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1 MACHINE
2   WaterTank_ode
3 REFINES
4   WaterTank_base
5 SEES
6   WaterTank_ode_Ctx
7 VARIABLES  $t, V, x_s$ 
8 INVARIANTIS
9   inv1:  $V \in RRealPlus \rightarrow S$ 
10 EVENTS
11 INITIALISATION
12 THEN
13   act1:  $t := Rzero$ 
14   act2:
15      $V :|$ 
16      $V' \in RRealPlus \rightarrow S \wedge$ 
17      $solutionOf(RRealPlus, V', ode(NoFlow, V0, Rzero))$ 
18   act3:  $x_s := Stable$ 
19 END
20
21 Progress
22 REFINES Progress
23 THEN
24   act1:  $t :| t' \in RRealPlus \wedge (t \mapsto t' \in lt)$ 
25 END
26
27 Behave
28 REFINES Behave
29 ANY  $e$ 
30 WHERE
31   grd1:  $e \in DE(S)$ 
32   grd2:  $Solvable(Closed2Infinity(t), e)$ 
33 THEN
34   act1:  $V :| V' \in RRealPlus \rightarrow S \wedge AppendSolutionBAP(e, RRealPlus, Closed2Open(Rzero, t), Closed2Infinity(t), V, V')$ 
35 END
36
37 ctrl_sense_too_high
38 REFINES ctrl_sense_too_high
39 WHERE
40   grd1:  $Vhigh \mapsto V(t) \in leq$ 
41 THEN
42   act1:  $x_s := Emptying$ 
43 END
44
45 ctrl_sense_too_low
46 REFINES ctrl_sense_too_low
47 WHERE
48   grd1:  $V(t) \mapsto Vlow \in leq$ 
49 THEN
50   act1:  $x_s := Filling$ 
51 END
52
53 ctrl_transition_emptying
54 REFINES ctrl_transition_emptying
55 WHERE
56   grd1:  $Vlow \mapsto V(t) \in lt$ 
57 THEN
58   act1:  $x_s := Emptying$ 
59 END
60
61 ctrl_transition_filling
62 REFINES ctrl_transition_filling
63 WHERE
64   grd1:  $V(t) \mapsto Vhigh \in lt$ 
65 THEN
66   act1:  $x_s := Filling$ 
67 END
68
69 ctrl_transition_normal
70 REFINES ctrl_transition_normal
71 WHERE
72   grd1:  $Vlow \mapsto V(t) \in lt$ 
73   grd2:  $V(t) \mapsto Vhigh \in lt$ 

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74 THEN
75   act1:  $x_s := Normal$ 
76 END
77
78 ctrl_transition_stable
79 REFINES ctrl_transition_stable
80 WHERE
81   grd1:  $V_{low} \mapsto V(t) \in lt$ 
82   grd2:  $V(t) \mapsto V_{high} \in lt$ 
83 THEN
84   act1:  $x_s := Stable$ 
85 END
86
87 ctrl_actuate_pumps
88 REFINES ctrl_actuate_pumps
89 ANY  $Phi, ss$ 
90 WHERE
91   grd1:  $Phi \in RRealPlus \times S \rightarrow S$ 
92   grd2:  $isFlowODE(ss, Closed2Infinity(t), Phi, Rzero, Vmax)$ 
93   grd3:  $Solvable(Closed2Infinity(t), ode(Phi, V(t), t))$ 
94   grd4:  $ss \in STATES$ 
95   grd5:  $x_s = ss$ 
96 WITH
97   e:  $e = ode(Phi, V(t), t)$ 
98 THEN
99   act1:
100     V:|
101      $V' \in RRealPlus \rightarrow S \wedge$ 
102     AppendSolutionBAP(
103        $ode(Phi, V(t), t),$ 
104        $RRealPlus,$ 
105        $Closed2Open(Rzero, t), Closed2Infinity(t),$ 
106        $V, V'$ 
107     )
108 END
109
110 END

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