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From: Jerriann Ernstsens
To: Dave Shaver
Date: 12/4/2007 5:09 PM
Subject: CORF
Attachments: CO Fish Worksheet_workingje.doc

CC: Jim Smith; Pam Grubaugh-Littig
Here you go Dave.

*Outgoing of
e/007/0033*

I would like you to only fill out the following portions:
SURFACE OPERATION CONSUMPTION
POND EVAPORATION

If you have a better way to determine your consumption values, you will need to submit your proposal for review.

The other sections don't apply to WC, but you do manage other mines. Just note that we have been trying over the last couple of years to come up with a FAIR process. We think that we need more work and now that Lila is basically over, we will now give this CORF more attention. But, for WC the sections that I have requested probably will not change much. If they do, I will request an update either with a new amendment or the next midterm.

Thanks for your time,

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AS OF 9/2006

**SUGGESTED FORMAT AND EQUATIONS
FOR COMPLIANCE WITH THE
COLORADO ENDANGERED FISH RECOVERY PROGRAM**

COAL PRODUCTION CONSUMPTION

This includes water consumption as a result of moisture added to coal during mining operations.

Equations

Percent moisture added to coal = Run of mine (%) - Inherent coal moisture (%)

*Tons of water/year = (% Moisture added/100) * Maximum yearly coal production (Tons)*

*Convert tons of water/year to acre-ft/year = (X tons) * (2,000 lbs/1 ton) * (1 gal/8.33 lbs)
* (1 acre-ft/325,850 gal)*

Provide the following values and calculations:

Inherent Coal Moisture (%)	_____
Run of Mine Moisture (%)	_____
Maximum Yearly Coal Production (Tons)	_____
Total Acre-ft/year	_____

SURFACE OPERATION CONSUMPTION

This includes water consumption as a result of surface facility operations.

Provide the following values:

Yearly water consumption (acre-ft) for dust suppression on surface	
Estimated _____ or Metered _____	_____
Yearly water consumption (acre-ft) from air dryers if there is a coal preparation plant	
Estimated _____ or Metered _____	_____
Total Acre-ft/year	_____

VENTILATION

This includes water consumption as a result of evaporation from ventilation through the mine workings.

Parameters for Exhaust/Intake Measurements

p_b = barometric pressure (in. Hg)

Q = ventilation quantity (cfm)

t_d = dry bulb temperature (°F)

t_w = wet bulb temperature (°F)

Equations for Exhaust Specific Humidity (W_E)

p_s' = sat. vapor press., wet bulb (in. Hg) = $0.18079 * e^{((17.27 * t_w - 552.64) / (t_w + 395.14))}$

p_v = actual vapor pressure (in. Hg) = $p_s' - [(p_b - p_s') * (t_d - t_w) / (2800 - 1.3 * t_w)]$

W = specific humidity (lb/lb dry air) = $0.622 * (p_v / (p_b - p_v))$

Equations for Intake Specific Humidity (W_I)

Calculate same as for exhaust degree of saturation

Equations for Total Water Loss to Ventilation (acre-ft/year)

p_a = partial pressure of air (in. Hg) = $p_b - p_v$

v = specific volume (ft³/lb) = $(0.754 * (t_d + 460)) / p_a$

G = weight flow-rate (lb/h) = $60 * Q / v$

total ventilation water loss = G (lb/h) * $(W_E - W_I) * .016018$ (ft³/lb) * 8766 (h/yr) / 43560 (ft³/acre-ft)

Provide the following values and calculations:

p_b = barometric pressure (in. Hg)

Q = ventilation quantity (cfm)

t_d = dry bulb temperature (°F)

t_w = wet bulb temperature (°F)

Exhaust Specific Humidity (%)

Intake Specific Humidity (%)

Total Acre-ft/year

Were values estimated because mine is not yet operating? If yes, provide explanation.

POND EVAPORATION

This includes water consumption as a result of evaporation from sediment, treatment, and/or slurry ponds.

Parameter and equation

P_y = Average pond area for the year (acres)

$E = P_y * 4.11$

Provide the following values:

P_y = Yearly average pond area (acres) _____

Total Acre-ft/year _____

DISCHARGE

This includes ground water from mine workings discharged to the surface.

Provide the following value:

Maximum projected yearly water discharge to the Colorado River Basin.

Estimated _____ or Metered _____

If estimated, what is the basis? _____

Total Acre-ft/year _____

Appendix A Equations and References

Ventilation Evaporation

Psychrometric equations documented in Mine Ventilation and Air Conditioning

Penman Equation

Data that can be found at <http://www.wrcc.dri.edu> and/or similar sources of information

T = monthly avg. temp (°C) _____

R_h = mean monthly percent relative humidity - afternoon (%)

n/d = mean monthly percent possible monthly sunshine (%)

v = average wind speed (m/s)

R_A = total possible shortwave radiation for the month (g-cal/cm²-day)

r = reflection coefficient (unitless)

α = psychrometric constant (mm Hg/°C)

a = empirical coefficient (unitless)

b = empirical coefficient (unitless)

n = number of days in the month

σ = empirical coefficient (cal/(cm²-°C⁴-day))

Calculated data

e_s = saturated vapor pressure (mm Hg) = $4.582^{(17.27*T/(237.3+T))}$

e = vapor pressure (mm Hg) = e_s*R_h/100

R_I = net longwave radiation exchange between the atmosphere and the water body (g-cal/cm²-day) = R_A*(1-r)*(a+b*(n/d)/100)

R_B = net outward flow of longwave radiation (g-cal/cm²-day) = $\sigma*(T+273)^4*(0.47-0.077*(2.71828182845904)^{.5}*(0.2+0.8*(n/d)/100)$

R_n = net radiation (g-cal/cm²-day) = R_I - R_B

H_v = latent heat of vaporization = (g-cal/cm³) = 596-0.52*T

E = Evaporation (mm/day) = R_n*10/H_v

Δ = slope of saturation vapor pressure curve (mm Hg/°C) = $(18817/(T+237.3)^2)^{17.27*(T/(237.3+T))}$

E_{ao} = evaporation based on air measurements (mm/day) = $0.35*(e_s-e)*(0.2+0.55*v)$

H_w = evaporation rate (mm/day) = $(\Delta*E+\alpha*E_{ao})/(\Delta+\alpha)$

E_T = total evaporation (acre-feet) = H_w*n*acres*(1/12/25.4)

Add total for each month to get yearly total.