MODULE *PDieHard*

EXTENDS *Integers*

$Min(n, m) \triangleq$ IF $m < n$ THEN m ELSE n

```
**************************************************************************
--algorithm DieHard
  { variables big = 0, small = 0 ;
    { while ( TRUE )
      { either big := 5       fill the big jug
        or     small := 3     fill the samll jug
        or     big := 0       empty the big jug
        or     small := 0     empty the samll jug
```

When pouring from small to big, we first ask if $big + small > 5$. If so, we make $big' = 5$ and $small' = small - (5 - big)$; if not, we make $big' = big + small$ and $small' = 0$. In the former case, the amount poured is $5 - big$; in the latter case, the amount poured is small, which equals $(big + small) - big$. In both cases, the amount poured is $Min(big + small, 5) - big$.

Symmetric reasoning applies to pouring from big to small.

```
        or     pour from small to big
               with ( poured = Min(big + small, 5) - big )
                  { big   := big + poured ;
                    small := small - poured }
        or     pour from big to small
               with ( poured = Min(big + small, 3) - small )
                  { big   := big - poured ;
                    small := small + poured }
  } } }
**************************************************************************
```

BEGIN TRANSLATION

VARIABLES *big*, *small*

$vars \triangleq \langle big, small \rangle$

$Init \triangleq$ Global variables
$\land\ big = 0$
$\land\ small = 0$

$Next \triangleq \lor \land\ big' = 5$
$\quad\quad\quad\quad\ \land\ small' = small$
$\quad\quad\quad\quad\lor \land\ small' = 3$
$\quad\quad\quad\quad\quad\ \land\ big' = big$
$\quad\quad\quad\quad\lor \land\ big' = 0$
$\quad\quad\quad\quad\quad\ \land\ small' = small$
$\quad\quad\quad\quad\lor \land\ small' = 0$
$\quad\quad\quad\quad\quad\ \land\ big' = big$

$$
\begin{array}{l}
\lor\ \land \text{LET } \mathit{poured} \triangleq \mathit{Min}(\mathit{big} + \mathit{small},\ 5) - \mathit{big} \text{IN} \\
\qquad \land\ \mathit{big}' = \mathit{big} + \mathit{poured} \\
\qquad \land\ \mathit{small}' = \mathit{small} - \mathit{poured} \\
\lor\ \land \text{LET } \mathit{poured} \triangleq \mathit{Min}(\mathit{big} + \mathit{small},\ 3) - \mathit{small} \text{IN} \\
\qquad \land\ \mathit{big}' = \mathit{big} - \mathit{poured} \\
\qquad \land\ \mathit{small}' = \mathit{small} + \mathit{poured}
\end{array}
$$

$$\mathit{Spec} \triangleq \mathit{Init} \land \Box[\mathit{Next}]_{\mathit{vars}}$$

END TRANSLATION

* Modification History
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