Wastewater/Water Sustainable Energy Cohort

WASTEWATER/WATER SUSTAINABLE ENERGY COHORT

Energy Efficiency in Pump Stations – Part 2 Wastewater

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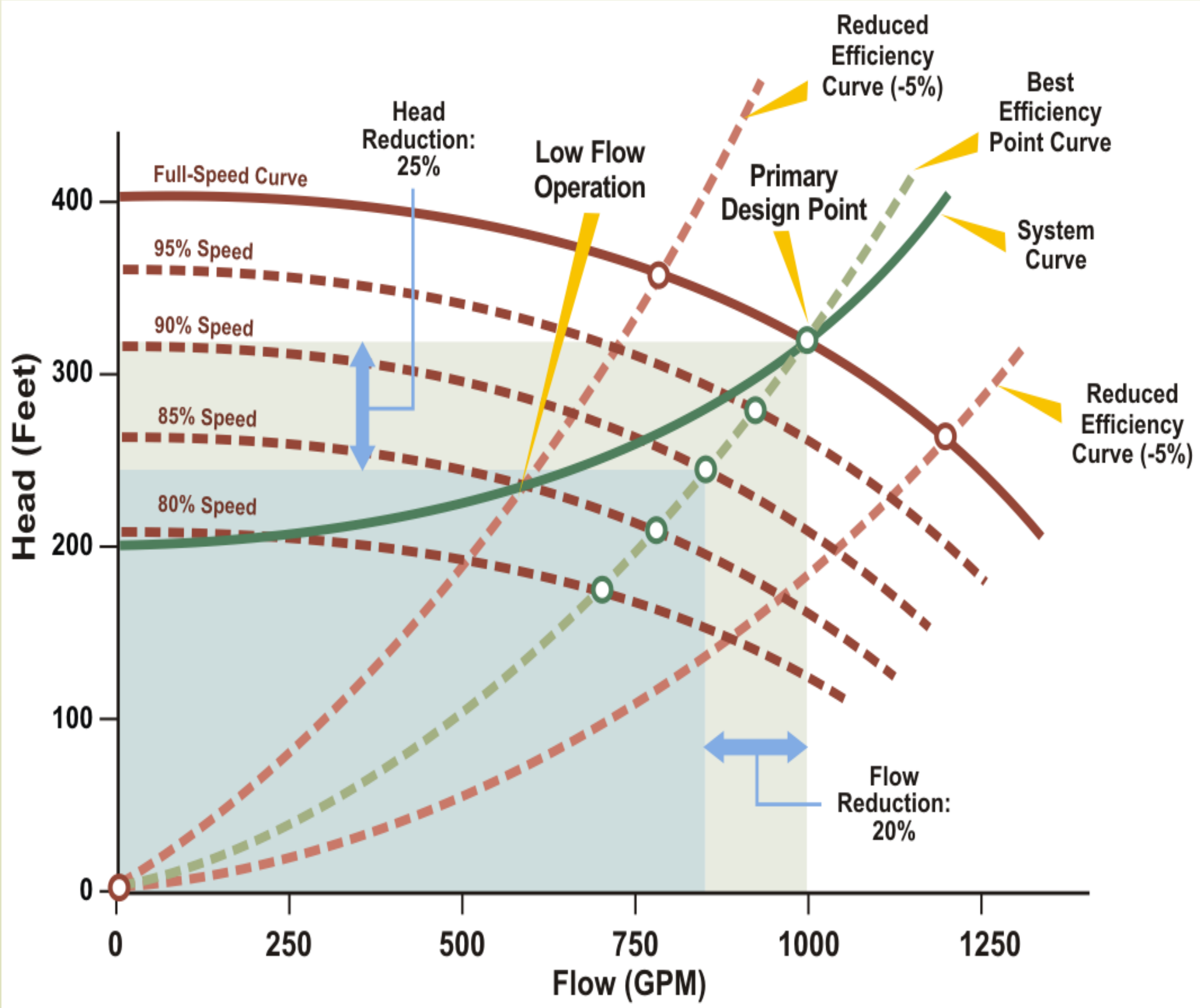
Optimize Pump Selection

- Operating on best part of pump curve
- Typical vs rated conditions
- Variable speed operation



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Optimize Force Main Route and Size

Competing issues affecting efficiency:

Solids deposition

- 3 to 3.5 fps minimum for intermittent operation
- 2 fps minimum for continuous operation

Detention time (odor/corrosion control)

- Varies (smaller pipe will result in more severe odor issues)
- Pierce County rule of thumb = 8 hours maximum

Water hammer

- Higher velocity, more hammer (> 4fps)

Future vs start-up flows

Optimize Force Main Route and Size

Air in force main reduces efficiency:

Importance of air release valves increases with pipe size

- Required velocity to flush air at 0% slope

4”	2.9 fps
6”	3.5 fps
8”	3.8 fps
10”	4.3 fps
12”	4.7 fps
16”	5.4 fps
18”	5.7 fps

Source: Table B-9, Pump Station Design, 3rd Ed, Garr Jones, et al.

Optimize Force Main Route and Size

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Routing opportunities

City of Shelton

- Capacity increase needed to 12 mgd
- New station constructed ½ way down force main
- Equipment upgrade at old station
- Savings:
  - Reduced horsepower
  - Reduced friction loss

Ragging Pumps

Most significant reduction in pump efficiency

Evaluate the conditions prior to design

- History of clogging
- Known upstream issues
    - Example – correctional facilities

Results of ragging

- Ragging causes shut downs and maintenance
- Minor ragging drops efficiency before problem is evident to maintenance
    - Added power draw
    - Added pump run time
    - More frequent need for lag pumps

Pumps Options for Ragging Issues

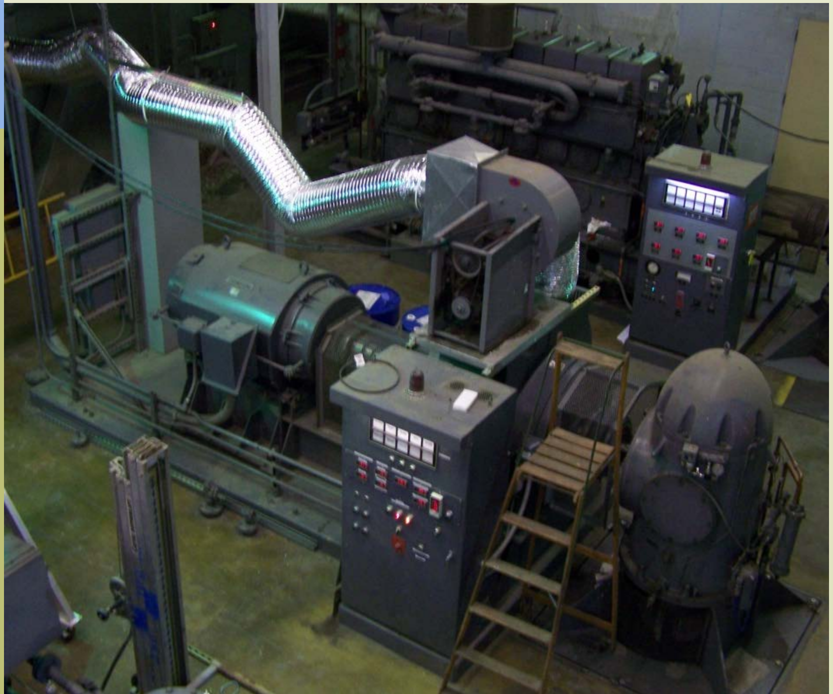
Impeller types for sewage

- Non-clog centrifugal (traditional impeller type for sewage)
  - Keep wear ring clearance at manufacturer's recommendation
    - » Tend to collect rags between wear rings
    - » Ragging worse on left side of pump curve (high head, low flow)
    - » Ragging worse with variable speed operation
- Screw centrifugal
  - Good solids passing and resistance to ragging in variable speed operation
    - » Can have vibration issues
- Proprietary semi-open impellers
  - Flygt N-Impeller
    - » Some models have reduced spherical solids passing ability
  - ABS Contrablock

Single volute vs double volute pumps (high head)

Drive Selection and Variable Speed

Inefficient Eddy Current Clutches



- Variable Frequency Drives (VFDs) vs Constant Speed
- Control valves to VFDs
  - Ball valves
- Eddy current clutches (ECC) to VFDs
  - King County Bellevue and Interbay Pump Stations
    - 40% efficiency gain
  - ECC % efficiency = % of full speed
  - ECC heat load on HVAC system
- Liquid rheostat variable speed systems to VFDs
  - City of Olympia Water St PS
  - City of Bellingham Oak St PS

Efficiency Gains in the Wet Wells

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Improve pump inlet conditions

- Provide adequate NPSHa
- Provide adequate submergence
- Avoid pre-swirl

Reduces ragging

Remove air entrainment

- Avoid free fall at inlet

Concrete fillets in corners

Flow splitter under pump inlet

Floor cone under pump

Other topics

- HVAC – primarily dictated by energy code
- Odor Control

  Improving design and operation to minimize odor control costs

  » Selecting suitable materials and equipment

  » Eliminating free fall in wet well

- System training
- Data collection and normalizing costs
- Demand charges

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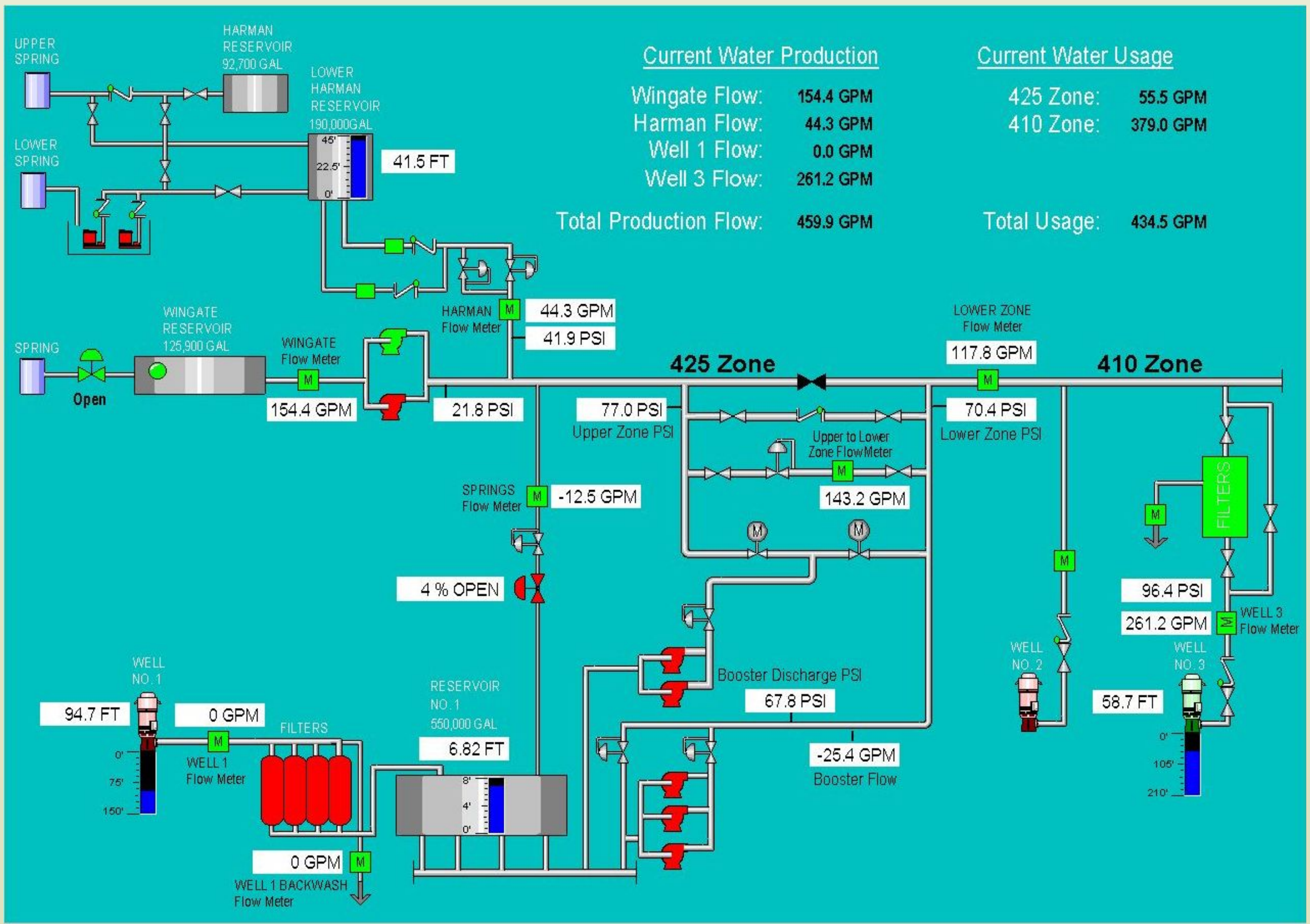
Data Collection and Normalizing Costs

Using SCADA (supervisory control and data acquisition) to find energy saving opportunities



Data Collection and Normalizing Costs

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Using SCADA (supervisory control and data acquisition) to find energy saving opportunities

- Electrical Utilization Reports
  - Manually enter cost from utility bills or install power monitoring equipment
  - Total gallons pumped
- Cost of Operation Report
  - Cost per unit of water for each facility
  - Coincide start and end dates with your utility bill
  - Report or “Live Screen”
- Objective: Create a real time report that allows for real time decisions

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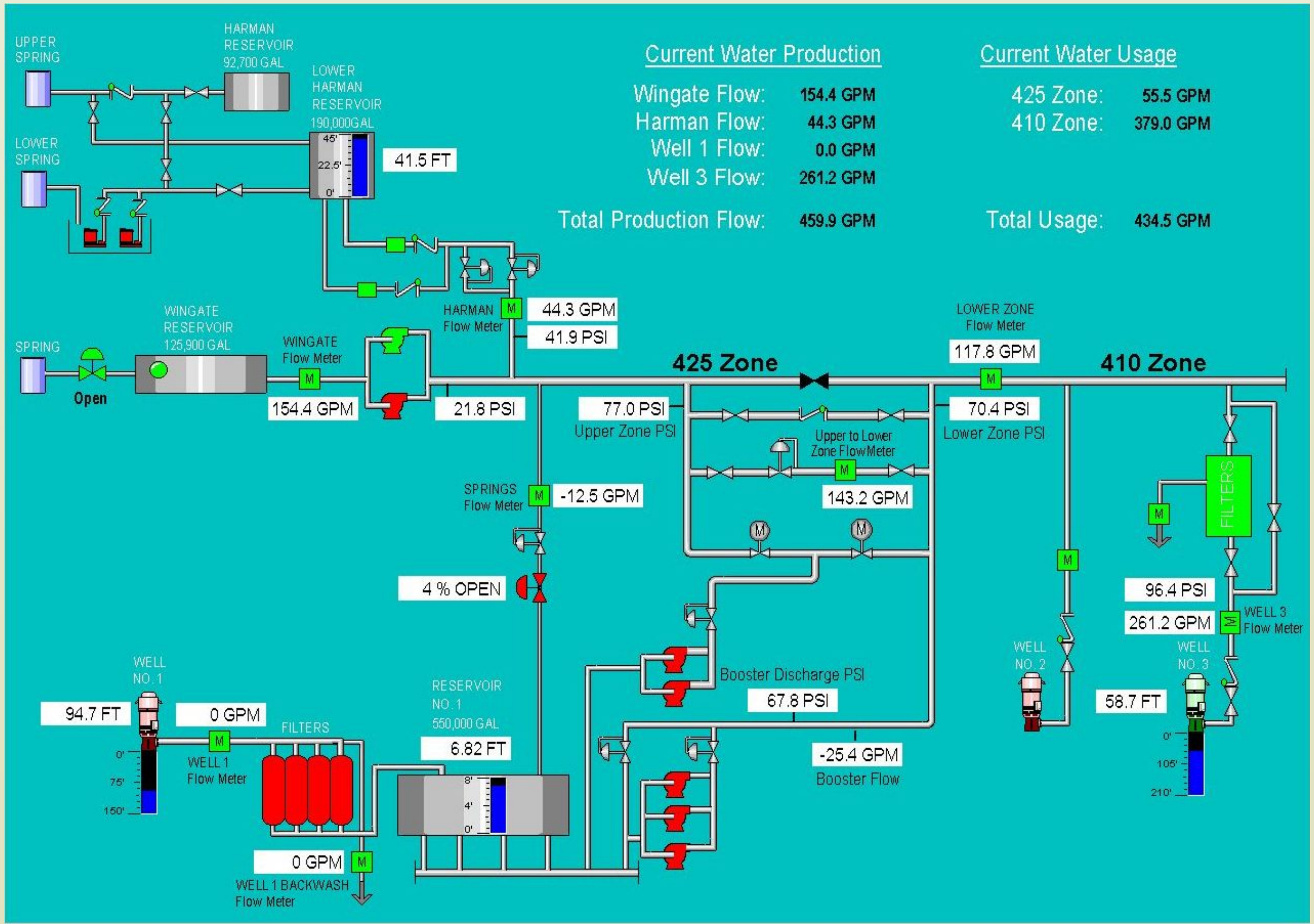
Data Collection and Normalizing Costs

Example:

- Filling reservoirs based on lowest power usage rather than only on low level



Demand Charges

Electric Detail:

Rate/ Dates	Meter Number	Pres Read	Prev Read	Pres Date	Prev Date	Mult	KWH (Usage)	Bill Demand	KVAR Hours	Code	Amount
25E-C-KV				10/14		40		111.36		ACTL	
25E-C-KV		08459	08344	10/14	09/15	40			4600	ACTL	
25E-C-KV		10679	10542	10/14	09/15	40	5480			ACTL	

09/16/10 09/30/10	Basic Charge		$26.07
09/16/10 09/30/10	Energy Charge	2,834.48 KWHS @ $.081614 Per KWH	$231.33
09/16/10 09/30/10	Demand Charge	50 KW @ $.00 Per KW	$.00
09/16/10 09/30/10	Demand Charge	61.36 KW @ $5.86 Per KW	$185.98
09/16/10 09/30/10	Reactive Power Charge	2,379.3 KVRH @ $.00276 Per KVRH	$6.57
09/16/10 09/30/10	Electric Conservation Program Charge	2,834.48 KWHS @ $.003972 Per KWH	$11.26
09/16/10 09/30/10	Power Cost Adjustment	2,834.48 KWHS @ $.00 Per KWH	$.00
09/16/10 09/30/10	Wind Power Production Credit	2,834.48 KWHS @ $.00 Per KWH	$.00
09/16/10 09/30/10	Merger Credit	2,834.48 KWHS @ $.000192CR Per KWH	$.54CR
09/16/10 09/30/10	Regulatory Asset Tracker	2,834.48 KWHS @ $.001762 Per KWH	$4.99
		Charge Total	**$465.66**
10/01/10 10/14/10	Basic Charge		$24.34
10/01/10 10/14/10	Energy Charge	2,645.52 KWHS @ $.089519 Per KWH	$236.82
10/01/10 10/14/10	Demand Charge	50 KW @ $.00 Per KW	$.00
10/01/10 10/14/10	Demand Charge	61.36 KW @ $8.79 Per KW	$260.38
10/01/10 10/14/10	Reactive Power Charge	2,220.7 KVRH @ $.00276 Per KVRH	$6.13
10/01/10 10/14/10	Electric Conservation Program Charge	2,645.52 KWHS @ $.003972 Per KWH	$10.51
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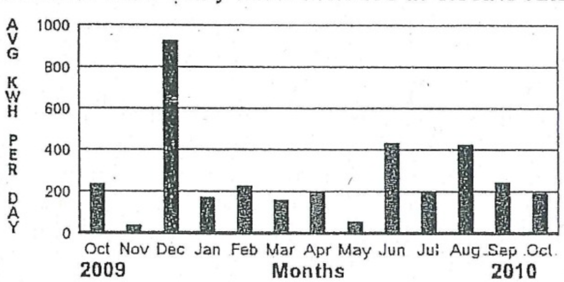
		Charge Total	**$542.33**
	Current Electricity Charges		**$1,007.99**

On October 01, 2010, a change to your bill became effective. Your usage charges for the periods before and after this date were calculated separately and are shown in separate sections, since these periods were billed differently.

Copies of the rate schedules are available upon request.

A late fee of 1% will apply to overdue charges, if any. Please see the reverse side for details on late payment charges.

A 3.873% state utility tax is included in electric rates charged.



ENERGY USAGE COMPARISON

For Bill Period	This Year	Last Year	Change
Sep-Oct			
No. of days	29	29	0
KWH use	5480	6760	-1280
Avg. KWH use per day	189	233.1	-44.1
Avg. temp. per day	57F	54F	3F

- 150 hp Well Pump
  - Total bill = $1007.99
  - Demand charges = $446 or 44%
- Avoiding demand charges is "green".
  - RCW 19.280.020 (2) "Conservation and efficiency resources" means any reduction in electric power consumption that results from increases in the efficiency of energy use, production, transmission, or distribution."

Demand Charges

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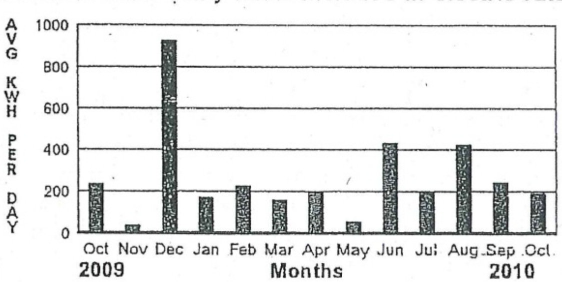

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PSE (example):

- Threshold: 50kW (67 hp)
- Highest 15 minute average
- Demand charges:
  - Apr-Sept $5.86 per kW
  - Oct-Mar $8.79 per kW
- Instant water heater vs hot water tank:
  - At 20 kW/gpm
  - 15 min shower = $175
  - vs. $2/mo for 80 gal water heater

Demand Charges

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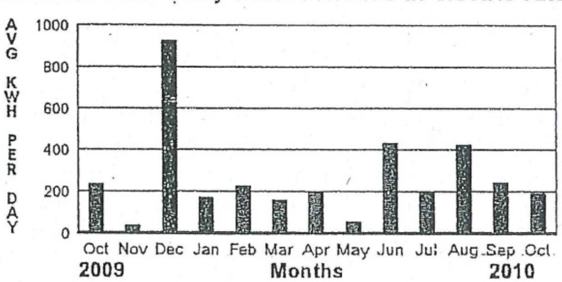

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Considerations:

- Instant water heaters
  - Water tanks
- Unit heaters
  - Interlocks
- Maintenance activities
  - Twice bi-monthly rather than once/mo
- Reservoirs
  - Fill slowly at night rather than based only on low level