Pumping Plant Detailed Evaluation Worksheet

Land user _____ Field office _____

Observer _____ Date _____ Checked by _____ Date _____

Field name or number _____ Acres irrigated _____

Hardware Inventory:

Power plant:

Electric motor(s):	Main pump	Booster (if used)
Make		
Model		
Rated rpm		
Rated hp		

Internal combustion engine:

Make _____

Model _____

Continuous rated hp at output shaft _____ hp at _____ rpm

Comments about condition of power plant _____

_____

Gear or belt drive mechanism:

Type: (check one) direct drive _____ gear drive _____ belt drive _____

_____ rpm at driver _____ rpm at pump

Pumps		
Type: (centrifugal, turbine, submers.)		
Make		
Model		
Impeller diameter		
Number of impellers		
Rated flow rate (gpm)		
at head of (ft)		
at rpm		

Pump curves: Attached _____ (yes or no)

Comments about conditon of equipment _____

_____

_____

_____

_____

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Existing suction or turbine column set-up (sketch showing dimensions)

Existing discharge set-up (sketch showing dimensions)

Data and computations:

Total Dynamic Head (TDH):

Elevation difference - water surface to pump outlet _____ feet

Pressure reading at pump outlet _____ psi

Pressure at pump inlet (where supply is pressurized) _____ psi

Estimated friction loss in suction pipe or pump column _____ feet

Miscellaneous friction loss _____ feet

TDH = (elevation difference between water source and pump discharge) + (discharge pressure - pressure at inlet) times 2.31 + (estimated suction pipe friction loss) + miscellaneous =

_____ = _____ feet

Flow rate:

Flow meter:

Flow rate = _____ gpm

Velocity meter:

Pipe ID _____ inches

Velocity _____ feet/second

Flow rate, Q, in gpm = (Velocity, in feet/second) x (2.45) x (pipe ID^2) =

= _____ = _____ gpm

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Water horsepower:

$$whp = \frac{\text{(flow rate, in gpm)} \times \text{(TDH, in feet)}}{3960} = \_\_\_\_\_ = \_\_\_\_\_ \text{ hp}$$

Energy input

Electric:

Disk revolutions _____

Time: min _____ sec _____ = _____ sec

Meter constant (Kh) _____

PTR (power transformer ratio - usually 1.0)[1/] _____

CTR (current transformer ratio - usually 1.0)[1/] _____

$$KW = \frac{(3.6) \times \text{(disk rev)} \times (Kh) \times (PTR) \times (CTR)}{\text{(time, in seconds)}} = \_\_\_\_\_ = \_\_\_\_\_ \text{(kwh/h)}$$

Diesel or gasoline:

Evaluation time: hours _____ minutes _____ = _____ hours

Fuel use _____ gallons (a small quantity of fuel may also be weighed, at 7.05 lb/gal for diesel and 6.0 lb/gallon for gasoline)

$$\frac{\text{(fuel use, in gallons)}}{\text{(time, in hours)}} = \_\_\_\_\_ = \_\_\_\_\_ \text{ gallons/hour}$$

Propane:

Evaluation time: hours _____ minutes _____ = _____ hours

Fuel use _____ lb (weigh fuel used from small portable tank)

$$\frac{\text{(fuel use, in lb)}}{(4.25 \text{ lb/gal}) \times \text{(time, in hr)}} = \_\_\_\_\_ = \_\_\_\_\_ \text{ gallon/hours}$$

Natural gas:

Evaluation time: hours _____ minutes _____ = _____ hours

Meter reading: End _____ minus Start _____ = _____ mcf

$$\frac{\text{(fuel used, in mcf)}}{\text{(time, in hr)}} = \_\_\_\_\_ = \_\_\_\_\_ \text{ mcf/hr}$$

1/ Some power companies use a type of meter that requires a PTR or CTR correction factor. Check with local power company.

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In the next step, the efficiency of the power plant and pump, as a unit, is compared to the Nebraska Standards for irrigation pumping plants. The Nebraska standard for a good condition, properly operated plant. If the comparison comes out less than 100%, there is room for improvement.

Nebraska performance rating:

Nebraska pumping plant performance criteria _____

Pump and Power Plant		
Energy source	**Whp-h/unit of energy**	**Energy unit**
Diesel	12.5	gallon
Propane	6.89	gallon
Natural gas	61.7	mcf
Electricity	0.885	kW=kwh/hr
Gasoline	8.66	gallon

The Nebraska standards assume 75% pump and 88% electric motor efficiency.

Percent of Nebraska performance rating

$$= \frac{\text{(whp) x (100)}}{\text{(energy input) x (Nebraska criteria, in whp-h/unit)}} =$$

= _____ = _____ %

Horsepower input:

Electric:

$$\frac{\text{(input kW)}}{\text{(0.746 kW/bhp)}} = \text{_____} = \text{_____ bhp}$$

Diesel:

(16.66) x (energy input, in gal/hr) = _____ = _____ bhp

Propane:

(9.20) x (energy input, in gal/hr) = _____ = _____ bhp

Natural gas:

(82.20) x (energy input, in mcf/hr) = _____ = _____ bhp

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Pumping plant efficiency:

$$Epp = \frac{\text{(water horsepower output, whp) x (100)}}{\text{(brake horsepower input, bhp)}} = \_\_\_\_\_ = \_\_\_\_\_ \%$$

Energy cost per acre-foot:

Fuel cost per unit _____ $/kW-hr, or $/gal, or $/mcf

$$\text{Cost, in \$/ac-ft} = \frac{\text{(5431) x (fuel cost, in \$/unit) x (energy input, in kW, gal/hr, or mcf/hr)}}{\text{(flow rate, in gpm)}}$$

= _____ = $ _____/acre-foot

Recommendations:

Pump performance curve