Closure to "Extending the Global-Gradient Algorithm to Solve Pressure-Control Valves" by Gioia Foglianti, Stefano Alvisi, Marco Franchini, and Ezio Todini

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First, we would like to thank the discussers for their interest in our work. The distinguished discussers focused their attention on the rules used to evaluate the valve status by the two proposed methods for pressure control valve modeling.

In particular, after detailing in our paper the rules to evaluate the status of a pressure-reducing valve (PRV) for each of the two proposed methods in Tables 1 and 2, it was added that "the same rules can be used to detect the status of a pressure-sustaining valve (PSV), but switching the upstream and downstream nodes and sign < with >."

The discussers properly observed that in addition one must also change the sign of the head loss terms, $r_i|Q(i)|^{n-1}Q(i)$ and $m_i|Q(i)|Q(i)$, and the head tolerance term, H_{TOL}.

We are grateful to the discussers for pointing it out and we fully agree with them.

Nonetheless, by considering a status change from open to active, as in the example proposed by the discussers, we would like to show that from a conceptual point of view what we wrote is correct as well.

By considering the controlled (downstream) node and disregarding tolerance, the basic condition for a PRV placed in pipe i to change its status from open to active would be

$$H^D(i) > H_{SET} \tag{1}$$

where $H^D(i)$ = pressure head at the controlled downstream node of pipe i; and H_{SET} = valve setting.

By considering the controlled (upstream) node and disregarding tolerance, the corresponding condition for a PSV placed in pipe i to change its status from open to active would then be

$$H^U(i) < H_{SET} \tag{2}$$

Therefore, from a conceptual point of view, the statement that the rules to detect the status of a PSV can be derived by those of a PRV by switching the upstream and downstream nodes and interchanging the inequality signs is not incorrect. However, since operationally (1) the rules are written by considering the uncontrolled node, instead of the controlled one, of the pipe i where the valve is placed; (2) the pressure at the uncontrolled node of pipe i can be obtained from the pressure at the controlled node accounting for the distributed and the minor losses; and (3) the tolerance has to be taken into account, in the case of a PRV Eq. (1) becomes

$$H^U(i) - r_i|Q(i)|^{n-1}Q(i) - m_i|Q(i)|Q(i) > H_{SET} + H_{TOL} \tag{3}$$

while Eq. (2) for the case of a PSV becomes

$$H^D(i) + r_i|Q(i)|^{n-1}Q(i) + m_i|Q(i)|Q(i) < H_{SET} - H_{TOL} \tag{4}$$

Accordingly, as properly observed by the discussers, the signs of the head loss terms and of the head tolerance term must also be changed.

Given that similar considerations apply to all the other rules listed in our paper, for the sake of clarity, we add here Tables 1 and 2 explicitly giving the rules to evaluate the status of a PSV for each of the two proposed methods mirroring the ones used to evaluate the status of a PRV reported in the original paper.

Table 1. Checks and resulting status of PSVs used for NSS

Current valve status	Check	New valve status
Active	If $Q(i) < Q_{TOL}$	Closed
	If $Q(i) \geq Q_{TOL}$ and $\delta_i \leq 0$	Open
	Otherwise	Active
Open	If $Q(i) < Q_{TOL}$	Closed
	If $H^D(i) < H_{SET} - r_i\|Q(i)\|^{n-1}Q(i) - m_i\|Q(i)\|Q(i) - H_{TOL}$	Active
	Otherwise	Open
Closed	If $H^D(i) \leq H_{SET} - r_i\|Q(i)\|^{n-1}Q(i) - m_i\|Q(i)\|Q(i) - H_{TOL}$ and $H^U(i) > H_{SET} + H_{TOL}$	Active
	If $H^D(i) > H_{SET} - r_i\|Q(i)\|^{n-1}Q(i) - m_i\|Q(i)\|Q(i) + H_{TOL}$ and $H^D(i) < H^U(i) - r_i\|Q(i)\|^{n-1}Q(i) - m_i\|Q(i)\|Q(i) - H_{TOL}$	Open
	Otherwise	Closed

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Table 2. Checks and resulting status of PSVs used for SS

Current valve status	Check	New valve status
Active	If $Q(i) < Q_{TOL}$	Closed
	If $Q(i) \geq Q_{TOL}$ and $H^D(i) > H_{SET} - r_i\|Q(i)\|^{n-1}Q(i) - m_i\|Q(i)\|Q(i) + H_{TOL}$	Open
	Otherwise	Active
Open	If $Q(i) < Q_{TOL}$	Closed
	If $H^D(i) < H_{SET} - r_i\|Q(i)\|^{n-1}Q(i) - m_i\|Q(i)\|Q(i) - H_{TOL}$	Active
	Otherwise	Open
Closed	If $H^D(i) \leq H_{SET} - r_i\|Q(i)\|^{n-1}Q(i) - m_i\|Q(i)\|Q(i) - H_{TOL}$ and $H^U(i) > H_{SET} + H_{TOL}$	Active
	If $H^D(i) > H_{SET} - r_i\|Q(i)\|^{n-1}Q(i) - m_i\|Q(i)\|Q(i) + H_{TOL}$ and $H^D(i) < H^U(i) - r_i\|Q(i)\|^{n-1}Q(i) - m_i\|Q(i)\|Q(i) - H_{TOL}$	Open
	Otherwise	Closed

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