FEB 2020 APPA INSTITUTE

Everything You Wanted to Know About the Language of Energy and Utilities But Were Afraid to Ask!
Elective #632

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San Diego, CA

AIA Continuing Education Provider

Credit(s) earned on completion of this course will be reported to American Institute of Architects (AIA) Continuing Education Session (CES) for AIA members.

Certificates of Completion for both AIA members and non-AIA members are available upon request.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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Course Description

Taking part in conversations related to the world of "energy and utilities" requires learning the language just like learning a foreign language. This elective will acquaint you with the common terms, phrases, and concepts associated with the "talking the talk" and, more importantly, understanding the "talk". Participants will be given access to a "wiki-like" comprehensive energy and utility glossary website with links to take a "deeper dive". This course has been designed for individuals that are new to the world of "energy and utilities" and those that interact with E&U "experts" from time-to-time and would like to understand what in the world they are talking about!

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Learning Outcomes

Learning Objective 1:
Discuss the world of energy and utilities.

Learning Objective 2:
Learn the common terms, phrases, and concepts associated with energy and utilities.

Learning Objective 3:
Learn to interact with energy and utility experts.

Learning Objective 4:
Discuss the comprehensive energy and utility glossary website.

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AGENDA

1. Introductory Comments
2. Campus Utility Systems
3. Energy Terminology
4. Boilers, Power Plants, Steam, and Heat
5. Chiller Plants and Chilled Water Systems
6. Building Heating & Cooling Systems
7. Environmental Regulations Terminology
8. Q/A

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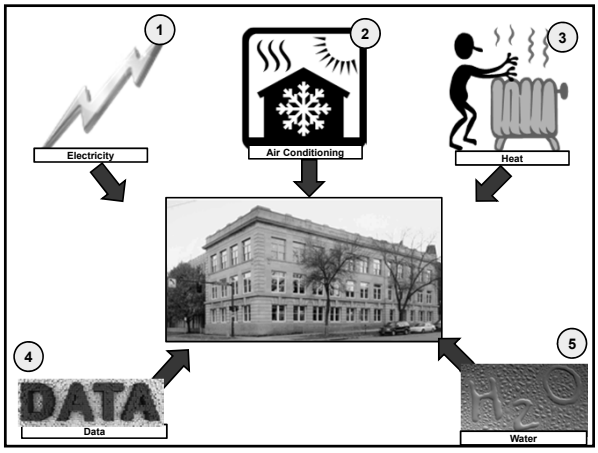

CAMPUS UTILITY SYSTEMS

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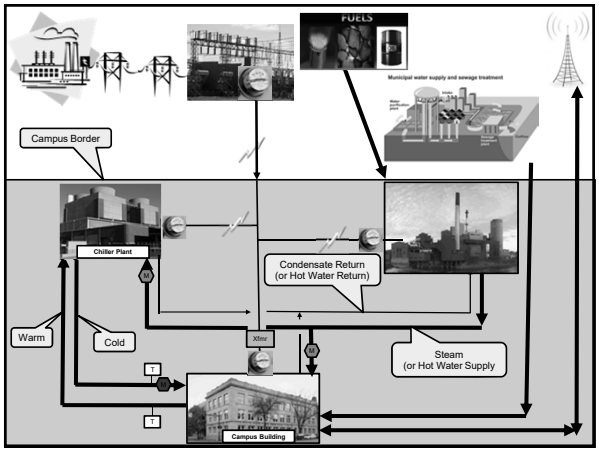

ENERGY TERMINOLOGY

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"Electrical Energy" Terminology

Kilowatt

Kilowatt-Hour

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Kilowatt

Kilowatt is "power" (the speed at which energy is "delivered").

One WATT = One Joule Per Second

One Horsepower = 0.746 Kilowatts

"KW" represents how "fast" or how much energy you are "demanding" from the utility company at any given time.

An indicator of how many electrical "things" are "on" at the same time.

Analogous to the "speed" indicator on a speedometer. The "energy" speedometer would indicate "joules/second."

Kilowatt-Hour

TEN 100 Watt light bulbs "on" for One hour consumes 1 KWH, or

A One KW hair dryer operating for One hour consumes 1 KWH.

Kilowatt-Hour is an amount of "energy".

"KWH" represents an amount of energy consumed over a period of time.

An indicator of "how long" a piece of equipment was running.

Analogous to the "odometer" on a speedometer. The "energy" odometer would register "kilowatt-hours" consumed.

"Electrical Energy" Terminology

Megawatt = Kilowatt x 1,000

Gigawatt = Kilowatt x 1,000,000

Megawatt-Hour = Kilowatt-Hour x 1,000

Gigawatt-Hour = Kilowatt-Hour x 1,000,000

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"Heat Energy" Terminology

BTU
Therm
MCF
MMBTU
Decatherm
Million BTU

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BTU

British Thermal Unit

The amount of energy required to raise one pound of water 1°F

1 BTU = 1,055 Joules

Therm

One Therm = 100,000 BTU

"Heat Energy" Terminology

One Decatherm = 10 Therms or 1,000,000 BTU

One MMBTU = 10 Therms or 1,000,000 BTU

One Million BTU = 10 Therms or 1,000,000 BTU

One MCF (~) 10 Therms or 1,000,000 BTU

1,000 Cubic Feet

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KV

- Kilovolts. Voltage is the electrical "pressure" that moves electrons through wires.
- "Transmission" Voltages: Voltages for moving electricity long distances (e.g. 69 KV or 115 KV)
- "Distribution" Voltages: Voltages used to move electricity around a town/campus (e.g. 12.5 KV or 13.8 KV)

ELECTRIC SUPPLY TERMS

Volts	The "force" behind the flow of electricity (analogous to water pressure)
"KV"	A unit of electrical voltage. KV = Kilovolt (or 1,000 volts)
"Transmission" Voltage	High voltages (e.g. 69 KV, 115 KV) of electrical wires transporting electricity of long distances/
"Distribution" Voltage	Voltages (12.5 KV to 33 KV) of electrical wires distributing to electricity with a relatively "local" area. Most common is 13 KV.
"Primary" Voltage	Voltage above 480 Volts (some utility companies will provide a discount if they provide higher voltages)
"Secondary" Voltage	Voltage level typically delivered to commercial buildings (480 Volts and less)
Amp (Amperes)	The typical measurement of electrical energy "flow" through a wire (analogous to water flow – GPM)
Power Factor	An indicator of how "efficiently" electricity is "utilized".
KVA	Stands for Kilovolt-Amps: Typically used as the rating of size of an electrical transformer.
NERC	North American Electric Reliability Corporation
Switchgear	The combination of electrical devices (switches, circuit breakers, fuses, etc.) used to control, protect, and isolate electrical equipment.
SCADA	Supervisory Control And Data Acquisition (monitoring and controlling systems remotely)
Substation	The part (a physical location) of a major electrical grid system where system voltages are increased (or reduced), electrical distribution systems are controlled.

OTHER FUEL SUPPLY TERMS

City Gate or Town Border Station	**The physical location at which a gas distribution company (like your local utility company) receives gas from a gas pipeline.**
Transport Gas	**Natural gas that is purchased directly from a natural gas marketer (not necessarily the utility company) and is "delivered" by the local utility company.**
System Gas	**Natural gas that is purchased from and delivered by the local utility company.**
LDC	**Local Distribution Company - refers to your friendly local utility company that delivers the gas.**
#1 through #6 Fuel Oils	**Types of fuel oils (liquids) that are used as fuels in boilers. The lower the number, the higher the price and the "thicker" it is. Sometimes, #6 is called "Bunker C".**
"Henry Hub"	**A major natural gas distribution hub located in Erath, LA. Often used as a natural gas "pricing point" for gas traded on the New York Mercantile Exchange (NYMEX).**
Biogas	**Mixture of methane and carbon dioxide produced by the bacterial decomposition of organic wastes and used as a fuel (landfills and anaerobic digesters give off lots of biogas)**
Biomass	**Organic matter derived from living, or recently living organisms used as as a source of "renewable" (most often refers to plants or plant-based materials which are not used for food)**

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ELECTRIC UTILITY TARIFFS

1. What is it?
   - Describes how the energy company will bill you for the electric service it provides.
2. Components of the electrical "tariff":
   - General characteristics/applicability
   - **Peak demand (KW) charges**
   - **Energy (KWH) charges**
   - Definition of "summer/non-summer" periods
   - More "peak demand" info
   - "Time of day" ("on-peak" vs. off-peak" definition)
   - Explanation of any "primary service" discounts
   - Explanation of "power factor" charge calculation
   - Description of the "energy efficiency cost recovery" charge
   - "Riders" and other information

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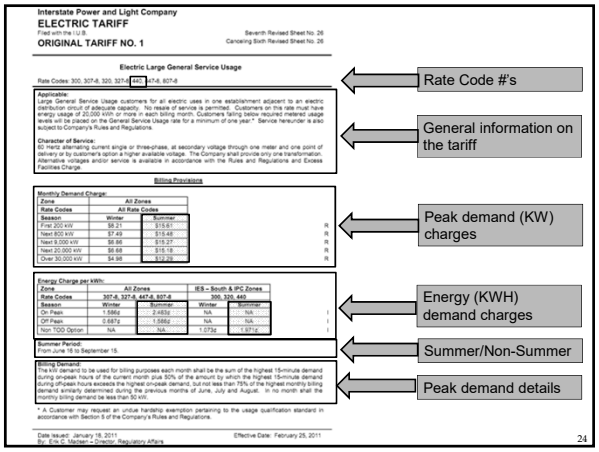
Interstate Power and Light Company

ELECTRIC TARIFF

Filed with the I.U.B.

ORIGINAL TARIFF NO. 1

Seventh Revised Sheet No. 26

Canceling Sixth Revised Sheet No. 26

Electric Large General Service Usage

Rate Codes: 300, 307-8, 320, 327-8, 447-8, 807-8

Applicable:

Large General Service Usage customers for all electric uses in one establishment adjacent to an electric distribution circuit of adequate capacity. No resale of service is permitted. Customers on this rate must have energy usage of 20,000 kWh or more in each billing month. Customers falling below required metered usage levels will be placed on the General Service Usage rate for a minimum of one year.* Service hereunder is also subject to Company's Rules and Regulations.

Character of Service:

60 Hertz alternating current single or three-phase, at secondary voltage through one meter and one point of delivery or by customer's option a higher available voltage. The Company shall provide only one transformation. Alternative voltages and/or service is available in accordance with the Rules and Regulations and Excess Facilities Charge.

Billing Provisions

Monthly Demand Charge:

Zone	All Zones	
Rate Codes	All Rate Codes	
Season	Winter	Summer
First 200 kW	$8.21	$15.61
Next 800 kW	$7.49	$15.48
Next 9,000 kW	$6.86	$15.27
Next 20,000 kW	$6.68	$15.18
Over 30,000 kW	$4.96	$12.29

Energy Charge per kWh:

Zone	All Zones		IES – South & IPC Zones	
Rate Codes	307-8, 327-8, 447-8, 807-8		300, 320, 440	
Season	Winter	Summer	Winter	Summer
On Peak	1.586¢	2.483¢	NA	NA
Off Peak	0.687¢	1.586¢	NA	NA
Non TOD Option	NA	NA	1.073¢	1.971¢

Summer Period:

From June 16 to September 15.

Billing Demand:

The kW demand to be used for billing purposes each month shall be the sum of the highest 15-minute demand during on-peak hours of the current month plus 50% of the amount by which the highest 15-minute demand during off-peak hours exceeds the highest on-peak demand, but not less than 75% of the highest monthly billing demand similarly determined during the previous months of June, July and August. In no month shall the monthly billing demand be less than 50 kW.

* A Customer may request an undue hardship exemption pertaining to the usage qualification standard in accordance with Section 5 of the Company's Rules and Regulations.

Date Issued: January 18, 2011

By: Eric C. Markert – Director, Regulatory Affairs

Effective Date: February 25, 2011

Rate Code #'s

General information on the tariff

Peak demand (KW) charges

Energy (KWH) demand charges

Summer/Non-Summer

Peak demand details

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BOILERS, POWER PLANTS, STEAM, AND HEAT

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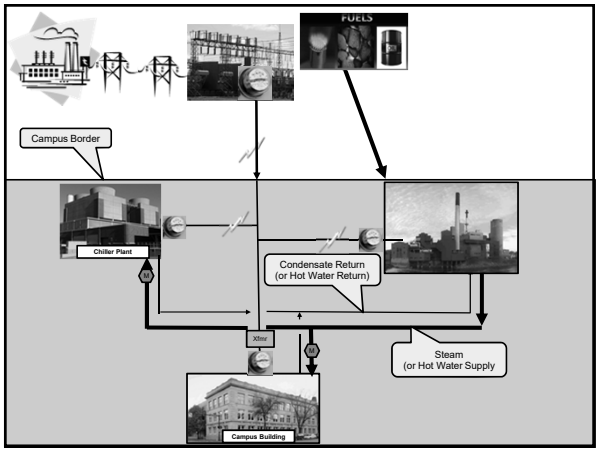

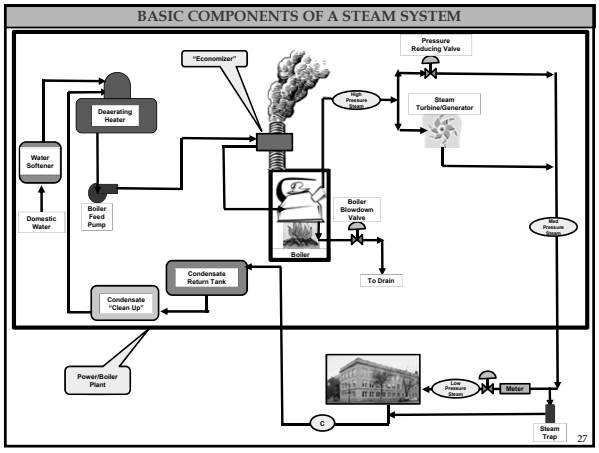

Cogeneration

Combined Heat and Power

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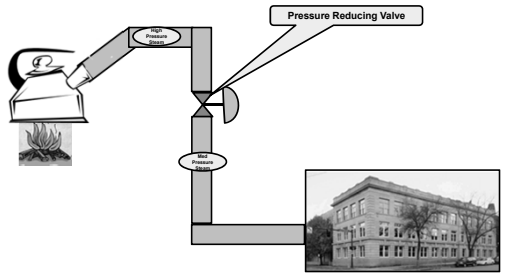
NOT Cogeneration!



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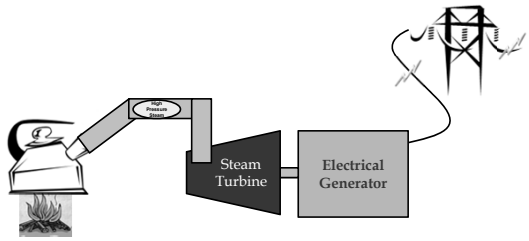
NOT Cogeneration!



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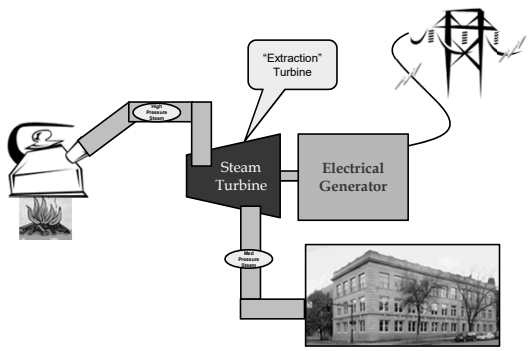
IS Cogeneration!



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From the EPA:

Cogeneration, also called "Combined Heat and Power" (CHP) is the simultaneous production of electricity **AND** heat from a single fuel source such as natural gas, biogas, coal, waste heat or oil.

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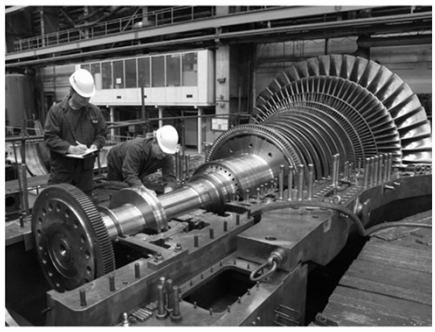

A modern steam turbine (source: Siemens).

Steam Turbine

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Combustion Turbine

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TWO MAIN TYPES OF BOILERS

Firetube

Watertube

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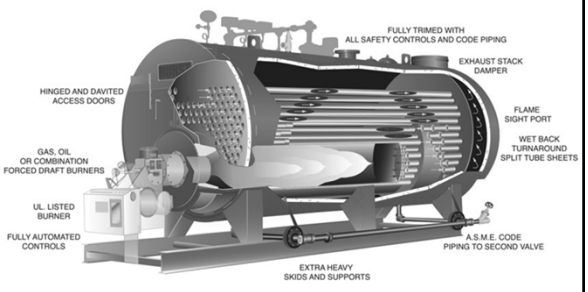

SOURCE: http://www.powerhouse.com/new-boiler/hurst-boiler-euro-series/

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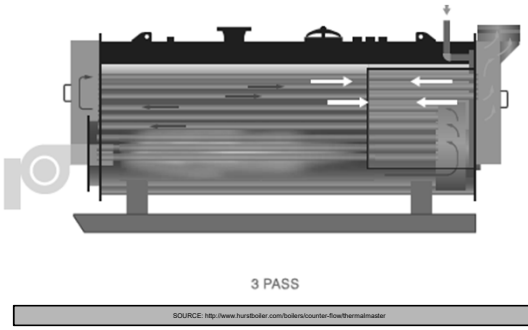

3 PASS

SOURCE: http://www.hurstboiler.com/boilers/counter-flowthermalmaster

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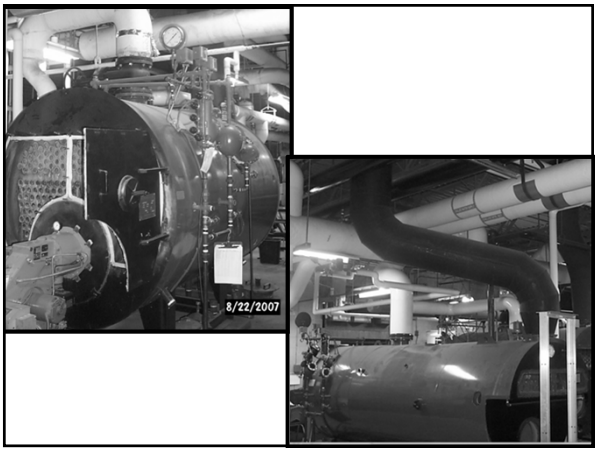
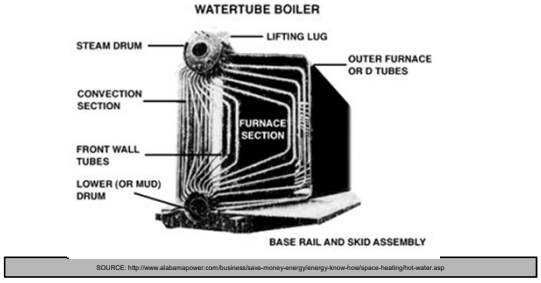


BOILER HORSEPOWER

- Used to designate the "steaming" capacity of certain types of boilers.
- Amount of energy required to evaporate 34.5 pounds of water in ONE hour at 212°F = 33,465 BTU/Hr



SOURCE: http://www.alabamapower.com/business/save-money-energy/energy-know-how/space-heating/hot-water.asp

Watertube boilers are normally rated in "pounds of steam per hour".

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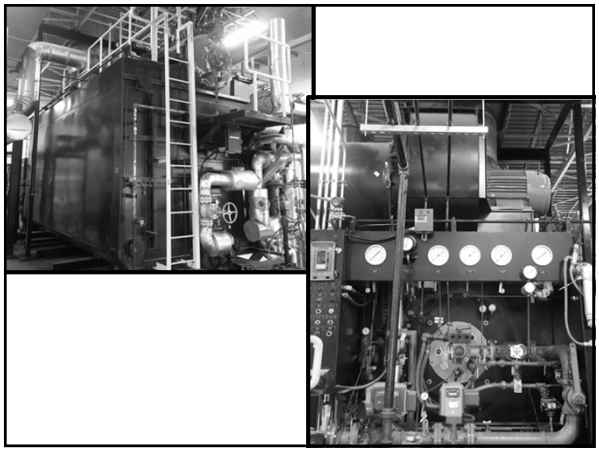
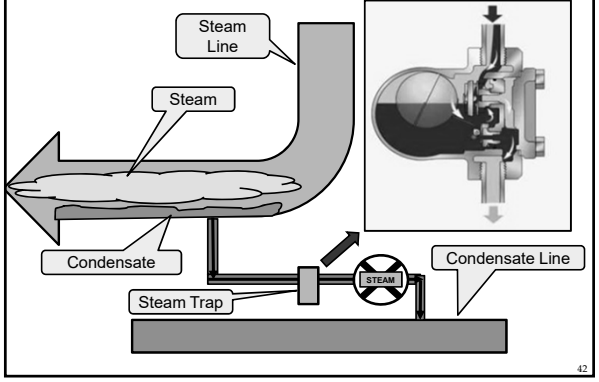


Steam Trap System



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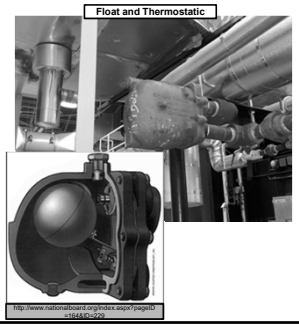
Steam Traps

Mechanical devices that allows steam condensate to leave a pipe or vessel but not steam!

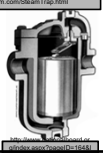
Float and Thermostatic



http://www.nationalboard.org/index.aspx?pageID=154&ID=229

Inverted Bucket

http://enerconsteam.com/SteamTrap.html



http://www.nationalboard.org/index.aspx?pageID=164&I

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POUNDS PER HOUR

- A way to indicate boiler capacity by the rate at which steam is generated in "Pounds of Steam per Hour".

BOILERS/HEATING/STEAM TERMS

HRSG	**Heat Recovery Steam Generator (pronounced "her-zig"). A HRSG is a non-fired boiler that generates steam using hot exhaust gases from a combustion turbine (or other source) as the source of energy.**
PRV	**Stands for Pressure Reducing Valve. Its function is to reduce steam pressure.**
Boiler Water Makeup	**Water that needs to be added to a steam system to replace steam that has been lost through leaks, boiler blow down and direct use applications**
Extraction Turbine	**A type of steam turbine that "exhausts" steam with enough energy left over so it can be used for space or process heating.**
High/Med/Low Temp Water	**High > 350°F; Medium between 250°F and 350oF; Low < 250°F**
High/Low Pressure Steam	**Low < 15 PSI; High > 15 PSI**

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Chiller Plants and Chilled Water Systems

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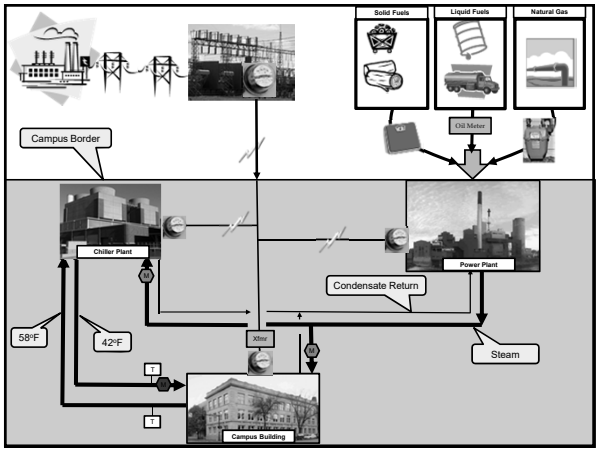

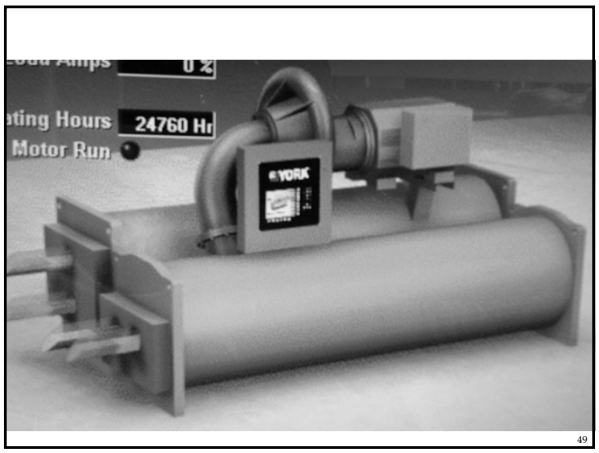

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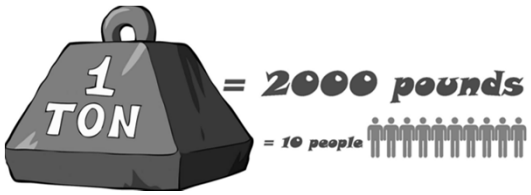
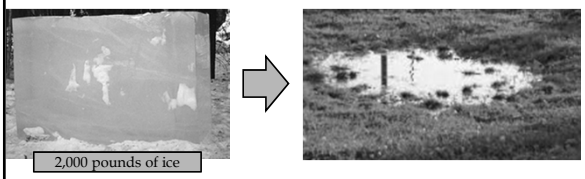
"TON" OF COOLING

NOT!

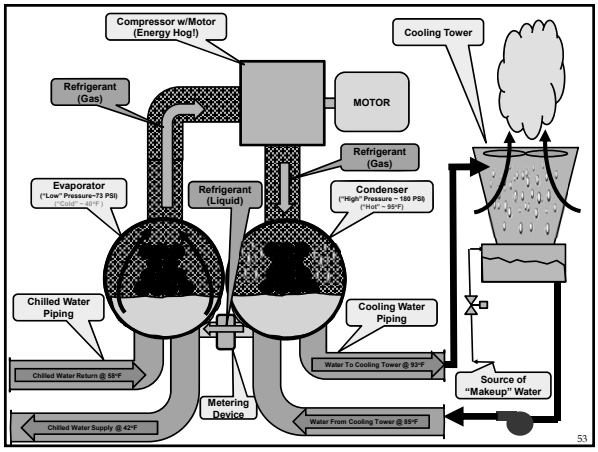


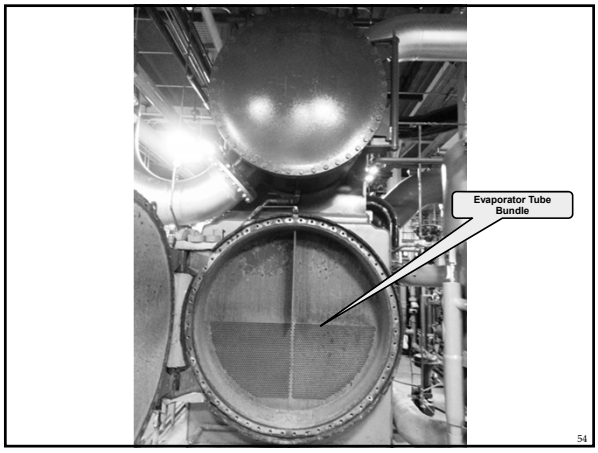
"TON" OF COOLING

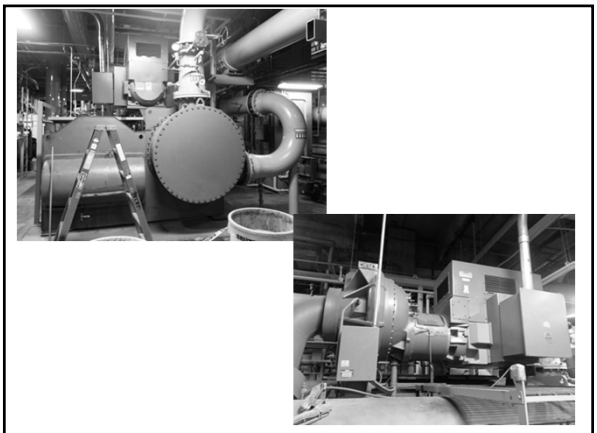
- Rate at which heat is being removed from a space or fluid.
- Defined at 12,000 BTU per hour.



Ice melting uniformly over a 24 period absorbs heat at a rate of 12,000 BTUs per hour!







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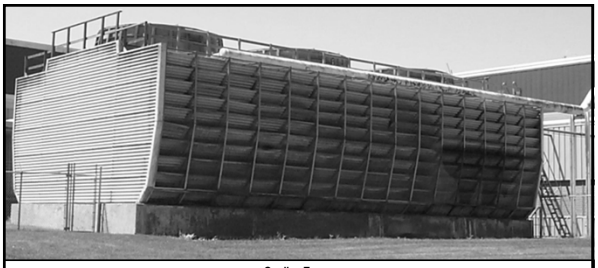


Cooling Tower

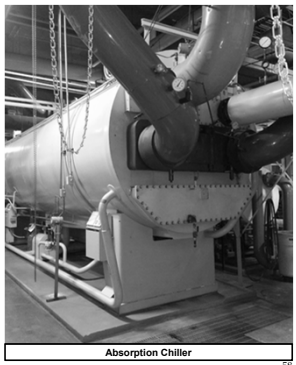
DELTA T

- Typically stands for "Temperature Difference".
- Often used to describe the performance of a cooling coil.

BTU's per Hour =
500 x Gallons per Minute (water) x Delta T

Using Steam To Make Chilled Water

Steam Turbine Driven Compressor



Absorption Chiller

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COOLING TERMS

Chiller	Large piece of equipment that "makes" chilled (or cold) water used to cool and dehumidifier air.
TON of cooling	Rate at which heat is being removed from a space or fluid (12,000 BTU/hr). Analogous to "Kilowatts".
TON-HOURS of cooling	Represents the amount energy being removed from a space (i.e. how much cooling took place). Analogous to "Kilowatt-Hours". (1 "MMBTU = 83.33 "TON-HOURS")
COP or Coefficient of Performance	An indicator of the efficiency of an air conditioning system. For cooling equipment: The ratio of the amount of heat removed to the amount of energy required to remove the heat. The higher the better!
KW/Ton	An indicator of the efficiency of an air conditioning (or chiller) system. This is the amount of electrical power (KW) required for "One Ton" of refrigeration. The lower the better!
Delta T	Typically stands for "Temperature Difference". Often used to describe the performance of a cooling coil.
Thermal Storage	Sometimes colleges and universities store "coldness" to draw on during periods of high electrical prices (they can shut down electrical chillers) and/or to supplement chilled water capacity. The "coldness" is stored in large tanks filled with cold water (chilled water) or ice.
Primary, Secondary, Tertiary Pumping Systems	Primary Pumping – pumping though the chillers, Secondary Pumping – pumping to the buildings, Tertiary Pumping – pumping in the buildings.
Absorption Chiller	A type of chiller that uses steam as the primary energy source to create the refrigeration effect.

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BUILDING HEATING AND COOLING SYSTEMS

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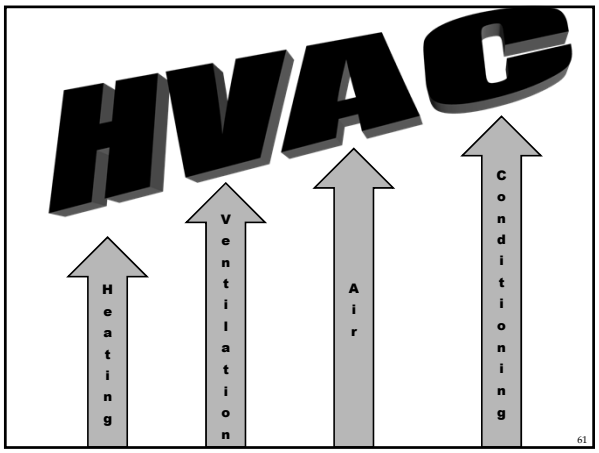
HVAC
Heating
Ventilation
Air
Conditioning
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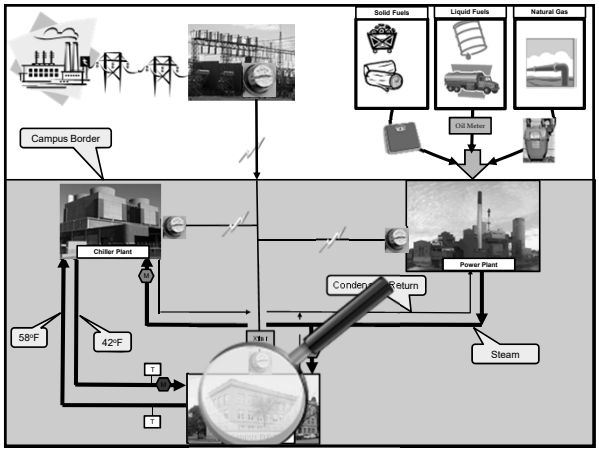
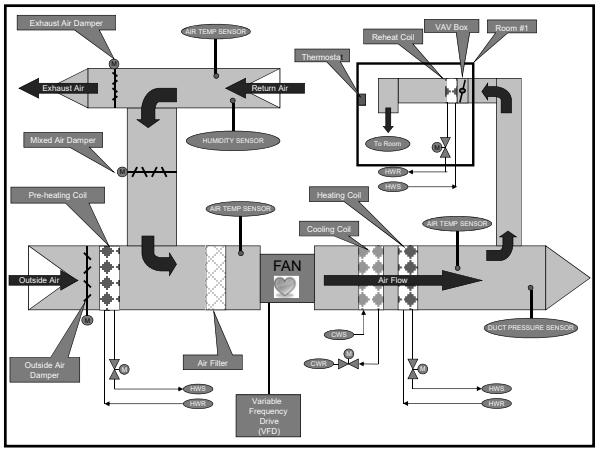

Solid Fuels
Liquid Fuels
Natural Gas
Oil Meter
Campus Border
Chiller Plant
Power Plant
Condens
Return
58ºF
42ºF
Steam


Exhaust Air Damper
AIR TEMP SENSOR
Reheat Coil
VAV Box
Room #1
Thermostat
Exhaust Air
Return Air
HUMIDITY SENSOR
To Room
Mixed Air Damper
HWR
HWS
Pre-heating Coil
AIR TEMP SENSOR
Heating Coil
Cooling Coil
AIR TEMP SENSOR
FAN
Outside Air
Air Flow
DUCT PRESSURE SENSOR
CWS
CWR
Outside Air Damper
Air Filter
HWS
HWR
Variable Frequency Drive (VFD)
HWS
HWR

VAV BOX

- Variable Air Volume Box – controls the amount of air entering a space.

BAS

Building Automation System

- The automatic control system that monitor and control the major building heating and cooling systems (and other systems).

AKA:
BES (Building Energy System)
BEMS (Building Energy Management System)

DDC

Direct Digital Controls

- A type of BAS that is based on electric, "digital," computer-based networked controls.

CFM

- Represents the air flow rate capacity of an a air handling system in "Cubic Feet per Minute."

VFD

Stands for Variable Frequency Drive.

- An electronic device the controls the rotational speed of a motor by changing the "frequency of the power" going to the motor.
- Goal: Allow a fan or pump to deliver only that amount of air/water that's needed.

HYDRONIC

- A heating or cooling system that uses circulating water (hot or cold) to heat or cool a space.

ENERGY MGMT, CONTROL AND HVAC TERMS

BAS	Building Automation System: The automatic control systems that monitors and controls the major building heating and cooling systems.
DDC	A type of BAS that is based on electric, "digital" control systems. Stands for Direct Digital Controls.
PNEUMATIC	Building control systems that uses compressed air as its "communication" and "operating" media.
BACnet	Building Automation and Control Networks: A data communication protocol is a set of rules governing the exchange of data over a computer network.
VFD	An electric device connected to an electric motor that changes the rotational speed of the motor. Stands for Variable Frequency Drive.
Converter	A heat exchanger that uses steam to heat water.
"Latent" Heat	Heat associated with condensing moisture from humid air
"Sensible" Heat	Heat associated with reducing or increasing air temperature
Freeze-Stat	A temperature sensing device that is located in an air handler that shuts the unit down automatically if the air temperature in the chilled water coil section gets too cold to prevent the cooling coil from freezing.

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ENVIRONMENTAL MANAGEMENT TERMINOLOGY

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Environmental Management

Title V Operating Permit: Large sources and some smaller sources must obtain a Title V permit to operate the facility. The permit includes all air pollution requirements that apply to the source, including emissions limits and monitoring, record keeping, and reporting requirements.

New Source Review (NSR)/ Prevention of Significant Deterioration (PSD) Permit: If a facility is planning to install a new major source of air pollution or a major modification to an existing source, it must first obtain a permit. A facility must acquire a nonattainment NSR permit if an area is in nonattainment, while it must obtain a PSD permit if it is in an attainment area.

Boiler MACT/RICE MACT: EPA Rules that require the highest possible degree of hazardous air pollutant (HAP) reduction while considering the costs of achieving such reductions. MACT = Maximum Achievable Control Technology. RICE = Reciprocating Internal Combustion Engines.

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Environmental Management

- **NPDES Permit: A facility that discharges pollutants into waters of the United States must obtain a NPDES permit. This program also includes permits for stormwater (MS4, or Municipal Separate Storm Sewer Systems). NPDES = National Pollutant Discharge Elimination System.**
- **SPCC: A rule issued by the EPA providing requirements for oil spill prevention, preparedness and response to prevent oil discharges to navigable waters. SPCC = Spill Prevention, Control and Countermeasures.**
- **Refrigerant Management: Facilities must comply with CAA Title VI requirements for ozone-depleting substances, including a prohibition on venting refrigerants and maintenance, monitoring, and record-keeping requirements.**

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This concludes The American Institute of Architects Continuing Education Systems Course.

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Q & A WRAP-UP

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