TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE CASPER, WYOMING NRCS

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Designing a Solar Pumping System

The examples shown in this bulletin may be used to design a solar pump system or to review the plans provided by the landowner for the installation of a solar pump system. The design information may be documented on Wyoming Standard Engineering Plan 533-01.

The information contained in this technical note has been re-written from information presented at:

The Remote Solar and Wind Electric Stockwater Pumping Workshop
Dr. Sadrul Ula and Steve Fletcher
Wyoming Motor Training and Testing Center, University of Wyoming Electrical and Computer Engineering, February 2006

Water Information

- Information about the Well
  - Static water level
  - Draw down water level and at what flow rate
  - Well casing size
  - Depth of well
- Pipeline Information
  - Pipeline size
  - Total length of pipeline and elevation change
- Amount of Water Required by Livestock
  - Cow-calf pair
    - Summer 15-20 gallons per day (GPD)
    - Winter 10-12 GPD
  - Yearling
    - Summer 12-15 GPD
    - Winter 10-12 GPD
  - Sheep
    - Summer 2-4 GPD
    - Winter 10-12 GPD
  - Horse about the same as cow/calf pair

Pump Charts

- Grundfos SQ Flex Chart
- Lorentz PS600/PS1200 Chart

Solar Isolation Map

- See the attached map or go to

http://www.eia.doe.gov/cneaf/solar.renewables/page/solarphotv/solarpv.html

Design Example 1

- Old windmill, produces ~10 GPM
- Has a 4” steel casing
- 100’ deep, static water level at 40’
- 200 cow/calf pairs water at this location
- Well empties to open tank at well head
- Total water needed:
  - 200 X 20 = 4000 GPD summer
  - 200 X 12 = 2400 GPD winter
- Drawdown is unknown, so assume the pump will be at 95’. Therefore maximum head will be ~92’ due to the low water sensor protection.
- Pump is limited to 10 GPM flowrate
- Go to the Pump Charts:
- First, Lorentz PS600 (See Pump Chart)
- Next, Grundfos SQ Flex (See Pump Chart)
- What will the 11 SQF2 produce in the winter sun?
- 10.15 GPM X 4.5 HR X 60 MIN/HR = 2740 GPD
- Since both systems are similar in size and production, which one to pick?
- Well casing is 4”, the SQ Flex is 3” diameter and the HR-14 is 3.875” in diameter.
- SQ Flex is the only system that will fit in the casing, regardless of other considerations
- Use Grundfos 11 SQF 2 Pump
- IO 101 Switch Box
- 500 Watt Array – 30-300 Volts DC
  - 3 X 165-170 Watt Panels
  - 4 X 125 Watt Panels
  - 5 X 100 Watt Panels
- Rack for Mounting Panels
- 2 Wire with ground Submersible Pump Cable, Pipe, Safety Rope
- Optional
  - CU 200 Control Unit

Design Example 2

- New well with 2 mile pipeline to storage tank – then gravity flow to open tanks
- Has a 5” PVC casing
- 100’ deep well, static water level at 50’
- At 5 GPM well draws down to 60’
- 150 cow/calf pairs will use this water at one time
- Pipeline runs 2 miles with 150’ increase in elevation and is 1.5” HDPE
- Total water needed:
  - 150 X 20 = 3000 GPD summer
  - 150 X 12 = 1800 GPD winter
- Total head, at 5 GPM, is 60’ + 150’ + Friction loss in pipe
- Friction loss = .18’ of head per 100’
  - 5280 X 2 X 0.18 / 100 = 19.008’
- Total Head = 229’
- Go to the Pump Charts
- First, Lorentz PS 1200 (See Pump Chart)
- Next, Grundfos SQ Flex (See Pump Chart)
- What will the 11 SQF 2 produce in the winter sun?
- 8.5 GPM X 4.5 HR X 60 MIN/HR = 2295 GPD
- In this case the SQF produces more water in the summer, however at a higher flowrate which could cause problems with draw down and increased friction losses in the pipeline resulting in a higher head.
- The PS1200 HR-14 will produce enough water in both winter and summer while not overloading the well.
- Again, both systems use the same size of solar array.
- Use Lorentz HR-14 Pump
- PS1200 Controller
- 1000 Watt Array – 72-96 Volts DC
  - 6 X 165-170 Watt Panels
  - 8 X 125 Watt Panels
  - 10 X 100 Watt Panels
- Rack for Mounting Panels
- 3 Wire with ground Submersible Pump Cable, Pipe, Safety Rope and 2 wire sensor cable
- Optional
  - AC Power Pack Generator Converter

Use Standard Engineering Plan 533-01, Solar Panel Well and Surface Installation, and the Solar Pumping Table of Quantities, for construction drawings and documentation.

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State Conservation Engineer