# A Manufacturer's Perspective on the Requirements and Recommendationsin the UV Disinfection Guidance Manual (UVDGM)


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The UVDGM is a complex document in support of a relatively simple technology that has been used for over two decades in several parts of the world for drinking water treatment. The document is a testament to the extensive knowledge already known about UV and the perspectives of many on how to use UV. Preparation of the UVDGM was a huge task, and few other technologies have been lavished with such a wealth and breadth of information prior to their extensive use in the water treatment industry. This is a credit to both the EPA and to the authors and contributors to the manual.

The intent to be supportive with an abundance of knowledge could backfire, however, if the complexity masks the simplicity, or if the UVDGM doesn't lead the reader quickly and concisely to the priorities that users must address to ensure that the UV installations they are designing or UV equipment they are selecting can achieve the target performance objectives.

The UVDGM has to carefully distinguish those aspects which are guidance from those which should become regulation, and to distinguish empirically validated content from speculation, or evolving theory. Confusion of these extremes could result in excess requirements for UV compared with other disinfection technologies and increase technology costs beyond what was intended and what can be demonstrated to be a contribution to public health protection.

Identification within the UVDGM of empirical validation as being a key principle of UV technology acceptance is a significant contribution, and one that we support strongly. Nonetheless, validation is costly, and if different regulators were to interpret the guidelines and enact different validation requirements, the costs for compliance could become prohibitive, inhibiting the introduction of new technologies or limiting their use to certain jurisdictions.

In addition, we are concerned that the document as it reads will inhibit our ability to bring new innovations to market. The guidelines should speak not only to the details but also the intent of validation, the latter being the fundamental principles by which validation protocols for new technologies can be assessed. While section 1.4 speaks to the acceptance of UV technologies other than those currently available commercially, we are concerned that the endorsement for innovation is not strong enough. Adequate empirical validation must be defined by the UVDGM as relevant validation, where relevance is determined by both the intent of the testing and the details of the current or new technology being validated.

The UVDGM rightly strikes a conservative approach with respect to the implementation of UV technology for water treatment. However, the selection of a virus inactivation dose based on adenovirus may be seen as being more conservative than epidemiological considerations would warrant. Such a conservative dose target, combined with equipment safety factors based on mathematical analyses of data, which are yet to be understood theoretically by the industry and which have not been demonstrated empirically, can lead to significant oversizing of equipment and unnecessary increases in user costs.

The full impact of the UVDGM can be assessed only after we have experience with how the document is used by regulators, consultants, municipalities and the UV industry itself. The UVDGM is in fact only a primer from which others will derive implementation practices and regulations that impact upon the use of UV. Therefore, we pose some questions for consideration by all users who must critically assess the content of the UVDGM and move ahead to the implementation of practical UV regulations and installations that benefit public health in a cost-effective manner.

Those questions are:

***Has the UVDGM clearly prioritized the key guidance elements that, if adhered to during design or equipment selection, would ensure a high-level confidence in performance of the installed UV equipment?*** For example, empirical validation of UV technology should be clearly identified as the top element on the list of priorities. (It is first discussed in earnest in Section 3.1.4.3.) While validation is not a guide to competitive shopping for UV technology, it is clear that once UV technologies from different suppliers can be designed or assessed to be functional in meeting target disinfection objectives, then the purchaser can select the technology most suitable for the specific site on the basis of cost, supplier experience, monitoring technology features,

service availability, or other desired features. The UVDGM provides legitimacy to the use of UV, and a comfort level for the water industry, but it is not always easy for the reader to identify primary concerns for equipment design or selection and their relative priority. Such a listing of priorities would be helpful.

***Can the complexity of the UVDGM be a barrier to use of UV technology by those communities that could benefit from the technology, but who do not have access to resources to interpret the UVDGM in terms of the fundamental guidance elements?*** For example, will communities attempt to get Cryptosporidium removal/-inactivation credits by alternative more costly routes, or implement expensive prolonged monitoring programs rather than gravitate to a cost-effective UV solution simply because their local consultants are overwhelmed by the UVDGM? Perhaps the call for clarity and prioritization prescribed earlier might help.

***Is the UVDGM clear on what are the key elements of guidance (leading to practice) and what are the mandatory requirements (leading to regulation) for UV system design?*** This question is similar to the preceding one, but speaks more specifically to whether state regulators will be able to build for their jurisdictions enforceable requirements that embody the priority elements for all UV installations, but leave flexibility for the site-specific considerations. For example, placing UV technology after filtration may be a common practice, and some would even suggest common guidance or strong recommendation, but it is not a limitation that should be transformed into a regulation. Again, a listing of priorities and recommendations would be helpful.

***Can the new guidance in the UVDGM or new regulations that jurisdictions might build from these become an obstacle to new UV technology or process developments?*** For example, if UV were required to be placed after filtration, could this impede efforts to explore pre-filtration UV to kill parasites and increase the safety of recycling filter backwash water to the head of the plant? Can preconceived ideas on requirements for UV intensity sensors in earlier intensity set point monitoring methods preclude acceptance of different requirements for sensors used in more recent dose monitoring methods? Can guidance that end-of-life lamps and sleeves be used in validation become a barrier to the validation of new technology designs that use sleeves with a 10 to 20-year lifetime? We worry that the answers to questions like these questions may be "yes", and that innovation resulting in superior offerings to the public could be delayed in coming to market or abandoned.

***Is adenovirus a relevant target virus for UV disinfection considering its limited epidemiological importance in drinking water and its sensitivity to other disinfectants or unit operations that are part of the treatment process?*** Due to adenovirus becoming the proposed target virus, the UV doses proposed for 4-logs of virus control have been increased by up to 750% above what has been successfully used in the water industry for the last several decades without compromising public health, as evidenced by the European experience. We are concerned that the selection of adenovirus as the target organism is extremely conservative, and will significantly increase the cost of using UV. Such an increase in cost serves no group well, as the increased costs make the technology less competitive, inhibiting public access to a fundamentally robust, environmentally responsible, and cost-effective technology.

***Has the UVDGM guided regulators, consultants and end-users to better position UV use within the context of the entire treatment process? Should the concepts of UV disinfection be integrated with other unit operations?*** In North America, a residual disinfectant is

added following primary disinfection. We are concerned that the determination of required UV design dose be compatible with the overall process. The end-user is best served when the entire process is considered as an integrated whole when selecting and designing for a single unit operation within that process.

***Has the UVDGM introduced to UV, relative to other disinfection options, a level of overguidance that will increase the cost of UV technology to the end user? Is there an excessive level of conservatism?*** It is clear that it is within the purview of regulatory guidance to set safety factors on the target design doses for various organisms based on peer review of solid data. It is less clear that equipment safety factors should move away from purely empirically-based values derived during equipment validation and become reliant upon a mathematical derivation from an expanded list of uncertainties without some analysis indicating that the anticipated risks to public health and the need for elevated doses are realities in the field. The issue of safety factors and the methods of their application need to be considered carefully, since extremely conservative assumptions ultimately serve no group well. We do not have epidemiological evidence that public health has been compromised by previously regulated design doses, nor do we have empirical evidence that pushing design doses higher has a cost-effective benefit. Some of the concepts in the UVDGM warrant additional research to assess the actual values that should appear in guidance. It is especially of concern that the UVDGM that was focussed on supporting the two new regulations [LT2ESWTR and S2DBPR] has been extended to address the virus issues without the apparent level of review and discussion that went into preparing the content of the UVDGM for the Cryptosporidium and Giardia issues.

***Has the UVDGM presented practical validation protocols that are not adding significant cost to the technology?*** There is concern that a technology may have to undergo validation in different jurisdictions even within the US. The number of manufacturers that offer UV technologies combined with the number of different technologies that are available could lead to backlogs for testing in order to gain approval to provide the technology in different jurisdictions. Whether this becomes a problem is hard to predict.

It might be asked whether the UVDGM serves its purpose of facilitating access to a readily available and cost-effective technology that can benefit public health. We feel that the issues surrounding the clarity of guidance priorities, potential costs of validation, conservatism in dose selection and safety factor implementation, and the possible inhibition of longer-term or radically new innovations could have a negative effect on the ability of the UVDGM to reach this goal. However, careful attention to detail and intent in the next phases of the process could go far to mitigating these issues. We would hope that all stakeholders would play an active role to that end and certainly support this endeavor. The benefits for all end users would be a UVDGM that identifies and prioritizes the primary concerns that can be addressed to ensure that equipment will meet design objectives and performance once installed, and provides a helpful, concise, roadmap through the design and/or equipment selection process.

*Trojan System UV4000™; 4 channels, 150 MGD flow rate*