virginia State University.

Manufacturer's Maintenance Cost Comparisons

The "Magnitude" Centrifugal Chiller by Daikin has none of these associated maintenance costs

Discount rate = 5%

Year	Maintenance	Cost	NPV	Cost	NPV	Cost	NPV
1	Oil inspection, vibration analysis	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00
2	Oil inspection, vibration analysis	$2,060.00	$2,060.00	$2,060.00	$2,060.00	$2,060.00	$2,060.00
3	Oil inspection, vibration analysis	$2,120.00	$2,120.00	$2,120.00	$2,120.00	$2,120.00	$2,120.00
4	Oil inspection, vibration analysis	$2,185.00	$2,185.00	$2,185.00	$2,185.00	$2,185.00	$2,185.00
5	Minor Overhaul/Shaft Seal Replacement	$21,000.00	$21,000.00	$11,000.00	$11,000.00	$0.00	$0.00
5	Complete Oil Change, vibration analysis	$3,500.00	$3,500.00	$3,500.00	$3,500.00	$3,500.00	$3,500.00
6	Oil inspection, vibration analysis	$2,316.00	$2,316.00	$2,316.00	$2,316.00	$2,316.00	$2,316.00
7	Oil inspection, vibration analysis	$2,385.00	$2,385.00	$2,385.00	$2,385.00	$2,385.00	$2,385.00
8	Oil inspection, vibration analysis	$2,457.00	$2,457.00	$2,457.00	$2,457.00	$2,457.00	$2,457.00
9	Oil inspection, vibration analysis	$2,530.00	$2,530.00	$2,530.00	$2,530.00	$2,530.00	$2,530.00
10	Complete Oil Change, vibration analysis	$4,025.00	$4,025.00	$4,025.00	$4,025.00	$4,025.00	$4,025.00
10	10-year tear down and bearing replacement	$42,000.00	$42,000.00	$45,000.00	$45,000.00	$50,000.00	$50,000.00
11	Oil inspection, vibration analysis	$2,682.00	$2,682.00	$2,682.00	$2,682.00	$2,682.00	$2,682.00
12	Oil inspection, vibration analysis	$2,765.00	$2,765.00	$2,765.00	$2,765.00	$2,765.00	$2,765.00
13	Oil inspection, vibration analysis	$2,848.00	$2,848.00	$2,848.00	$2,848.00	$2,848.00	$2,848.00
14	Oil inspection, vibration analysis	$2,934.00	$2,934.00	$2,934.00	$2,934.00	$2,934.00	$2,934.00
15	Complete Oil Change, vibration analysis	$4,630.00	$4,630.00	$4,630.00	$4,630.00	$4,630.00	$4,630.00
15	Minor Overhaul/Shaft Seal Replacement	$27,500.00	$27,500.00	$14,300.00	$14,300.00	$0.00	$0.00
16	Oil inspection, vibration analysis	$3,110.00	$3,110.00	$3,110.00	$3,110.00	$3,110.00	$3,110.00
17	Oil inspection, vibration analysis	$3,203.00	$3,203.00	$3,203.00	$3,203.00	$3,203.00	$3,203.00
18	Oil inspection, vibration analysis	$3,300.00	$3,300.00	$3,300.00	$3,300.00	$3,300.00	$3,300.00
19	Oil inspection, vibration analysis	$3,398.00	$3,398.00	$3,398.00	$3,398.00	$3,398.00	$3,398.00
20	Complete Oil Change, vibration analysis	$5,325.00	$5,325.00	$5,325.00	$5,325.00	$5,325.00	$5,325.00
20	10 year tear down and bearing replacement	$54,600.00	$54,600.00	$58,500.00	$58,500.00	$65,000.00	$65,000.00
21	Oil inspection, vibration analysis	$3,600.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
22	Oil inspection, vibration analysis	$3,708.00	$3,708.00	$3,708.00	$3,708.00	$3,708.00	$3,708.00
23	Oil inspection, vibration analysis	$3,820.00	$3,820.00	$3,820.00	$3,820.00	$3,820.00	$3,820.00
24	Oil inspection, vibration analysis	$3,934.00	$3,934.00	$3,934.00	$3,934.00	$3,934.00	$3,934.00
25	Oil inspection, vibration analysis	$4,052.00	$4,052.00	$4,052.00	$4,052.00	$4,052.00	$4,052.00
		Present value	$223,987.00	Present value	$207,687.00	Present value	$193,887.00

	Daikin	Carrier	York	Trane
Current Cost of Refrigerant / per 100lb	$905.00	$905.00	$905.00	$1,000.00
Projected Cost of Refrigerant / per 100lb in 5 years	$1,040.00	$1,040.00	$1,040.00	$1,500.00
Projected Cost of Refrigerant / per 100lb in 10 years	$1,175.00	$1,175.00	$1,175.00	???????

3% increase per year as a result of inflation and rising labor and material costs
Required maintenace intervals based on company IOM information as industry averages
Pricing based on average typical installed 300-700 Ton Centrifugal installation

Comparisons compiled by Dan Davis and Dan May – HAVTECH Inc., Columbia, MD