UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MD 20814

This document has been electronically approved and signed.

BALLOT VOTE SHEET

DATE: March 16, 2016

TO: The Commission
Todd A. Stevenson, Secretary

THROUGH: Patricia H. Adkins, Executive Director
Stephanie Tsacoumis, General Counsel

FROM: Patricia M. Pollitzer, Assistant General Counsel
Barbara E. Little, Attorney, OGC

SUBJECT: Petition VGBA 15-1; Petition for Classification of "Vacuum Diffusion Technology" as an Anti-Entrapment System Under the Virginia Graeme Baker Pool and Spa Safety Act

BALLOT VOTE Due: March 22, 2016

Paul C. McKain, Chief Executive Officer of PSD Industries, LLC, requested that the Commission classify vacuum diffusion technology ("VDT") as an anti-entrapment device or system under the Virginia Graeme Baker Pool and Spa Safety Act ("VGB Act"). On July 22, 2015, the Office of the General Counsel docketed the request as a petition under the VGB Act, VGBA 15-1. In the attached briefing package, staff recommends that the Commission deny the petition.

Please indicate your vote below:

I. Grant the petition and direct staff to begin developing a notice of proposed rulemaking.

_____ _____
(Signature) (Date)

II. Defer the petition.

_____ _____
(Signature) (Date)

III. Deny the petition and direct staff to draft a letter of denial to the petitioner.

_____ _____
(Signature) (Date)

IV. Take other action (please specify).

_____

_____

_____

_____ _____
(Signature) (Date)

Attachment: Staff briefing package: Vacuum Diffusion Technology Petition

Staff Briefing Package

Vacuum Diffusion Technology Petition

March 15, 2016

Table of Contents

Briefing Memo

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
4330 EAST WEST HIGHWAY
BETHESDA, MARYLAND 20814

This document has been electronically approved and signed.

Memorandum

Date: March 15, 2016

TO: The Commission
Todd A. Stevenson, Secretary

THROUGH: Stephanie Tsacoumis, General Counsel
Patricia H. Adkins, Executive Director

FROM: George Borlase, Ph.D., P.E., Assistant Executive Director
Office of Hazard Identification and Reduction

Perry Sharpless, Project Manager
Division of Mechanical Engineering, Directorate for Laboratory Sciences

SUBJECT: Vacuum Diffusion Technology Petition Briefing Package

I. INTRODUCTION

The Virginia Graeme Baker Pool and Spa Safety Act (the "Act", or "VGB") requires public pools and spas with a single unblockable drain to have installed one or more of five enumerated devices or systems, which are designed to prevent suction entrapment by pool or spa drains.

The Act also directs the Consumer Product Safety Commission ("CPSC" or "Commission") to allow "other systems" as a means of compliance with VGB if they are "determined by the Commission to be equally effective as, or better than, the [five codified systems] at preventing or eliminating the risk of injury or death associated with pool drainage systems." The petitioner seeks to have "vacuum diffusion technology" ("VDT") included as an "other system." If determined to be an "other system," a VDT-based product could be installed in a single blockable drain to make it compliant with the requirements of the Act.

II. BACKGROUND

A. Drain-Cover-Related Hazards

Before the use of recirculating water sanitation systems, pools were routinely emptied through a drain located at the deepest part of the pool, and subsequently refilled with fresh water instead of being treated with chemicals – actions that were typically done when the pool was closed for service. When pool circulation systems were developed, they allowed continuous treatment of the pool water even while the pool was in use. Operating a water recirculation system while the bathers were present introduces a new hazard pattern involving suction entrapment. Suction entrapment occurs when the water being pulled into the drain by the pump holds a person's body against the drain, or causes a person's hair to become entangled in the drain cover. Drain cover entrapments are discussed at length below.

The Act refers to "drains" and "drain covers" when referring to what are termed suction outlet fitting assemblies ("SOFAs") by the pool industry. The words "suction outlet" help to highlight the potential hazard that is present. SOFAs encompass all parts of the drain – the cover, the sump, and the suction outlet within the sump that allows water to return to the pump. The terms "drain," "drain cover," and "SOFA" can in most instances be used interchangeably as long as context is preserved.

There are five recognized types of hazards associated with drain covers. The following is a list and brief description of each hazard. Hair, body, limb, and mechanical entrapments typically result in death by drowning. Evisceration and drowning may happen concurrently, but that is not always the case. However, drowning and evisceration may happen concurrently.

> Hair Entrapment – Occurs when water flowing into the drain from the pool carries a person's hair through and behind the openings in the cover, where it becomes sufficiently entangled to prevent their escape.
>
> Body Entrapment – Occurs when a person is held against the pool wall or floor due to the suction of the pool circulation system.
>
> Limb Entrapment – Occurs when a drain cover is broken and a person gets a limb stuck in the broken portion of the cover, or when a cover is completely missing and a person gets a limb wedged in the suction outlet[1] that is within the pool drain sump.
>
> Mechanical Entrapment – Occurs when something that the bather is wearing, *e.g.*, an earring, or a swim suit with knotted strings, becomes physically wedged into the drain cover.
>
> Evisceration – A suction-induced disembowelment, which typically involves children who sit on drains. Often, the victim initially survives the disembowelment but subsequently dies of injuries related to the incident.[2]

[1] The "suction outlet" is the orifice within the drain, technically called the suction outlet fitting assembly ("SOFA"), where the water is drawn from the pool by the pump.
[2] http://www.twincities.com/ci_8651186

B. Virginia Graeme Baker Pool and Spa Safety Act

Section 1404 of the Act concerns the installation of devices intended to prevent entrapment by pool drains. Section 1404 states:

> a) each public pool and spa in the United States shall be equipped with anti-entrapment devices or systems that comply with the ASME/ANSI A112.19.8 performance standard, or any successor standard; and
>
> b) each public pool and spa in the United States with a single main drain other than an unblockable drain shall be equipped, at a minimum, with one or more of the following devices or systems designed to prevent entrapment by pool or spa drains:
>
> (I) SAFETY VACUUM RELEASE SYSTEM.—A safety vacuum release system which ceases operation of the pump, reverses the circulation flow, or otherwise provides a vacuum release at a suction outlet when a blockage is detected, that has been tested by an independent third party and found to conform to ASME/ANSI standard A112.19.17 or ASTM standard F2387.
>
> (II) SUCTION-LIMITING VENT SYSTEM.—A suction-limiting vent system with a tamper-resistant atmospheric opening.
>
> (III) GRAVITY DRAINAGE SYSTEM.—A gravity drainage system that utilizes a collector tank.
>
> (IV) AUTOMATIC PUMP SHUT-OFF SYSTEM.—An automatic pump shut-off system.
>
> (V) DRAIN DISABLEMENT.—A device or system that disables the drain.
>
> (VI) OTHER SYSTEMS.—Any other system determined by the Commission to be equally effective as, or better than, the systems described in subclauses (I) through (V) of this clause at preventing or eliminating the risk of injury or death associated with pool drainage systems.

The petitioner seeks to have the Commission determine that vacuum diffusion technology is "equally effective as, or better than, the systems described in subclauses (I) through (V)." at "preventing or eliminating the risk of injury or death associated with pool drainage systems."

C. Hazard Pattern Characterization Based on Incident Data

Staff reviewed reports of drain-cover-related injuries that occurred in the 2010 – 2014 time period. Hazard scenarios for the reported incidents included victims trapped by suction, outlet covers missing/removed, and victims caught on outlet covers, among other and unknown hazard scenarios. There was one death, which was the result of body suction entrapment. Refer to Tab A for an analysis of the incidents which occurred during the reporting period.

III. DISCUSSION

A. Comparison of Codified Entrapment Prevention Methods

Before addressing the question of whether vacuum diffusion technology might qualify as an "other system," it is important to first examine the protections afforded by the other codified methods of compliance with VGB. It is important to remember, however, that there is no method available to the public to report successful operation of any safety-related device -- only deaths and injuries are tracked. When determining the protections afforded by the codified methods, it is important to consider what is likely or what has been shown to occur.

Table 1, which may be found after the discussion of the codified entrapment prevention methods, summarizes a comparison of the five recognized types of drain cover hazards versus the five types of codified methods of compliance. It is important to state the assumptions that must necessarily be made when deciding whether a particular method of compliance protects against a particular hazard.

1. Safety Vacuum Release System ("SVRS")

SVRSs function by detecting an increase in the suction pressure in the piping between the circulation pump and the pool drain, which would occur if the flow through the drain was blocked while the circulation pump is operating. If a blockage is detected, the system turns off the pump and/or opens a vent that allows air into the suction side of the circulation system, thus relieving the vacuum. Note that the SVRS standard requires that the drain cover be removed before testing.

Hair Entrapment – SVRSs provide no protection from hair entrapment, because hair entrapments typically involve entanglement of the hair in the cover. If the cover is not present, there are likely no places in or around the drain where hair could become entangled. SVRSs cannot detect hair entrapment.

Body Entrapment – SVRS protect against body entrapment. SVRSs that rely on electronic detection of changes in suction pressure will trip in time to prevent suction entrapment that lasts for more than several seconds, as will mechanical systems that sense a sudden change in momentum of the water to activate the SVRS. However, whether electronic or mechanical, the SVRS must be continually maintained and kept in calibration in order to reliably mitigate entrapment hazards.

Limb Entrapment – Limb entrapment typically occurs when a cover is broken or missing. If the cover is broken, it might be possible to become entrapped in the damaged area of the cover. In this case, there is unlikely enough blockage to cause the SVRS to activate. If the cover is missing and a person sticks their limb into the suction outlet within the drain, they will probably block the flow sufficiently to cause the SVRS to activate. Whether the SVRS activates depends on how much of the flow is blocked.

Mechanical Entrapment –Without substantial or complete blockage of circulation water flow into the drain, SVRSs will not activate. Typically, mechanical entrapments do not provide adequate blockage to activate an SVRS. Note that mechanical entrapments can only occur if the drain cover is on. No portion of the sump or suction outlet besides the cover likely contains crevices or other geometry that would mechanically capture jewelry or swimsuits.

Evisceration – The SVRS standard says that SVRSs do not protect against evisceration, which can occur in as little as 1.86 seconds.[3] The SVRS standard allows 4.5 seconds from the onset of complete and sudden blockage until vacuum release. Evisceration can occur before the SVRS can activate and lower the eviscerating pressure.

2. Suction-Limiting Vent System ("SLVS")

These systems work by allowing air to enter the pump when a blockage causes higher than normal suction pressures. This causes the pump to lose its prime and therefore its ability to create suction. SLVSs are covered by ASTM F2707-10 *Standard Safety Performance Specification for Safe Design and Installation of Field Fabricated Suction-Limiting Vent Systems for Suction Entrapment Prevention in Swimming Pools, Spas, Hot Tubs, and Wading Pools.* Paragraph 1.2 of the standard says "The vent is intended to prevent body entrapment at the suction outlet(s) and may also mitigate limb entrapment. It is not intended to prevent other injuries caused by the suction outlet(s) such as hair entrapment, mechanical entrapment, or evisceration."

Hair Entrapment – The standard itself says that it doesn't protect against hair entrapment.

Body Entrapment – SLVSs do protect against body entrapment. The vacuum level necessary to cause the vent to activate is low enough for the entrapped person to escape. SLVSs will release the victim's body from the drain whether it has a cover or not.

Limb Entrapment – Limb entrapment typically occurs when a cover is broken or missing. If the cover is merely broken, it might be possible to become entrapped in the damaged area of the cover. In this case, there is unlikely enough blockage to cause the SLVS to activate. If the cover is missing and a person sticks their hand or leg into the suction outlet within the drain, they may be able to block the flow sufficiently to cause the SLVS to activate. Whether the SVRS activates depends on how much of the flow is blocked.

Mechanical Entrapment – The standard itself says that it doesn't protect against mechanical entrapment.

Evisceration –The standard itself says that SLVSs aren't designed to protect against evisceration.

3. Gravity Drainage Systems

A pool or spa that relies on a gravity drainage system exhibits lower suction force at the drains than any other drainage system, other than a pool with drain disablement (described below); gravity drainage systems are not associated with any reported incidents of body entrapments or eviscerations. What sets gravity drainage systems apart from direct-suction systems is that gravity drainage systems develop hold-down forces slowly over time. With a direct-suction

[3] http://poolsafetycouncil.org/pdfs/2011/NASA_PDFs.pdf

system, the suction available at the drain is constant and of large magnitude. Gravity drainage systems effectively have a hydraulic buffer that prevents sudden changes in suction outlet vacuum levels.

Hair Entrapment – Gravity drainage systems provide no protection from hair entrapment, because hair entrapments typically involve entanglement of the hair in the cover. If the cover is not present, there are likely no places in or on the drain where hair could become entangled.

Body Entrapment – Gravity drainage systems protect against body entrapment. Because suction entrapment forces develop over time, potential victims have the time to sense and react to the sensation of being held against the drain, whether the cover is present or not. Furthermore, there is the issue of how long a person can hold his/her breath. If minimally trapped against the drain, the reflex need to breathe would likely cause a person to head to the surface before the suction entrapment forces are too great to overcome. However, the rate at which suction develops with respect to time depends on the design of the circulation system. Evidence of the virtues of gravity drainage systems as a means to mitigate injury can be found in injury data for the state of Florida, where there have been no body entrapment or evisceration deaths since they made such systems mandatory in the mid '70s.

Limb Entrapment – Limb entrapment typically occurs when a cover is broken or missing. If the cover is broken, it might be possible to become entrapped in the damaged area of the cover. If the cover is missing and a person sticks a hand or foot into the suction outlet within the drain, unless it becomes mechanically wedged in a manner that is not related to pressure or flow, the same sense-and-react scenario and need to breathe issues raised in the gravity drain body entrapment discussion apply to limb entrapment, too.

Mechanical Entrapment – Gravity drainage systems do not protect against mechanical entrapment. Note that mechanical entrapments can only occur if the drain cover is on. No portion of the sump or suction outlet besides the cover likely contains crevices or other geometry that would mechanically capture jewelry or swimsuits.

Evisceration – In a gravity drain system, it is not practically possible to develop enough suction to cause evisceration. A blocked drain causes suction pressure to develop slowly over time. The sense-and-react and need to breathe issues raised in the gravity drain body entrapment discussion are valid here, too.

4. Automatic Pump Shutoff ("APS")

The complete definition of this in VGB is "An automatic pump shut-off system." Presumably, this system would detect a blockage and then shut-off the pump. There is no requirement to relieve the suction from the drain line. Such a system would not likely detect mechanical or hair entrapments. Depending on the sensing technology, an automatic pump shutoff system may be similar to an SVRS that similarly shuts-off the pump.

Hair Entrapment – An APS would provide no protection from hair entrapment, because hair entrapments typically involve entanglement of the hair in the cover. If the cover is not present, there are likely no places in or on the drain where hair could become entangled. It is possible that someone could develop a technology to sense hair entrapment and turn-off

the pump, but automatic pump shut-off, that necessarily must occur after an entrapment has been detected, does not mitigate drowning deaths due to hair entrapment.

Body Entrapment – Done in a timely manner, automatic pump shut-off would protect against body entrapment.

Limb Entrapment – Limb entrapment typically occurs when a cover is broken or missing. If the cover is broken, it might be possible to become entrapped in the damaged area of the cover. Automatic pump shut-off would not protect against this type of incident. If the cover was missing and a person stuck their limb into the suction outlet within the sump, and the obstruction was detected by the automatic pump shut-off system, the person could still be trapped in the suction outlet.

Mechanical Entrapment – Mechanical entrapments are a function of the drain cover only. Automatic pump shut-off cannot protect against mechanical entrapment.

Evisceration – Automatic pump shut-off systems rely on detection of blockage, for the same reasons listed in SVRS evisceration, and are unlikely to mitigate evisceration injuries.

5. Drain Disablement

VGB defines drain disablement as "A device or system that disables the drain." CPSC staff has expounded on this definition to indicate that this method may be fulfilled by the following means:

- Fill the sump with concrete, in effect, filling the outlet piping as long as another source(s) of water for the suction side of the pump is (are) available, such as skimmers.
- Cut and cap the piping in the equipment room in such a way that it cannot be reinstalled.
- Re-plumb the suction line from the drain to the pressure side of the pump to create a return line and reverse the flow.[4]

The assumption made with regard to re-plumbing is that a new VGB-compliant suction source can be found for the water that is now discharged through the former drain. Such sources could include water taken in by skimmers, which do not have to meet the requirements of APSP-16.

Hair Entrapment – Disablement protects against hair entrapment, because hair entrapments typically involve entanglement of the hair after it is drawn through and beneath the cover, which is caused by the movement of water flowing out of the pool. For disabled drains, the flow is either not present, or reversed and directed into the pool through the former drain, thus providing no flow that favors entanglement.

[4] http://www.poolsafely.gov/wp-content/uploads/VGBA.pdf

Body Entrapment –The same argument made for hair entrapment applies to body entrapment. For disabled drains, there is no flow that favors entrapment.

Limb Entrapment – Limb entrapment typically occurs when a cover is broken or missing. If the cover is broken, it might be possible to become entrapped in the damaged area of the cover. If the cover is missing, it is still possible to suffer limb entrapment in the former suction outlet, by mechanically wedging an appendage into an opening from which it cannot easily be removed. Limb entrapment can only be guaranteed to be prevented by drain disablement if the drain is filled with concrete or equivalent.

Mechanical Entrapment – Flowing water is not required for there to be a mechanical entrapment. Mechanical entrapment occurs when something attached to or worn by the bather becomes wedged in the drain cover with sufficient tenacity to cause the swimmer to be trapped. Note that mechanical entrapments can only occur if the drain cover is on. There is no requirement in VGB that drains that have been disabled have their cover removed. If there is a cover, mechanical entrapment is possible.

Evisceration – This type of injury is not possible if the drain is disabled.

Table 1. Comparison of codified methods vs. hazard mitigated.

HAZARD MITIGATED _____ **VBG METHOD**	Hair Entrapment	Body Entrapment	Limb Entrapment	Mechanical Entrapment	Evisceration
SVRS	No	Yes	No	No	No
Suction-Limiting Vent	No	Yes	No	No	No
Gravity Drain	No	Yes	Maybe	No	Yes
Automatic Pump Shut-Off	No	Yes	No	No	No
Disablement	Yes	Yes	Maybe	Maybe	Yes

Because it is clear that no single system protects against all five of the injury types, the problem in determining whether vacuum diffusion technology should be considered an "other system" lies in capturing the essence of the codified methods of compliance, looking for commonalities, and then determining if VDT is "equally effective as, or better than, the [five codified systems] at preventing or eliminating the risk of injury or death associated with pool drainage systems." As demonstrated in Table 1, each of the five codified entrapment protection devices or systems protects against body entrapment. Indeed, the Act's namesake, Virginia Graeme Baker, died from body entrapment. Furthermore, the Act excludes public pools with an unblockable single main drain, and defines unblockable to be "a drain of any size and shape that a human body cannot sufficiently block to create a suction entrapment hazard," reflecting an emphasis on preventing body entrapment. It is reasonable to conclude, therefore, that an "other system" should also offer protection against body entrapment.

B. Observations By Staff

In order to provide a fair comparison of how VDT attempts to reduce or eliminate the hazards associated with pool drains, it is necessary to subject VDT to the same scrutiny already applied above to the codified methods of compliance. Staff conducted the same comparison of codified methods vs. hazards mitigated assessment for VDT that was performed for the codified systems and summarized in Table 1.

1. CPSC Staff Analysis of Vacuum Diffusion Technology

The petitioner defines VDT as:

> A system that removes the intense vacuum draw from the intake point of a pumping system by occluding the intake orifice from swimmers and diffusing the vacuum from a potential blockage immediately in multiple directions from the blockage. To be considered Vacuum Diffusion Technology, covering 50% of the Vacuum Diffusion Technology intake should not raise the normal vacuum draw by more than .4" Hg. Vacuum Diffusion Technology devices must automatically adjust to changing conditions in the system in which it is installed, cannot be by-passed, require no calibration and contain no electronics or moving parts to malfunction.

Using the petitioner-provided definition, as well as the same basic assumptions used to assess the performance of the codified systems, staff assessed the performance of VDT for each of the five recognized types of drain-cover-related standards. Because the petitioner cited the Protektor, a vacuum-diffusion-technology-based device, in the petition, staff used the ProteKtor as a basis for comparing VDT to other technologies.

The ProteKtor, which was invented by the petitioner and others, is the "initial device that led to the discovery and subsequent development of Vacuum Diffusion Technology." This device is already commercially available through at least one national retail chain. Figure 1 was captured from a retail website maintained by In The Swim.[5] Because no other vacuum-diffusion-technology-based product is known to exist, the ProteKtor is used as an example for this discussion. Figure 2 was captured from the ProteKtor manufacturer's online product manual. It shows one possible mounting installation, where the VDT-based product is mounted within the sump, and is completely below the drain cover and pool surface. Other designs which meet the definition of VDT established by the petitioner are possible.

The petitioner states that the device shown in the picture simply slides into place in the suction outlet of the pool drain, requiring no tools to install or remove. The petitioner further states that updates to the product are being made that would necessitate the use of tools for removal of the product from the suction outlet.

[5] Retrieved from http://www.intheswim.com/p/protektor-auxiliary-entrapment-protection-kit on February 10, 2016

Figure 1. Front-quarter view of the ProteKtor.

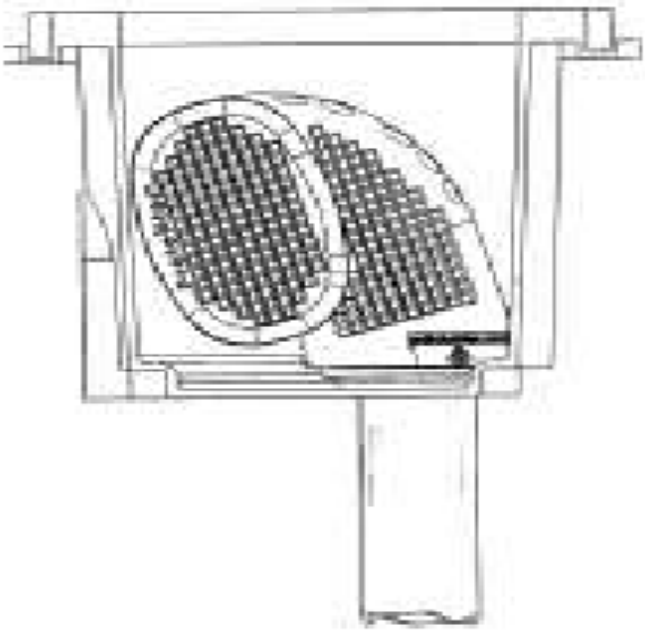

Figure 2. Drawing of ProteKtor installed in pool sump.[6]

[6] Retrieved from http://www.psdindustries.com/product-manual.pdf on March 15, 2016

Hair Entrapment – VDT may protect against hair entrapment. However, there are currently no hair entrapment standards that directly apply to this proposed technology. APSP-16 has requirements that cover hair testing on drain covers, but to staff's knowledge, no such testing has been performed on any VDT devices.

A complicating factor for hair entrapment is the interaction of a VDT-based device with a drain cover. While a VDT-based product may be compliant with a hair test, such as that found in APSP-16, and a drain cover may be compliant with a hair test for a given flow rate,[7] in order to ensure that no hair entrapment is possible, each combination of VDT device and drain cover must also be tested together as a system. Testing as a system would be required in order to detect whether a VDT device introduces a new hazard pattern when installed under drain covers.

Body Entrapment – Petitioner states in his letter, "Since the ProteKtor sits down inside the sump, we cannot protect against body entrapment." Staff concurs.

Limb Entrapment – Limb entrapment typically occurs when a cover is broken or missing. If the cover is broken, it might be possible to become entrapped in the damaged area of the cover regardless of whether a VDT device is installed. If the cover is missing, a person could suffer limb entrapment in a suction outlet. However, due to the broad definition of vacuum diffusion technology proposed by the petitioner, as well as the lack of any standard governing the design, installation, or operation of vacuum-diffusion-based products, it cannot be said with certainty that vacuum diffusion technology would prevent limb entrapment. Furthermore, because it introduces new geometry within the sump, vacuum diffusion technology introduces new opportunities for potential limb entrapment.

Mechanical Entrapment –Mechanical entrapment occurs when something attached to or worn by the bather becomes wedged in the drain cover with sufficient tenacity to cause the bather to become trapped. Mechanical entrapments can only occur if all or part of the drain cover is on. Historically, mechanical entrapments only relate to the drain cover. No aftermarket technology can protect against these entrapments if the drain cover is present. A device that is effectively a second drain cover and that is placed within the SOFA, like the ProteKtor, adds an additional opportunity for mechanical entrapment if the actual drain cover is missing or broken.

Evisceration – VDT is unlikely to prevent evisceration for any reasonably foreseeable scenario. The petitioner states that VDT does not protect against body entrapment, which occurs when a person's body effectively seals the perimeter of the sump. This is exactly how evisceration occurs, for the special case of the sealing being effected by a person's buttocks, instead of their torso or other area.

The petitioner requested that "vacuum diffusion technology" be recognized as an "other system," not that any particular product be granted such recognition. In order to provide a comparison of VDT with the codified methods, a particular product or specific technology must be considered

[7] In APSP-16, there is no "pass" or "fail" for hair the test, or for the body-block test. Each cover is rated for the maximum flow at which the cover passes all of the tests in APAP-16. It benefits manufacturers to have the highest flow rating possible, because it allows the widest commercial use of their product.

along with the petitioner-provided definition. Because the petitioner referenced the ProteKtor in the petition letter, and because no other VDT system is known to staff, staff used the features of the ProteKtor to develop the assessments provided above, that are summarized below in Table 2.

Table 2. Comparison of VDT vs. hazard mitigated.

HAZARD MITIGATED	Hair Entrapment	Body Entrapment	Limb Entrapment	Mechanical Entrapment	Evisceration
VDT	Maybe	No	Maybe	No	No

If determined to be an "other system," VDT would not have to comply with APSP-16, because APSP-16 only deals with suction outlet fitting assemblies, which VDT is not. Using the ProteKtor as an example of VDT, it appears to be a potential source of hair entrapment, and possibly mechanical entrapment, since there is no design restriction on water passage size or shape, and no test for entrapment of these types. VDT as proposed by the petitioner is effectively a second drain cover that would not be subject to the requirements of the drain cover standard.

The current draft of APSP-16 contains language that voids a SOFA's compliance with the standard, if after testing the SOFA is modified in a manner not approved by the manufacturer, for example, by inserting a third-party device into the sump or altering the sump dimensions. If the language is adopted, addition of a device such as the ProteKtor would make the pool not compliant with APSP-16, and hence VGB, unless the SOFA manufacturer has approved the modification.

C. Assertions Made By The Petitioner and Staff Responses

The petitioner makes several claims as to why vacuum diffusion technology should be granted "other systems" status. Each of these claims is stated below, immediately followed by the staff response to each claim.

1). The petitioner states that safety vacuum relief systems do not work with variable speed pumps.

Staff response: This blanket statement is simply not true. An SVRS can be calibrated over a wide range of constant flow rates. A variable speed pump is often used to set a safe flow rate that matches the flow rating on the drain cover. It is the pool operator's responsibility to select a secondary system, such as an SVRS, that is compatible with the circulation system, including circulation system flow rate.

2). The petitioner states that "VDT can help prevent the risks of entrapment as a back-up layer of protection."

Staff response: VDT can at best only mitigate some limb entrapments within the suction outlet, but may introduce new types of mechanical and limb entrapments, and may introduce hair entrapment issues where none were present before. Additionally, the

ProteKtor is allowed to be installed with a portion of it above the rim, potentially interfering with proper installation of VGB compliant drain covers, which it is supposed to supplement, not replace. Furthermore, the petition letter states that the device does not protect against body entrapment.

3). The petitioner states that VDT can "diffuse the intense suction and indeed eliminate the entrapment potential."

Staff response: VDT may introduce a mechanical entrapment hazard when a cover is off. As it fits within the SOFA, below the drain cover, the VDT may introduce hair entrapment issues where none were present before. A VDT-based device cannot protect against body blockage or evisceration from its position within the sump whether the drain cover is installed or not. The petition letter states that the device does not protect against body entrapment.

4). The petitioner asserts that if VDT is "located within the sump, it is working."

Staff response: If VDT is located in the sump, then it cannot protect against evisceration or body entrapment; probably cannot protect against hair entrapment; may actually introduce hair entrapment as a hazard where it was not present before; and cannot protect against cover-related mechanical entrapment.

5). The petitioner states "Although VDT does not make a bad drain cover good, VDT does diffuse the concentrated vacuum over the entire aspect of the drain cover instead of the concentrated pull of an unobstructed open suction orifice in the sump."

Staff response: Essentially, all of the codified methods do, to some degree, make a bad drain cover better, because they provide entrapment protections that were not present when the SOFA was installed. VDT does not.

6). The petitioner states that VDT mitigates evisceration.

Staff Response: Staff is unsure how this can be the case. If a drain cover of any size is installed, adding VDT as staff understands it can have no effect on the evisceration resistance of existing drain covers.

For drains that are able to be shadowed by the portion of a person's body including their buttocks, VDT would provide no protection against evisceration, as evisceration occurs when a seal is formed by the person's buttocks around the rim of the SOFA. Therefore, a device located within the sump could provide no countermeasure to evisceration for smaller drains.

For drains that are unable to be shadowed by the portion of a person's body including their buttocks, VDT is unlikely to provide any additional protection against evisceration. The only possible way for VDT in its current form to mitigate evisceration, would be for the special case of a missing cover, and a person's body fitting into the sump in a manner that would allow that portion of their body necessarily including their buttocks to block the suction outlet pipe within the SOFA. Staff considers this scenario unlikely.

7). The petitioner states that VDT "removes the intense vacuum draw from the intake point of a pumping system by occluding the intake orifice from swimmers and diffusing the vacuum from a potential blockage immediately in multiple directions from the blockage."

Staff response: The key to responding to this statement is the phrase "intake point." If the intake point is taken to be the suction outlet that is located within the SOFA, and exposed by virtue of a missing drain cover, the petitioner is probably correct. However, as an entrapment prevention measure, VDT must necessarily function to prevent or mitigate entrapments that occur when the drain cover is properly installed. If the intake point is taken to be the SOFA, including its installed cover, hardware installed below the drain cover can have only limited effect in diffusing the vacuum in multiple directions above the cover, and can have no positive effect on body entrapment or evisceration.

C. Public Comments and Staff Response

Two people submitted comments during the public comment period. Both commenters favor granting the petition. A summary of comments is provided below, followed by staff's response.

Commenter 1: *One commenter, writing on behalf of Abbey's Hope Charitable Foundation ("Foundation"), supports granting the petition to initiate rulemaking for VDT. The commenter mentions the Foundation's experience in helping to draft and pass the Abigail Taylor Pool & Spa Safety Act of Minnesota and working with Congress to pass the VGB. The Commenter states that the Foundation saw a demonstration of the Petitioner's product and "were impressed with its ability to diffuse the water as it moved through an intake pipe." The commenter states that, with the device installed, they "saw the water in the tank (which replicates pool/spa conditions) more organized and the suction vacuum draw almost completely eliminated." The commenter states that "it is our understanding that the technology is not meant to replace the safety drains or other safety devices required by the VGBA, but instead is meant to be used as a backup when those safety drain covers or other devices fall off or do not work." The commenter urges the Commission to determine that the VDT is equally effective as the other anti-entrapment devices "when used in combination with other safety devices now allowed by the Act.*

Response: Staff agrees that "no suction or less severe suction" is the goal of secondary systems. The VDT is not proposed to be a "backup" to the secondary systems as the commenter may be implying. If determined to be an "other system," VDT would be allowed to be used on its own without any other entrapment prevention devices present. The VDT is proposed to be a secondary system to the "anti-entrapment devices or systems that comply with the ASME/ANSI A112.19.8 performance standard, or any successor standard." In that successor standard, the anti-entrapment devices or systems comprise the drain cover, hardware, and sump.

The commenter is describing a "diffusion" of water that was more "organized" with an attendant reduction in "vacuum draw." Staff recognizes the likelihood that the commenter is describing the movement of water and not likely a suction entrapment event. Hair

entanglement due to water movement through structures, including the prospective VDT within the sump, is discussed elsewhere in this briefing package.

Commenter 2: *One commenter, the petitioner, submitted a letter reiterating points made in the petition and offering a physical demonstration of the VDT. The petitioner states that the "ProteKtor technology" was designed to address the hazard of entrapment. The petitioner lists other benefits of the "ProteKtor technology," including "low cost, indestructability, improved flow and chemical mixing in the pool or spa, no need to calibrate, automatically stay with changes in the system, inability to by-pass the device and the energy savings…"*

Response: The petitioner describes additional attributes of the ProteKtor technology that are unrelated to entrapment protection. Low cost, improved flow and energy savings are generally not relevant to an entrapment mitigation assessment. Staff does view "indestructability," "no need to calibrate, automatically stay with changes in the system, inability to by-pass the device" as features that, if possessed by VDT, should be considered. "Indestructability" requires physical testing and this has not been described to staff. The ProteKtor is a passive device with no moving parts, much like a drain cover, and therefore staff concurs that the ProteKtor does not require calibration. As a passive device through which water flows, the ProteKtor does "automatically" affect changes in system water flow. Staff notes that the ProteKtor, installed in the sump between the drain cover and the outlet piping, will always add some resistance and decrease water flow. A constriction added to piping is not considered a good attribute. In the context of by-passing the ProteKtor, disabling by removal is the most obvious means. If the ProteKtor is made permanent, by cementing in place for example, staff concurs that the device cannot easily be bypassed. However, a permanent installation within the sump may not comply with other requirements in VGB or other standards and building codes. Attachment means involving fasteners can easily be by-passed. Furthermore, if a VDT device is removed for winterizing or other pool service, it may not necessarily be replaced before reopening the pool to bathers. The Commission denied the BeeSafe petition[8] in part because the subject product contained a part that was removed for servicing the pool, and whose absence created an entrapment hazard should the pool be returned to service without installing the removed part.

The commenter states that the ProteKtor was designed to address the hazard of entrapment. However, the ProteKtor does not address body entrapment, which causes the most entrapment deaths.

Two additional comments were received from one commenter via electronic mail after the close of the comment period. Because time allowed, staff included a summary of the comments, and provided the response below:

Commenter 3 Comments: *The commenter was concerned that there is no performance standard governing this technology, and enumerated the standards governing some of the other codified technologies. The commenter cited comments from an un-named "former APSP-16 chairman" that indicated that a device that is intended to be installed in a SOFA needs to be addressed by*

[8] http://www.cpsc.gov/pagefiles/138127/beesafedenial.pdf

the APSP standard and the SOFA manufacturer. The commenter also stated that there are no known problems with the use of variable speed pumps on SVRS-equipped circulation systems, and that the petitioner noted that the proposed system does not prevent body entrapment, which has caused the greatest number of entrapment-related deaths. The commenter urged that the Commission deny the petition.

Response: Staff agrees that there are no safety standards governing VDT, that there is a standard governing SVRS certification, and that there is a standard governing drain cover certification. However, the Act states that "other systems" "shall meet the requirements of any ASME/ANSI or ASTM performance standard if there is such a standard for such a device or system, or any applicable consumer product safety standard," which allows new technology to come to market in advance of there being a performance standard for such technology. Staff further agrees that VDT does not prevent body entrapment, and agrees that body suction entrapment has been the cause of the greatest number of pool circulation-system-related deaths.

IV. Conclusion

The Act directs CPSC to review new technologies that are developed with the intention of "preventing or eliminating the risk of injury or death associated with pool drainage systems," and if appropriate, determine that they are "equally effective as, or better than" the five methods of entrapment prevention that are codified in the law. The petitioner requests that the Commission determine that "vacuum diffusion technology" qualifies as an "other system" as a means of complying with VGB.

Occluding the suction outlet and diffusing the intense suction present in a drain is precisely the function of pool drains and drain covers. A device which is inserted into the suction outlet is effectively a second drain cover, and is therefore not an "other system."

A comparison of the five entrapment prevention methods codified in the Act reveals that the baseline hazard mitigation provided by these systems is reducing body suction entrapment. Furthermore, body suction entrapments are the leading cause of death due to injuries associated with pool circulation systems. While none of the five codified entrapment prevention methods protects against every type of entrapment, all five types afford some degree of protection against body entrapment.

Staff analysis of the ProteKtor, a product the petitioner claims meets the requirements of a VDT-based system, does not, according to the petitioner, protect against body entrapment, nor in the staff's opinion does it protect against evisceration. When installed in a suction outlet, a ProteKtor-like device may actually increase the possibility of hair entrapment, it does not protect against mechanical entrapment, but it may protect against limb entrapment. However, the interaction of a VDT device and the drain in which it is installed largely determines the hazard mitigations for hair, limb, and mechanical entrapments. These interactions are not clear.

Draft language in the standard that addresses drain covers would void the certification of covers if they are altered in any way after testing, such as by inserting a VDT-based device into the sump of a drain.

V. Staff Recommendation

Staff recommends that the Commission deny this petition. In the petition letter, the petitioner states that vacuum diffusion technology does not protect against body entrapment. The staff assessment is that VDT cannot protect against evisceration either, and may possibly introduce new hair, limb, and even mechanical entrapment scenarios. If the Commission determines that VDT is an "other system," a VDT-based product could be installed on a blockable single-main-drain pool and would meet the requirements of VGB without protecting against body entrapment, which is the leading cause of death associated with pool circulation systems, or protecting against evisceration.

TAB A:

Fatalities, Injuries, and Non-injury Incidents Involving Circulation Entrapments in Pools, Spas, and Whirlpool Bathtubs: 2010 - 2014

TAB A

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: December 9, 2015

TO : Perry Sharpless, Project Manager
Directorate for Laboratory Sciences,
Division of Mechanical Engineering

THROUGH: Kathleen Stralka, Associate Executive Director
Directorate for Epidemiology

Stephen Hanway, Director
Division of Hazard Analysis

FROM : Qian Zhang, M.S., Mathematical Statistician
Division of Hazard Analysis

SUBJECT : Fatalities, Injuries, and Non-injury Incidents Involving Circulation Entrapments in Pools, Spas, and Whirlpool Bathtubs: 2010 - 2014

This memorandum was prepared in response to Petition VGBA 15-1 which requests that the U.S. Consumer Product Safety Commission ("CPSC") classify vacuum diffusion technology as an anti-circulation entrapment device or system under the Virginia Graeme Baker Pool and Spa Safety Act. A "circulation entrapment" is defined as an entrapment involving the water circulation system of a product. A multidisciplinary team of industry and CPSC staff collaboratively developed this definition and determined the types of products that are of interest regarding circulation entrapments. Using definitions developed by the Association of Pool and Spa Professionals, there are five types of circulation entrapment: body, limb, evisceration, hair, and mechanical. One limb entrapment, which resulted in a fatality, and one hair entrapment, which resulted in no injury, occurred in the 2010 – 2014 time period and were reported to CPSC. Hazard scenarios for the reported incidents included victims trapped by suction, outlet covers missing/removed, and victims caught on outlet covers, among other and unknown hazard scenarios.

This memorandum summarizes information on circulation entrapment incidents associated with pools, spas,[9] and whirlpool bathtubs that were reported to the CPSC staff. CPSC staff is aware of 24 incidents involving circulation entrapments reported to have occurred from 2010 through 2014. Three of the 24 incidents reported two victims each. Overall, there was 1 fatality, 22 injuries, and 4 non-injury incidents. Twenty-one victims were female (78 percent) and 6 were

[9] The term "spa" is used to refer to spas and hot tubs.

male (22 percent). Table 1 lists the yearly frequency of the reported victims based on incident severity (fatality, injury, and no injury).

Table 1
Number of Victims of Reported Circulation Entrapments Associated with Pools, Spas and Whirlpool Bathtubs by Severity and Year of Incident, 2010- 2014

Year	Fatality	Injury	No Injury	Yearly Total
2014	1	1	0	2
2013	0	2	1	3
2012	0	8	1	9
2011	0	7	2	9
2010	0	4	0	4
Column Total	1	22	4	27

Source: U.S. Consumer Product Safety Commission: The Consumer Product Safety Risk Management System database ("CPSRMS") and National Electronic Injury Surveillance System ("NEISS"). Reporting is ongoing for all of these years.

Table 2 lists the counts of the reported victims by age category and injury severity. The majority of the victims (20 victims, 74 percent) were children and minors younger than 18 years of age. Children in the younger than 5 year (7 victims, 26 percent) age category had the highest frequency of circulation entrapments. This is followed by the 5 to 9 year (6 victims, 22 percent) and the 10 to 14 year (6 victims, 22 percent) age categories.

Table 2
Number of Victims of Reported Circulation Entrapments Associated with Pools, Spas, and Whirlpool Bathtubs by Victim Age Category and Severity, 2010–2014

Victim Age Category (years)	Fatality	Injury	No Injury	Row Total
Younger than 5	1	6	0	7
5–9	0	5	1	6
10–14	0	5	1	6
15–19	0	1	0	1
20–29	0	1	1	2
30–39	0	3	0	3
40–49	0	1	0	1
50 and Older	0	0	0	0
Unknown Age	0	0	1	1
Column Total	1	22	4	27

Source: U.S. Consumer Product Safety Commission: CPSRMS and NEISS. Reporting is ongoing for all of these years.

References:

M. Hnatov, *2009–2013 Reported Circulation/Suction Entrapment Incidents Associated with Pools, Spas, and Whirlpool Bathtubs, 2014 Report*, Consumer Product Safety Commission, May 2014.