We write the state variable $X = (\rho h, \rho Y_1, \ldots, \rho Y_N)$, and then solve the ODE

$$(I - tJ)X_t = Q(t) + \Omega(X),$$

where $Q(t)$ is a source term, $\Omega = (0, \dot{\omega}_1, \ldots, \dot{\omega}_N)$ represents the reactions, and J is the Jacobian of the reaction term. Using VODE to calculate the solution, and refining in time and space we obtain the following results.

Variable	Error	Order	Error	Order	Error
$Y(H_2)$	8.00E-08	2.09	1.88E-08	2.05	4.54E-09
$Y(O_2)$	1.31E-06	2.04	3.18E-07	2.05	7.67E-08
$Y(N_2)$	1.36E-07	1.99	3.42E-08	2.02	8.42E-09
$Y(H_2O)$	1.31E-06	2.04	3.19E-07	2.06	7.65E-08
$Y(H_2O_2)$	4.85E-09	1.94	1.26E-09	1.97	3.21E-10
$Y(HO_2)$	1.67E-08	2.04	4.04E-09	2.10	9.39E-10
ρ	1.01E-08	1.99	2.56E-09	1.98	6.46E-10
T	1.36E-02	2.03	3.33E-03	2.06	7.97E-04
ρh	1.23E+01	1.60	4.07E+00	1.30	1.66E+00
U	2.98E-02	1.66	9.44E-03	1.42	3.52E-03