{ TC "'APPENDIX C: MEASURED DATA UNCERTAINTY APPROXIMATION"' \l 1 }APPENDIX

C

MEASURED DATA UNCERTAINTY APPROXIMATION

This EES program was used to approximate the random uncertainty to be ascribed to the measurements made at the NIST and FSEC PV-SDHW system installations (see Chapter 4):

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"Function to determine the random uncertainty in the average of several numbers
of uncertainty delta"
Function del_avg(N,delta)
del_avg=sqrt(N*delta^2)/N
end


"Function to determine the random uncertainty in the sum of several numbers
of uncertainty delta"
Function del_sum(N,delta)
del_sum=sqrt(N*delta^2)
end


"uncertainty in temperature measurements"
delta_T_min=1 "C" "uncertainty Type T TC from Omega"
delta_Tav_min=del_avg(6,delta_T_min) "C" "minutely uncertainty in tank temp."
delta_Tav_hr=del_avg(60,delta_Tav_min) "C" "hourly uncertainty in tank temp."
delta_Tav_day=del_avg(24,delta_Tav_hr) "C" "daily uncertainty in tank temp."
delta_Tav_month=del_avg(30,delta_Tav_day) "C" "monthly uncertainty in tank temp."
delta_Tav_hr_amb=del_avg(60,delta_T_min) "C" "hourly uncertainty in ambient temp."


"uncertainty in tank heat loss"
loss_hr=UA*(T_avg_hr-T_a_avg_hr) "kJ" "approx. avg. hourly loss"
UA=2.70 "kJ/h-C" "approx. of tank UA"
delta_UA/UA=0.05 "approx. of fractional uncert. in UA"
T_avg_hr=45 "C" "approx. of avg. tank temp."
T_a_avg_hr=25 "C" "approx. of avg. ambient temp."
delta_T_a_avg_hr=del_avg(60,delta_T_min) "C"
delta_loss_hr=sqrt(((T_avg_hr-T_a_avg_hr)*delta_UA)^2+(UA*delta_Tav_hr)^2+(UA*delta_T_a_avg_hr)^2)
"kJ"
delta_loss_day=del_sum(24,delta_loss_hr) "kJ"
delta_loss_month=del_sum(30,delta_loss_day) "kJ"
deltafract_loss_month=delta_loss_month/(loss_hr*24*30) "fractional uncertainty in monthly tank heat loss"
```

"uncertainty in tank load"
load_hr=m*c_p*(T_out-T_in) "kJ" "approx. avg. hourly load"
m=40 "kg" "approx. of tank water mass"
delta_m/m=0.01 "approx. of fractional uncert. in m"
c_p=4.18 "kJ/kg-C" "specific heat"
delta_c_p/c_p=0.005 "approx. of fractional uncert. in c_p"
T_out=50 "C" "approx. of avg. outlet temp."
delta_T_out=del_avg(4,delta_T_min) "C" "uncert. in outlet temp. per draw"
delta_T_in=del_avg(4,delta_T_min) "C" "uncert. in inlet temp. per draw"
T_in=30 "C" "approx. of avg. inlet temp."
delta_load_hr=sqrt((c_p*(T_out-T_in)*delta_m)^2+(m*(T_out-
T_in)*delta_c_p)^2+(m*c_p*delta_T_out)^2+(m*c_p*delta_T_in)^2) "kJ"
delta_load_day=del_sum(6,delta_load_hr) "kJ"
delta_load_month=del_sum(30,delta_load_day) "kJ"
deltafract_load_month=delta_load_month/(load_hr*6*30) "fractional uncertainty in monthly tank load"

"uncertainty in tank electrical energy input"
P_min=I_min*V_min "W" "approx. avg. power"
I_min=8 "A" "approx. avg. current"
V_min=150 "V" "approx. avg. voltage"
delta_V_min/V_min=0.01 "approx. fractional uncertainty in V"
delta_I_min/I_min=0.01 "approx. fractional uncertainty in I"
delta_PVenergy_min=(I_min*delta_V_min+V_min*delta_I_min)*60/1000 "kJ"
delta_PVenergy_hr=del_sum(60,delta_PVenergy_min) "kJ"
delta_PVenergy_day=del_sum(24,delta_PVenergy_hr) "kJ"
delta_PVenergy_month=del_sum(30,delta_PVenergy_day) "kJ"
deltafract_PVenergy_month=delta_PVenergy_month/(P_min*60/1000*60*24*30) "fractional uncertainty in monthly electrical input"