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1 MACHINE
2   WaterTank_base
3 REFINES
4   Generic
5 SEES
6   WaterTank_base_Ctx
7 VARIABLES  $t, V, x_s$ 
8 INVARIANTIS
9    $inv1: V \in RRealPlus \rightarrow S$ 
10   $inv2: V = x_p$ 
11   $inv3: V \in DI(Closed2Infinity(t), RReal) \wedge boundedBy(Closed2Infinity(t), Der(Closed2Infinity(t), RReal, V), dv\_min, dv\_max)$ 
12   $inv4: boundedBy(RRealPlus, V, Vlow, Vhigh)$ 
13 EVENTS
14 INITIALISATION
15 WITH
16    $x_p': x_p' = V'$ 
17 THEN
18   act1:  $t := Rzero$ 
19   act2:
20      $V :|$ 
21      $V' \in RRealPlus \rightarrow S \wedge$ 
22      $solutionOf(RRealPlus, V', ode(NoFlow, V0, Rzero))$ 
23   act3:  $x_s := Stable$ 
24 END
25
26 Progress
27 REFINES Progress
28 THEN
29   act1:  $t :| t' \in RRealPlus \wedge (t \mapsto t' \in lt)$ 
30 END
31
32 Behave
33 REFINES Behave
34 ANY  $e$ 
35 WHERE
36    $grd1: e \in DE(S)$ 
37    $grd2: Solvable(Closed2Infinity(t), e)$ 
38 WITH
39    $x_p': x_p' = V'$ 
40 THEN
41   act1:  $V :| V' \in RRealPlus \rightarrow S \wedge AppendSolutionBAP(e, RRealPlus, Closed2Open(Rzero, t), Closed2Infinity(t), V, V')$ 
42 END
43
44 ctrl_sense_too_high
45 REFINES Sense
46 WHERE
47    $grd1: Vhigh \mapsto V(t) \in leq$ 
48 WITH
49    $s: s = \{Emptying\}$ 
50    $p: p = STATES \times RRealPlus \times \{V\_ | Vhigh \mapsto V\_ \in leq\}$ 
51 THEN
52   act1:  $x_s := Emptying$ 
53 END
54
55 ctrl_sense_too_low
56 REFINES Sense
57 WHERE
58    $grd1: V(t) \mapsto Vlow \in leq$ 
59 WITH
60    $s: s = \{Filling\}$ 
61    $p: p = STATES \times RRealPlus \times \{V\_ | V\_ \mapsto Vlow \in leq\}$ 
62 THEN
63   act1:  $x_s := Filling$ 
64 END
65
66 ctrl_transition_emptying
67 REFINES Transition
68 WHERE
69    $grd1: Vlow \mapsto V(t) \in lt$ 
70 WITH
71    $s: s = \{Emptying\}$ 
72 THEN
73   act1:  $x_s := Emptying$ 

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74  END
75
76  ctrl_transition_filling
77  REFINES Transition
78  WHERE
79      grd1:  $V(t) \mapsto V_{high} \in lt$ 
80  WITH
81      s:  $s = \{Filling\}$ 
82  THEN
83      act1:  $x_s := Filling$ 
84  END
85
86  ctrl_transition_normal
87  REFINES Transition
88  WHERE
89      grd1:  $V_{low} \mapsto V(t) \in lt$ 
90      grd2:  $V(t) \mapsto V_{high} \in lt$ 
91  WITH
92      s:  $s = \{Normal\}$ 
93  THEN
94      act1:  $x_s := Normal$ 
95  END
96
97  ctrl_transition_stable
98  REFINES Transition
99  WHERE
100     grd1:  $V_{low} \mapsto V(t) \in lt$ 
101     grd2:  $V(t) \mapsto V_{high} \in lt$ 
102  WITH
103     s:  $s = \{Stable\}$ 
104  THEN
105     act1:  $x_s := Stable$ 
106  END
107
108  ctrl_actuate_pumps
109  REFINES Actuate
110  ANY e, ss
111  WHERE
112     grd1:  $e \in DE(S)$ 
113     grd2:  $Solvable(Closed2Infinity(t), e)$ 
114     grd3:  $isFlowEq(ss, Closed2Infinity(t), e, Rzero, Vmax)$ 
115     grd4:  $ss \in STATES$ 
116     grd5:  $x_s = ss$ 
117  WITH
118      $x_{p'}: x_{p'} = V'$ 
119     s:  $s = \{ss\}$ 
120  THEN
121     act1:
122         V :|
123          $V' \in RRealPlus \rightarrow S \wedge$ 
124          $AppendSolutionBAP(e, RRealPlus, Closed2Open(Rzero, t), Closed2Infinity(t), V, V')$ 
125  END
126
127  END

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