1. $\left|\frac{x - rd(x)}{x}\right| \leq 2^{-p}$

1st discarded bit is 0:

$$|x - rd(x)| < (0.0111\ldots)_2 \times 2^{t-p} = \frac{1}{2} 2^{t-p} = 2^{t-p-1}$$

$$(0.b_1 b_2 \ldots)_2 > (0.b_1 00\ldots)_2 = (0.1)_2 \quad \checkmark$$

1st discarded bit is 1:

$$x - rd(x) = (0.1 b_{p+2} \ldots)_2 \times 2^{t-p} - 2^{t-p}$$

$$x - rd(x) = \frac{1}{2} + \frac{1}{2}(0.b_{k+2}\ldots)_2 - 1] \times 2^{t-p}$$

$$|x - rd(x)| = \frac{1}{2}[1 - (0.b_{k+2}\ldots)_2] \times 2^{t-p} < \frac{1}{2} \cdot 2^{t-p} = 2^{t-p-1}$$

$$(0.b_1 b_2 \ldots)_2 \geq (0.b_1 000\ldots)_2 = (0.1)_2$$

$$\frac{|x - rd(x)|}{|x|} < \frac{0.1\ldots 2^{-k} 2^t}{0.b_1 b_2 \ldots 2^t} < \frac{2^{-k-1} 2^t}{2^t \cdot \frac{1}{2}} = 2^{-k}$$