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1 MACHINE
2   WaterTank_1Ctrl_1Tank_Cylinder
3 REFINES
4   WaterTank_1Ctrl_1Tank
5 SEES
6   WaterTank_1Tank_Cylinder_Ctx
7 VARIABLES  $t, H, x_s$ 
8 INVARIANTIS
9   inv1:  $H \in RRealPlus \rightarrow RReal$ 
10  inv2:  $V = cylinderV \circ H$ 
11 EVENTS
12 INITIALISATION
13 WITH
14    $V': V' = cylinderV \circ H'$ 
15 THEN
16   act1:  $t := Rzero$ 
17   act2:
18      $H :|$ 
19      $H' \in RRealPlus \rightarrow S \wedge$ 
20     solutionOf(
21       RRealPlus,
22        $H'$ ,
23       ode(
24         NoFlow,
25          $H0$ ,
26         Rzero
27       )
28     )
29   act3:  $x_s := STATES$ 
30 END
31
32 Progress
33 REFINES Progress
34 THEN
35   act1:  $t :| t' \in RRealPlus \wedge (t \mapsto t' \in lt)$ 
36 END
37
38 Behave
39 REFINES Behave
40 ANY  $e$ 
41 WHERE
42   grd1:  $e \in DE(S)$ 
43   grd2: Solvable(Closed2Infinity(t), e)
44 WITH
45    $V': V' = cylinderV \circ H'$ 
46 THEN
47   act1:  $H :| H' \in RRealPlus \rightarrow S \wedge AppendSolutionBAP(e, RRealPlus, Closed2Open(Rzero, t), Closed2Infinity(t), H, H')$ 
48 END
49
50 ctrl_sense_too_high
51 REFINES ctrl_sense_too_high
52 WHERE
53   grd1:  $Vhigh \mapsto cylinderV(H(t)) \in leq$ 
54 THEN
55   act1:  $x_s := Emptying$ 
56 END
57
58 ctrl_sense_too_low
59 REFINES ctrl_sense_too_low
60 WHERE
61   grd1:  $cylinderV(H(t)) \mapsto Vlow \in leq$ 
62 THEN
63   act1:  $x_s := Filling$ 
64 END
65
66 ctrl_transition_emptying
67 REFINES ctrl_transition_emptying
68 WHERE
69   grd1:  $Vlow \mapsto cylinderV(H(t)) \in lt$ 
70 THEN
71   act1:  $x_s := Emptying$ 
72 END
73

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74 ctrl_transition_filling
75 REFINES ctrl_transition_filling
76 WHERE
77    $\text{grd1: } \text{cylinder}V(H(t)) \mapsto V_{\text{high}} \in lt$ 
78 THEN
79    $\text{act1: } x_s := \text{Filling}$ 
80 END
81
82 ctrl_transition_normal
83 REFINES ctrl_transition_normal
84 WHERE
85    $\text{grd1: } V_{\text{low}} \mapsto \text{cylinder}V(H(t)) \in lt$ 
86    $\text{grd2: } \text{cylinder}V(H(t)) \mapsto V_{\text{high}} \in lt$ 
87 THEN
88    $\text{act1: } x_s := \text{Normal}$ 
89 END
90
91 ctrl_transition_stable
92 REFINES ctrl_transition_stable
93 WHERE
94    $\text{grd1: } V_{\text{low}} \mapsto \text{cylinder}V(H(t)) \in lt$ 
95    $\text{grd2: } \text{cylinder}V(H(t)) \mapsto V_{\text{high}} \in lt$ 
96 THEN
97    $\text{act1: } x_s := \text{Stable}$ 
98 END
99
100 ctrl_actuate_pumps
101 REFINES ctrl_actuate_pumps
102 ANY ss, io
103 WHERE
104    $\text{grd4: } ss \in \text{STATES}$ 
105    $\text{grd5: } x_s = ss$ 
106    $\text{grd6: } io \in \text{SingleTankPolicy}(ss)$ 
107 WITH
108    $V': V' = \text{cylinder}V \circ H'$ 
109 THEN
110    $\text{act1:}$ 
111      $H :|$ 
112      $H' \in R\text{RealPlus} \rightarrow S \wedge$ 
113      $\text{AppendSolutionBAP}(\text{ode}(\text{flowIO}(R_{\text{zero}}, H_{\text{max}}, \text{delta\_in\_}H, \text{delta\_out\_}H)(io)(t \mapsto H(t)), H(t), t),$ 
114        $R\text{RealPlus},$ 
115        $\text{Closed2Open}(R_{\text{zero}}, t), \text{Closed2Infinity}(t),$ 
116        $H, H'$ 
117     )
118   )
119 END
120
121 END

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