In the Thomas et al Code:

First Runge-Kutta Step

$$\begin{aligned} Y_{n-1}(i) &= Q_{ij}(Y_n, [ij](T_n), [kl](T_n)) \times Y_{n\alpha}(j) \\ \frac{dY(i)}{dt}(t, Y_n(i)) &= \frac{Y_{n\alpha}(i) - Y_{n-1}(i)}{\Delta t_{n-1}} \\ \tilde{Y}_n(i) &= Y_n(i) + \frac{Y_{n\alpha}(i) - Y_{n-1}(i)}{\Delta t_{n-1}} \Delta t_n \end{aligned}$$

It's clear that $Y_{n\alpha}(i)$ corresponds to $Y_n(i)$, and $\tilde{Y}_n(i)$ corresponds to $Y_{n+1}(i)$. So one can see how this scheme corresponds to Equation (2).

Second Runge-Kutta Step

$$\begin{aligned} Y_n(i) &= Q_{ij}\left(\tilde{Y}_n, [ij](\tilde{T}_n), [kl](\tilde{T}_n)\right) \times Y_{n\beta}(j) \\ \frac{dY(i)}{dt}(t + \Delta t_n, Y_{n+1}(i)) &= \frac{Y_{n\beta}(i) - Y_n(i)}{\Delta t_n} \\ Y_{n+1}(i) &= Y_n(i) + \frac{1}{2}\left[\frac{Y_{n\alpha}(i) - Y_{n-1}(i)}{\Delta t_{n-1}} + \frac{Y_{n\beta}(i) - Y_n(i)}{\Delta t_n}\right] \Delta t_n \end{aligned}$$

And here $Y_{n\beta}(i)$ corresponds to $Y_{n+1}(i)$.