APPENDIX B

"COORDINATE TRANSFORMATIONS FOR GOUDEY SIMULATIONS"

The transformations consisted of two rotations and one translation from the actual x,y,z coordinates of the Goudey 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:

$$x'' = -\sin\alpha\,(x\cos\Phi + p\sin\Phi) + c\cos\alpha$$
$$y'' = -\sin\Phi + p\cos\Phi$$
$$z'' = \cos\alpha\,(x\cos\Phi + p\sin\Phi + c\sin\alpha$$

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

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

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