1. 3.1.2

$$S \Rightarrow aAa \Rightarrow aSSa \Rightarrow abAbaAaa \Rightarrow$$

$$abSSbaSSaa \Rightarrow abbabAbaa \Rightarrow abbabSSbaa \Rightarrow abbabbaa$$

2. As the hint suggests, by regularity's closure under intersection, it suffices to show $L \cap a^*bba^* = \{a^nbba^n : n \geq 0\}$ is non-regular. Take arbitrary $N > 0$. Let $w = a^Nbba^N$. Take arbitrary $xyz = w$, with $|xy| \leq N$, $y \neq \epsilon$. Note that $x = a^h, y = a^i, z = a^jbba^N$, where $h \geq 0, i > 0, j \geq 0$ and $h + i + j = N$. Let $k = 2$, then $x(y^k)z = a^ha^{2i}a^jbba^N = a^{N+i}bba^N \notin L$.

   Note: we actually have a stronger conclusion in this case that w can be arbitrary and $k > 0$ is sufficient, since any repetition has to be done both before and after bb, and repetition of y can only appear before or after bb (or containing bb).

3. $$L = (a \cup b)^*, S = a^nb^n$$