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# PROBLEM 7-14N QUESTION

## Containment Pressurization Reactor Thermodynamics

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What should the containment volume for a 3000 MWt PWR be to prevent a primary coolant pipe rupture from resulting in an overpressurization of 45 psi, assuming all heat removal systems fail and the fuel may add up to 180 Gw-sec. of energy before mitigating procedures begin? What overpressurization may occur with this design if a steamline ruptures and the steam generator provides the same amount of energy before any safety system intervention? Assume thermal equilibrium within the containment and no heat losses to structures.

### DATA

#### Initial Containment Atmosphere

Pressure	$p_{ao} = 14.7 \text{ psia}$
Temperature	$T_{ao} = 90^\circ\text{F}$
Relative humidity	$\phi = 95\%$

#### Specific Heat at Constant Volume

Air	$c_{va} = 0.172 \text{ B./lb.F}$
Steam	$c_{vw} = 0.379 \text{ B./lb.F}$

#### PWR – NSSS Operating Conditions and Design Parameters

Primary coolant volume	$V_p = 12,500 \text{ ft}^3$
Secondary coolant volume	$V_s = 3,145 \text{ ft}^3$
Primary system pressure	$p_{po} = 2,250 \text{ psia}$
Secondary system pressure	$p_{so} = 1,000 \text{ psia}$
Primary system temperature	$T_{po} = 650^\circ\text{F}$
Secondary system temperature	$T_{so} = 550^\circ\text{F}$