Governing Equations

$$\dot{n}_{ox,v} + \dot{n}_{ox,l} = -C_d N_{inj} A_{inj} \sqrt{\frac{2(P_T - P_{losses} - P_C)}{(MW)_{ox} \overline{V}_{ox,l}}}$$

$$-\overline{V}_{ox,l} P_{cr,ox} \dot{n}_{ox,l} + \left(\left(V_T - n_{ox,l} \overline{V}_{ox,l} \right) \left(\frac{P_{cr,ox}}{dT} \right) - n_{ox,l} P_{cr,ox} \left(\frac{\overline{V}_{ox,l}}{dT} \right) \right) \dot{T}_T = R_u \left(n_{ox,v} \dot{T}_T + T_T \dot{n}_{ox,v} \right)$$

$$(m_T c_{P_T} + n_{ox,l} \overline{C}_{P_{ox,l}} + n_{ox,v} \overline{C}_{V_{ox,v}} + n_{sp,v} \overline{C}_{V_{sp,v}}) \dot{T}_T = \dot{n}_{ox,v} (R_u T_T - \Delta \overline{H}_{ox,v}) + \dot{n}_{ox,l} (P_T \overline{V}_{ox,l})$$

The unknowns are $\dot{n}_{ox,l}$, $\dot{n}_{ox,v}$ and $\dot{T}_T$
And so we proceed to solve the equations to isolate each of the unknowns:

$$\dot{n}_{ox,v} = \frac{\sqrt{2} A_{\mathrm{inj}} C_d N_{\mathrm{inj}} \sqrt{-\frac{P_C + P_{\mathrm{losses}} - P_T}{\mathrm{MW}_{\mathrm{ox}} \bar{V}_{\mathrm{ox},l}}} \left(\bar{V}_{\mathrm{ox},l} \left(P_{\mathrm{cr,ox}} \left(n_{\mathrm{ox},l} \bar{C}_{P_{\mathrm{ox},l}} + n_{\mathrm{ox},v} \bar{C}_{V_{\mathrm{ox},v}} + n_{\mathrm{sp},v} \bar{C} \right.\right.\right.}{m_T c_{P_T} \left(T_T R_u - P_{\mathrm{cr,ox}} \bar{V}_{\mathrm{ox},l} \right) + R_u \left(T_T \left(n_{\mathrm{ox},l} \left(\bar{C}_{P_{\mathrm{ox},l}} - \bar{V}_{\mathrm{ox},l} P_{\mathrm{cr,ox,dT}} - P_{\mathrm{cr,ox}} \bar{V}_{\mathrm{ox},l,\mathrm{dT}} \right) + n_{\mathrm{ox},v} \bar{C}_{V_{\mathrm{ox},v}} + n_{\mathrm{sp},v} \bar{C}_{V_{\mathrm{sp},v}} + V_T \right.\right.\right.$$