MODULE $appex1\_3$

$petri10$

EXTENDS $Naturals$, TLC

CONSTANTS $Places$, N, Q, B

VARIABLES M

$$
\begin{aligned}
t1 \triangleq\ & \wedge M[\text{“p2”}] = 1 \wedge M[\text{“pi”}] \geq 1 \\
& \wedge M' = [[[M \text{ EXCEPT } ![\text{“p1”}] = 1] \\
& \qquad \text{EXCEPT } ![\text{“pi”}] = M[\text{“pi”}] - 1] \\
& \qquad \text{EXCEPT } ![\text{“p2”}] = @ - 1]
\end{aligned}
$$

$$
\begin{aligned}
t2 \triangleq\ & \wedge M[\text{“p1”}] \geq 1 \wedge M[\text{“p5”}] < B \\
& \wedge M' = [[[M \text{ EXCEPT } ![\text{“p1”}] = @ - 1] \\
& \qquad \text{EXCEPT } ![\text{“p5”}] = M[\text{“p5”}] + 1] \\
& \qquad \text{EXCEPT } ![\text{“p2”}] = 1]
\end{aligned}
$$

$$
\begin{aligned}
t3 \triangleq\ & \wedge M[\text{“p5”}] \geq 1 \wedge M[\text{“p4”}] \geq 1 \\
& \wedge M' = [[[M \text{ EXCEPT } ![\text{“p3”}] = @ + 1] \\
& \qquad \text{EXCEPT } ![\text{“p5”}] = M[\text{“p5”}] - 1] \\
& \qquad \text{EXCEPT } ![\text{“p4”}] = @ - 1]
\end{aligned}
$$

$$
\begin{aligned}
t4 \triangleq\ & \wedge M[\text{“p3”}] \geq 1 \wedge M[\text{“po”}] < Q \\
& \wedge M' = [[[M \text{ EXCEPT } ![\text{“p3”}] = M[\text{“p3”}] - 1] \\
& \qquad \text{EXCEPT } ![\text{“po”}] = M[\text{“po”}] + 1] \\
& \qquad \text{EXCEPT } ![\text{“p4”}] = M[\text{“p4”}] + 1]
\end{aligned}
$$

$$Init1 \triangleq M = [p \in Places \mapsto \text{IF } p \in \{\text{“p4”}, \text{“p2”}\} \text{ THEN } 1 \text{ ELSE IF } p = \text{“pi”} \text{ THEN } N \text{ ELSE } 0]$$

$$Init \triangleq Init1$$

$$Next \triangleq t1 \vee t2 \vee t3 \vee t4 \vee M' = M$$

$$TypeInvariant \triangleq \forall\, p \in Places :\ M[p] \geq 0$$

$$Inv1 \triangleq M[\text{“pi”}] + M[\text{“p5”}] + M[\text{“po”}] + M[\text{“p1”}] + M[\text{“p3”}] = N$$

$$Inv2 \triangleq M[\text{“po”}] \leq Q$$

$QInv4 \triangleq \quad M[\text{“pi”}] + M[\text{“p5”}] + M[\text{“po”}] + M[\text{“p2”}] + M[\text{“p4”}] = N + 2$
$Inv5 \triangleq \quad M[\text{“p3”}] + M[\text{“p4”}] + M[\text{“p1”}] + M[\text{“p2”}] = 2$

$Inv3 \triangleq \quad M[\text{“p3”}] = 0$
$Inv \triangleq \ TypeInvariant$
$Question \triangleq \ M[\text{“po”}] \neq \ Q$
$Safety1 \triangleq \quad M[\text{“p2”}] \leq \ 1 \ \wedge M[\text{“p2”}] \geq \ 0$