

APPENDIX
"COORDINATE TRANSFORMATIONS FOR GOUDEY SIMULATIONS

The transformations consisted of two rotations and one translation from the actual x,y,z coordinates of the Goudy reactor to the ρ and ξ used by PCGC-2. The first rotation around the z axis by the 49 degrees of the burner orientation is around the resulting y axis and corresponds to the tilt of the burner. That is:

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} \xrightarrow{\Phi_z} \begin{pmatrix} x' \\ y' \\ z' = z \end{pmatrix} \xrightarrow{-\Phi'_y} \begin{pmatrix} x'' \\ y'' = y \\ x'' \end{pmatrix}$$

with $\Phi = 90 + \alpha$

$$\begin{pmatrix} x \\ y'' \\ z' \end{pmatrix} = \begin{pmatrix} -\sin \alpha & 0 & -\cos \alpha \\ 0 & 1 & 0 \\ \cos \alpha & 0 & -\sin \alpha \end{pmatrix} \begin{pmatrix} \cos \Phi & \sin \Phi & 0 \\ -\sin \Phi & \cos \Phi & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ p \\ -c \end{pmatrix}$$

where:

α is the tilt angle (degrees)

Φ is the burner orientation (degrees)

p is the distanced from the reactor wall to the probe (m)

c is the distance from the inlet to the probe in the z direction (m)

q is the radius of the secondary (m)

that is:

$$\begin{aligned} x'' &= -\sin \alpha (x \cos \Phi + p \sin \Phi) + c \cos \alpha \\ y'' &= -\sin \Phi + p \cos \Phi \\ z'' &= \cos \alpha (x \cos \Phi + p \sin \Phi) + c \sin \alpha \end{aligned}$$

with the translation $\xi = z'' - q$ and using cylindrical coordinates $\rho = (x'')^2 + (y'')^2$ the following equations represent the final transformation used:

$$\xi = \cos \alpha (x \cos \Phi + p \sin \Phi) + c \sin \alpha - q$$

$$\rho = (\sin \alpha (x \cos \Phi + p \sin \Phi) + c \cos \alpha)^2 + (-\sin \Phi + p \cos \Phi)^2$$

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