NUCL 402 HMWK 10

1) Pressurizer Size for Surge

$$M_{maximumoutsurge} = 17500\ kg$$
$$M_{maximuminsurge} = 9700\ kg$$
$$Cold\ leg\ spray\ express\ as\ fraction\ of\ hot\ leg\ insurge\ (f) = [0.01: 0.001: 0.085]$$

Table 7-3 Conditions for pressurizer design problem

Saturation pressure	15.5 MPa
Saturation temperature	618.3°K
Saturation properties	
u_f	1.60×10^6 J/kg
u_g	2.44×10^6 J/kg
v_f	1.68×10^{-3} m³/kg
v_g	9.81×10^{-3} m³/kg
[redacted]	[redacted]
[redacted]	[redacted]
Hot leg insurge enthalpy	1.43×10^6 J/kg
Cold leg spray enthalpy	1.27×10^6 J/kg
[redacted]	[redacted]
Outsurge enthalpy	1.63×10^6 J/kg
Mass of liquid water necessary to cover the heaters (requires an assumption about the pressurizer configuration)	1827 kg

$$(Q_h)_{insurge} = \frac{m_{surge}(1+f)[v_g u_f - v_f u_g]}{v_g - v_f} - m_{surge}(h_{surge} + f h_{spray})$$
$$m_{g_1} = \frac{m_{surge}(1+f)v_f}{v_g - v_f}$$
$$(V_{g_1})_{insurge} = m_{g_1} v_g$$
$$(Q_h)_{outsurge} = m_{surge} h_{surge} - \left(u_f - \frac{v_f}{v_g} u_g\right)\left(m_{surge}\frac{v_g}{v_g - v_f}\right)$$
$$m_{f_1} = m_{f_2} + m_{surge}\frac{v_g}{v_g - v_f}$$
$$(V_{f_1})_{outsurge} = m_{f_1} v_f$$
$$V_T = (V_{g_1})_{insurge} + (V_{f_1})_{outsurge}$$

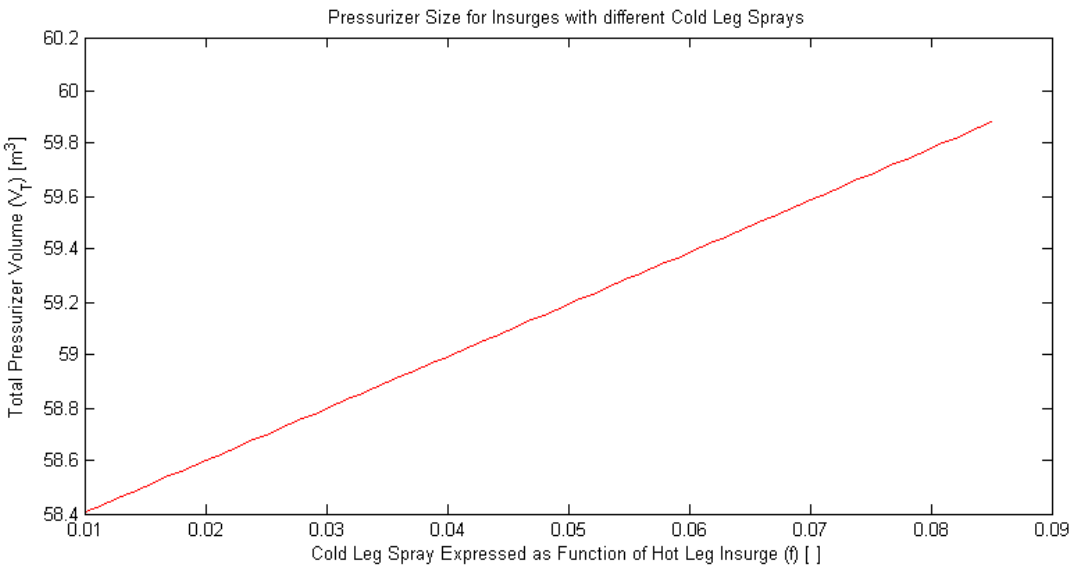

FIGURE 1 PRESSURIZER SIZE WITH DIFFERENT COLD LEG SPRAYS

Code:

```
minsurge=9700;  %maximum insurge mass in kg
f=0.01:0.001:0.085;
vf=1.68E-3;  %saturation property for fluid in m^3/kg
vg=9.81E-3;  %saturation property for gas in m^3/kg
mf2=1827;  %mass of liquid water necessary to cover heaters in kg
moutsurge=17500;  %maximum outsurge mass in kg
mg1=minsurge*(1+f)*vf/(vg-vf);
Vg1=mg1*vg;
mf1=mf2+moutsurge*vg/(vg-vf);
Vf1=mf1*vf;
Vtotal=Vg1+Vf1;
plot(f,Vtotal,'r-');
xlabel('Cold Leg Spray Expressed as Function of Hot Leg Insurge (f) [ ]');
ylabel('Total Pressurizer Volume (V_T) [m^3]');
title('Pressurizer Size for Insurges with different Cold Leg Sprays');
```