

General comment

The paper deals with the evaluation of the reliability of a water distribution system served by a pumping station and in particular with the increase of reliability deriving from the use of variable speed pumps compared with single speed pumps. The topic is of interest for the readership of Drinking Water Engineering and Science.

The paper is clearly organized, but in many points the English language is poor, or even wrong in some cases, and I recommend that it is checked by a mother tongue.

About the scientific contents of the manuscript, the presented application seems just an exercise, and the validity of the main conclusion drawn by the Authors (the use of VSP increases the reliability of the system, which is probably obvious regardless of this manuscript) is not supported by the presented results and their discussion: in particular, it is plain that the result strongly depends upon: (i) the shape of the relationship expressing the reliability at a single demand node; (ii) the probability of failure of the pumps.

Both these quantities have been assigned without any explanation. In particular, for the first, the three checked shapes seem arbitrary; for the second, no information is provided about how the probabilities of failure have been evaluated (I have doubts about such values, as explained in the following “detailed comments” section).

I also have some minor concern about the use of the word “fuzzy” for the relationships expressing the reliability at demand nodes: usually the recourse to fuzzy variables is done when the vagueness of truth is such that a certain degree of truth can be found even in opposite statements, and the membership functions are introduced just to quantify the degree of truth of opposite statements. In this case, I understand that the proposed relationships are just a way to quantify the degree of fulfillment of design requirements at nodes.

In conclusion, I think that the manuscript cannot be accepted in its present form and that major revisions are needed. In particular, the choice of the expressions (1), (2) and (3) (especially the last two) must be discussed and motivated, as well as the evaluation of the probabilities of pump failures.

Detailed comments

Pag. 355, lines 17-20: I suggest to discuss here the limitations of a Demand Driven approach rather than at pag. 358, lines 27-29;

Eq. (1) and pag. 356, line 3: clarify the meaning of the pressure head H_{MIN} ;

Pag. 356, line 12, Eq. (3) and fig. 2: what are H_1 , H_2 and H_3 ? If they are just shape parameters of the reliability expression, as I guess, their choice should be discussed;

Pag. 356 and figures 1 and 2: the choice of the expressions of the reliability at nodes (especially eq. (3)) should be discussed and clarified;

Pag. 357, eq. (4) and lines 6-7: I really don't understand how the use of demands to weigh the reliability at nodes could “increase the accuracy of the reliability calculation” (it makes no sense);

Pag. 357, lines 14-15: the Authors should provide more information about the analyses carried out to evaluate r_{sc} ;

Fig. 3 and pag. 358, lines 3-4: counting the nodes (they result 78, as stated two lines above), it seems that the entire network is depicted, and not only a part;

Pag. 358, lines 11-12: it should be made clearer that the obtained result have not general validity, but refer only to the considered network;

Table 1 and pag. 358 lines 13-14: the table provides the pumping schedules, and not the “demand levels”, as stated. However, it would be worth to add a table or a figure with the temporal demand pattern;

Pag. 359, lines 16-18: how the probabilities were evaluated? The assumed values seem questionable, because, if the probability of failure of a single pump is 0.85 (extremely high), it’s difficult to understand how the probability of two failures is 0.1. If the events were stochastically independent, the probability of two failures (the pumps have the same characteristics, as stated at pag. 358, line 3) should be $0.85 \times 0.85 = 0.72$. If the failure of pumps can be caused, at least in some cases, by the same reasons, the probability of contemporary failure is even higher than the product of the probabilities of single failures. This point is crucial for the entire study, because the obtained results strongly depend on the values assumed for r_i . Thus, the Authors should thoroughly discuss it;

Pag. 360, lines 16-19: equations (1), (2) and (3) should be discussed in a less simplistic way;

Pag. 361, lines 5-11: these conclusions strongly depend on the chosen equations expressing the reliability at single demand nodes. This point should be discussed before drawing conclusions;

Pag. 361, lines 12-17: the use of pumps at speeds higher than the normal has not been investigate here; however, the conclusion is rather obvious.

Typing mistakes and English language errors

I cannot assure that the following list is complete, so I repeat my recommendation to carefully check the English language, possibly with the help of a mother tongue.

Pag. 352, lines 18-20: check English language;

Pag. 353, line 10: replace “deference” with “difference”;

Pag. 353, lines 19-20: check English language;

Pag. 353, lines 26-28: check English language;

Pag. 354, lines 11-14: check English language;

Pag. 354, line 17: replace “Tanyiemboh” with “Tanyimboh”;

Pag. 354, line 19: replace “Goupta” with “Gupta”;

Pag. 355, lines 9-12: check English language;

Pag. 355, line 14: eliminate “in this research”;

Pag. 357, line 11: eliminate “of” between “scenario” and “sc”;

Pag. 358, line 3: the word “downer” should be replaced with “low”;

Pag. 359, lines 9-12: check English language;

Pag. 360, line 23: check English language;

Pag. 361, lines 1-5: check English language;

Pag. 361, line 21: eliminate the word “tanks” between “system” and “by”;