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Recognizing Value From Virtual Reality During Design. Case-Study Example Of A Wastewater Utility's Approach To and Use Of This Technology

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Introduction:

Hampton Roads Sanitation District (HRSD) provides service to 20 cities and counties of southeast Virginia and the Eastern Shore, an area of nearly 5,000 square miles with a population of 1.7 million. Their conveyance system includes over 500 miles of pipelines, 100+ pump stations (PS) and 16 treatment facilities with a combined capacity of 249 million gallons per day (MGD. Although HRSD is an innovator in treatment processes, their approach to project designs has typically been traditional two-dimensional (2D) plan and profile sheets. In 2017 HRSD was introduced to Virtual Reality (VR) design through a construction-management-at-risk (CMAR) project, where the CMAR developed VR models of the existing AutoCAD designs as part of their value engineering design review. Since then, HRSD has been increasing their use of VR as part of their design review process in conjunction with or in lieu of reviewing 2D plans. After 5 years and 20 projects using VR, HRSD has developed an understanding of how a VR model can add benefit to a project, how best to conduct design reviews with staff to optimize the operational and maintenance (O&M) of new facilities, and how to efficiently use these models to convey design comments back to the engineer.

However, without a formal standard for applying VR during design, HRSD still has to consider, on a project-by-project basis, how much value VR will add to the design process, and ultimately, the operation and maintenance of the asset. Furthermore, to fully determine the extent of which VR will benefit the project, several more questions must be considered surrounding technology, cost and end use of the model. A textbook example of these considerations and the corresponding decision-making process took place during a recent project in which the design phase was starting on two PSs. The following sections will expand upon the project, the determination for and to what extent VR is used and highlights of the model and HRSD's beneficial use of the technology's features.

Project Background:

The Suffolk PS Replacement Project, located in Suffolk, Virginia, addressed HRSD's need to reduce sanitary sewer overflows (SSOs) through the replacement of the existing, under-capacity Suffolk PS and the associated, deteriorating, extremely-hard-to-access gravity sewer system. During the design, several alternatives were explored and ranked using a triple bottom line analysis. Ultimately, an alternative of two PSs (#159 and #160) to replace the existing Suffolk PS was selected, which had the secondary benefit of allowing approximately 6,500 linear feet of hard to access gravity system adjacent to a tidal creek and environmentally sensitive area to be abandoned.

The two proposed PSs were very different in size: PS #159 and PS#160 capacities were approximately 700 and 3,300 gpm, respectively. As a result of the size difference, and HRSD's PS Design Standards, PS #159 design was based on a submersible pump concept and PS #160 is based on a dry well/wet well orientation with an above-grade superstructure which included a loading bay, open dry well to provide full accessibility to a bridge crane, electrical room, bathroom, HVAC and walkways. In summary, PS #160 was a multi-faceted station with multiple systems (process, mechanical, HVAC and electrical) that will require regular O&M. PS #159 was not as complex as it only included a small, prefabricated building to house electrical equipment and a valve vault adjacent to the wet well.

Based on the design complexity, areas for occupancy or work, and anticipated level of O&M for each station, HRSD decided to only develop a VR model for the larger station, PS #160.

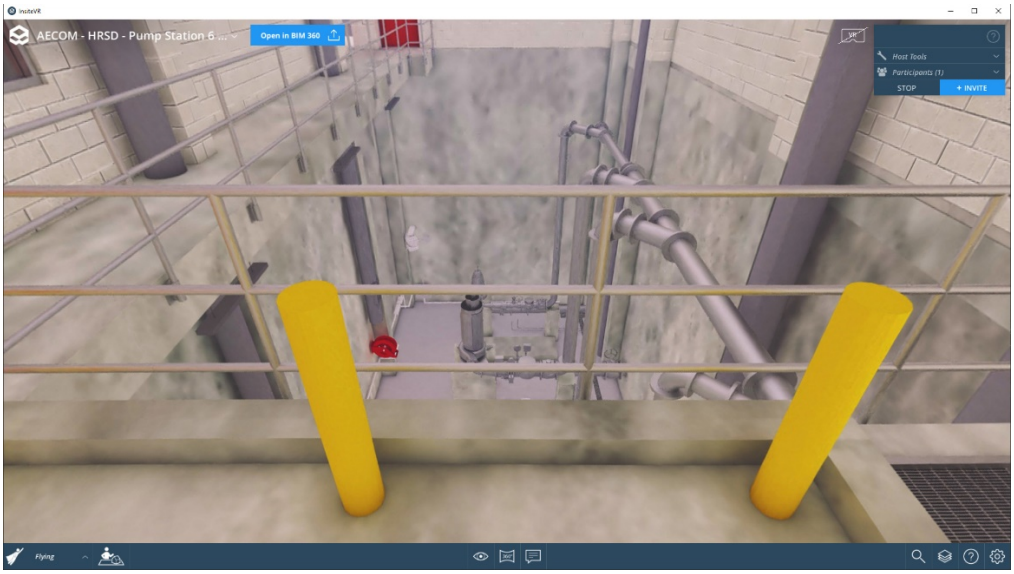
The VR Model:
After deciding that a project (or a specific PS in this case) are a good candidate for using VR during the design, there are many other considerations to consider, in addition to those presented in the Introduction. Specifically:

- What VR technology will be used?
- At what design level(s) will the VR model be included/updated?
- What software/hardware is being used and how is that obtained and shared with the designer and owner during the project?
- What level of detail should the model(s) be developed to?
- What type of VR experience is necessary to achieve the project goals (e.g, desktop visualization; full immersive VR with headsets; etc.)?
- How will the model be used (e.g., design reviews, public meetings, etc.)?
- How do the questions above influence the cost of the model(s)?

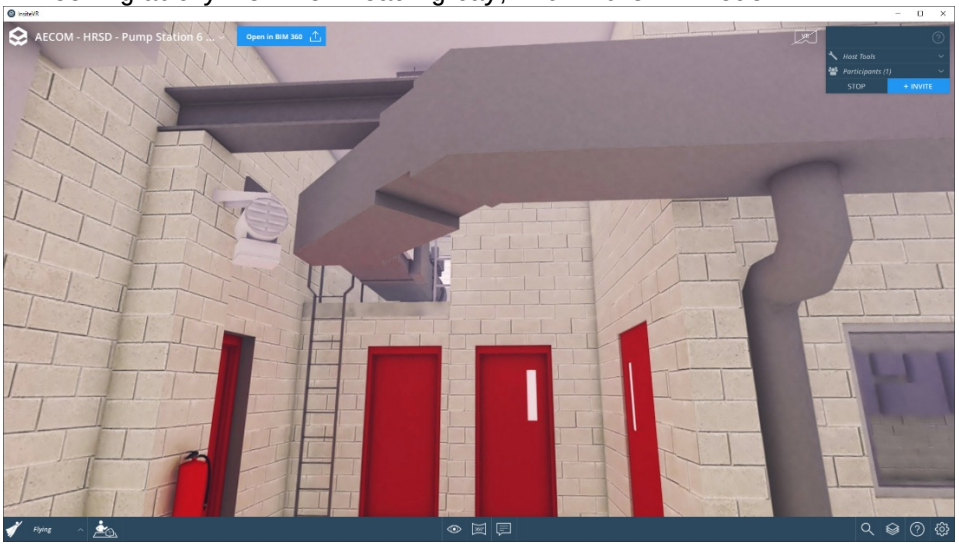
The answers to these questions can impact the design process, technologies utilized, development cost and project schedule, and ultimately, the answers to these questions can (and should) vary from project to project. Within this paper the Suffolk PS Replacement project will be used to show how these questions were influenced by HRSD's prior VR experiences and operator-centric design approach. Cost and development implications will be supported few other examples, in addition to the Suffolk PS Replacement project, that expand beyond design or water/wastewater applications.

To further showcase how HRSD is standardizing their internal review process using VR, this paper will also highlight features of the VR software used by HRSD for efficient design reviews in-house, design review best practices that ensure the O&M needs of staff are adequately addressed during design, limitations of 2D design for complex vertical structure, and how utility-specific details and standards can be incorporated into the model to supercharge the value of using VR. The VR model also brought an unplanned, added value from use of the internet-based, real-time reviews and collaboration between HRSD and the design consultant during the COVID-19 pandemic, when in-person meetings were impossible.

Audience Takeaway:
HRSD has standardized on the use of VR models for vertical design projects, recognizing the value and short- and long-term ROI. Many utilities who are considering VR may be questioning whether the technology will bring value to their design review process or which questions to even ask about this technology. The goal of this paper is to explore these questions through a case-study project, provide lessons learned from HRSD's VR experience, showcase how HRSD has standardized the internal review process using this technology and ultimately help other utilities become comfortable and recognize the same benefits from this new technology.

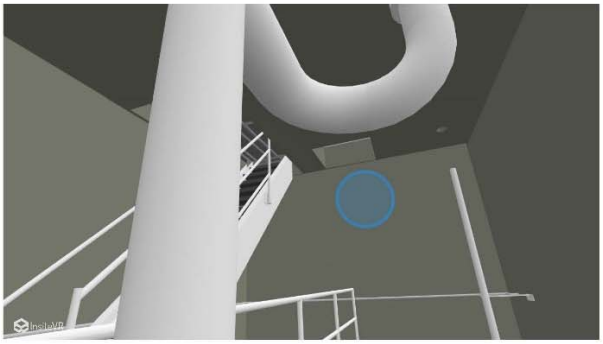


·Looking at dry well from loading bay, within the VR model



·Looking at HVAC system and multiple doorways, within the VR Model

·View from upon the walkway above the wet well's trough/influent channel



Added by: Jeff Scarano
Element: Concrete, Cast-in-Place gray

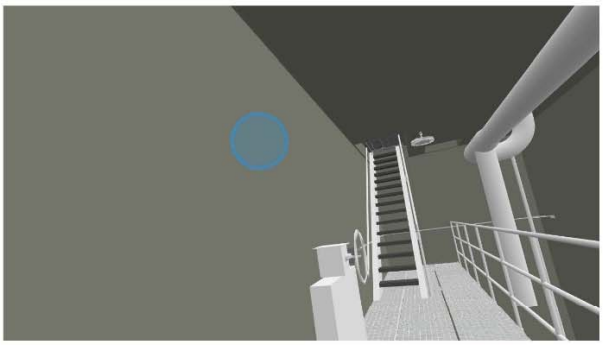
12-15-2020

"Reconsider permanent piping for well cleaning. Let's discuss. (Ss Int)"

Added by: Jeff Scarano
Element: Metal Weld - Aluminum

12-15-2020

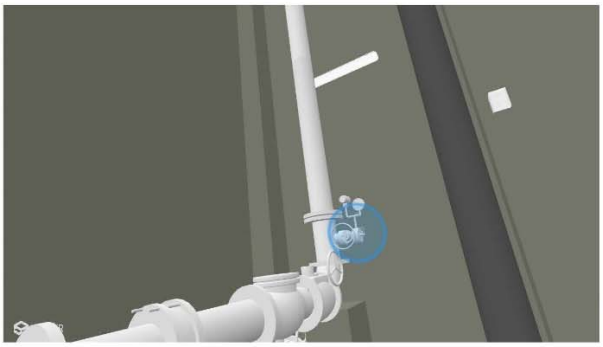
"Can a larger water service be installed to allow complete wet well cleaning? (SS Int)"



Added by: Jeff Scarano
Element: Concrete, Cast-in-Place gray

12-15-2020

"What is the Overflow elevation at this station? (SS Int)"



Added by: Jeff Scarano
Element: Processing

12-15-2020

"Why is this pressure gauge still here? (SS Int)"

·Example set of comments from within the model