NPRE 457: HW 35

Joseph F. Specht IV

December 2, 2024

Evaluate the difference between evaluation and best-estimate safety analysis computation models.

Evaluation safety analysis reveal if the temperature lies within a given range, which is helpful for preventing disasters. Best-estimate analysis leads to realistic results in calculations with careful accounting of the statistical uncertainties involved. Best-estimate analysis is the more accurate and realistic method for evaluating failure accident scenarios.

Consider a steam explosion with an energy release of 2 GJ.

1. If the mass of a generated vertically moving water piston is 9 metric tonnes, and it acquires the energy release as kinetic energy, calculate its vertical speed in m/sec.

$$KE = \frac{1}{2}mv^2 \tag{1a}$$

$$v = \sqrt{\frac{2KE}{m}} \tag{1b}$$

$$v = \sqrt{\frac{2(9e9J)}{9e3\ kg}} = 1414.214\frac{m}{s} \tag{1c}$$

2. Assuming that the top concrete shielding plate with a weight of 700 metric tonnes exchanges momentum with the water piston upon their collision, by applying the law of conservation of momentum, calculate its vertical speed in m/sec.

$$m_1 v_1 = m_2 v_2 \tag{2a}$$

$$v_2 = \frac{m_1}{m_2}v_1 \tag{2b}$$

$$v_2 = \frac{9mt}{700mt}\left(1414.214\frac{m}{s}\right) = 18.18\frac{m}{s} \tag{2c}$$

3. Estimate the height in meters to which that top plate would have risen vertically as a result of the

collision with the water piston by applying conservation of the kinetic and potential energies and use the gravity acceleration constant as g = 9.81 m/sec^2.

$$mgh = \frac{1}{2}mv^2 \tag{3a}$$

$$h = \frac{v^2}{2g} \tag{3b}$$

$$h = \frac{\left(18.18\frac{m}{s}\right)^2}{2\left(9.81\frac{m}{s^2}\right)} = 16.846m \tag{3c}$$

List the sources of pressure buildup in the Clad Ballooning accident. What are the consequences of such an occurrence?

Pressure buildup can occur when:

1. the external coolant pressure becomes less than the internal pressure inside the cladding that causes an pressure difference that acts as the gap pressure is high,
2. the temperature is too high that causes the fission products to diffuse from the fuel matrix and increase the pressure in the gap between the clad and fuel,
3. fission product gasses build up outside the fuel pins that causes the internal pressure of the gap between the clad and fuel,
4. and a flow blockage occurs in the coolant flow that restricts coolant flow and increased the fuel temperature, which causes severe fuel damage.