Sugarloaf Conservancy's Response to PATH Allegheny's Letter of January 15th, 2009

On November 19, 2008, Sugarloaf Conservancy presented Allegheny Energy an inch and a half thick notebook filled with technical information on High Voltage Direct Current (HVDC). They promised to evaluate this information seriously and get back to us by January 15, 2009. The response we received on the 15th was disappointing, although unfortunately expected based on their actions at their Open House on December 4th. As stated in our e-mail to Allegheny on December 14, 2008:

> **If Allegheny were "seriously" looking at HVDC, then your staff would have acknowledged the commitment made at this meeting to "seriously" look at the material provided on HVDC technology. Instead, we heard the standard phrases of misinformation such as: HVDC underground would cost 10-20 times more than overhead HVAC and HVDC underground was only good for short distances.**

The purpose of the notebook was to demonstrate that HVDC is a well-respected, viable technology that until very recently was too costly for many applications. Through tremendous advances in technology, it has now become more practical. Unfortunately, PATH is more interested in trying to disarm our efforts instead of actually taking an unbiased look at the information, preferring to "cherry pick" statements from the materials we supplied, which *appear* to indicate that HVDC is not a very realistic option.

Realizing that Allegheny Energy has always used HVAC and could possibly be unaware of the recent dramatic advances made in lowering the cost and increasing practical possibilities, our thought was to make the information we discovered available to them. Our hope was the PATH engineers would review the updated information and support the independent study needed to accurately determine the cost/benefit of an HVDC solution for the PATH project. Instead, they ignored the benefits of the technology and focused on the negatives. Many of the negative issues appear to be overstated or just incorrect. It appears Allegheny is unwilling or unable to conduct an unbiased review of the HVDC alternative for PATH.

The PATH project costs estimate using the overhead HVAC solution proposed by Allegheny is 1.8B. The Allegheny segment is expected to cost 1.2B. We need to insure this money is invested in the best solution. In cases where land cost is high like it is in Frederick County, MD, the cost to go underground HVDC may be about the same as overhead HVAC. We

believe it is a wise business decision for the Maryland Public Service Commission to require an unbiased independent study of the HVDC solution for PATH. The study must be of the same rigor and detail as the Allegheny HVAC study. The alternatives can than be evaluated quantitatively on a full life cycle cost/benefit basis to determine what is the better investment for Allegheny's customers.

Our goal was never to provide a complete how-to manual and plan for implementation of HVDC. That is not our role in this matter. We believed that rather than simply take the view of STOP PATH, we should endeavor to provide an alternative to help in the solution of a growing problem for many communities.

The following is a point-by-point rebuttal of the factually incorrect and misleading statements made by PATH in their evaluation of the material provided to them by Sugarloaf Conservancy. From this point forward the following formatting is used in this response in order to indicate if the information provided came from PATH, Sugarloaf Conservancy or other sources.

Normal print – PATH letter of January 15, 2009
Bold print – Sugarloaf Conservancy response
Blue print – Quotes from other sources
Boxes around print – information provided in specific reports being quoted by PATH but omitted in their reply.

Prior to the January 8, 2009 Technical Conference on the electrical need for PATH, PPRP provided us with a series of questions. Question 5 pertained to the application of HVDC technology and during the conference I indicated a response would be provided at a later time. Question 5: Has PJM considered HVDC for the Amos-Kemptown line and if so, what was the result of this analysis? Could the planned substations (Midpoint and Kemptown) be constructed to include AC [alternating current] to DC [direct current] conversion equipment to accommodate HVDC?

PATH answered this question by providing a response prepared by PJM. This response speaks of one of the special applications for HVDC and implies that HVDC is only used when no other alternative exists. This is factually incorrect, as many projects have used HVDC since the transmission lines lose less energy and, if buried underground, are more environmentally friendly.

PATH stated that the conversion equipment would significantly increase the size of the stations. This statement is inaccurate for a station using underground cable. The equipment used for an underground cable is not as large as for overhead HVDC stations. The following was taken from ABB's website titled HVDC/HVDC Light converter stations:

A HVDC Light converter station has a much smaller size than a classical converter station, see figure. Practically all HVDC Light equipment is contained in the building. In a classical converter station, the semiconductor valves are in the large building and the small building on the side is for the control and auxiliary systems.

Allegheny criticized our notebook by offering "observations":

Twelve of the documents address the use of HVDC generally and are not specifically directed to the application of this technology for underground purposes.

Four of the documents discuss and promote overhead HVDC without addressing the use of this technology for underground purposes.

Only three of the documents specifically discuss the application of HVDC for underground purposes.

> **These three observations deal with the specific number of documents, not addressing specifically the use of HVDC buried underground. The purpose of the notebook was to present Allegheny with a variety of information on the merits of HVDC technology, not to present a how-to manual of HVDC for the PATH project.**

Eleven of the documents were prepared by vendors of equipment and services with economic interests in the use of HVDC technology.

> **While the statement is factually correct, what better source would you go to for information on specific technology other than the experts at the companies manufacturing these products? Surely Allegheny Energy and AEP go to manufacturers when they need assistance in designing their HVAC equipment.**

PATH stated, "the documents indicate the cost of underground HVDC is significantly higher than overhead HVAC**." Any articles that even imply this type of statement are usually older articles, which are referring to older technology. This statement is untrue. Several of the comments in the material provided state:**

> **New HVDC technology in the form of HVDC Light® has made underground options technically feasible and economically viable. (Light and invisible underground transmission with HVDC light - ABB Review 4/2005) – (Tab E)**
>
> **The favorable economics of long-distance bulk-power transmission with HVDC together with its controllability make it an interesting alternative or complement to ac transmission. (The ABCs of HVDC Technology - IEEE Power & Engineering Magazine March/April 2007) – (Tab F)**

Many of the documents indicate the cost breakeven point for use of overhead HVDC requires projects of longer lengths and higher capacity than the entire approximately 285 mile PATH project. The length of PATH in Maryland is expected to be approximately 19 miles.

> **This statement is confusing as the PATH website states the Maryland portion is 46 miles. Experts have informed Sugarloaf Conservancy that the only way to accurately determine the cost for a HVDC project is to conduct a study that would include siting considerations and material costs.**

The documents do not address the allocation of additional costs associated with underground HVDC for this project within the PJM Region where the costs of new transmission projects of 500 kV or greater are allocated to all load serving entities within the Region.

Until an independent study of the routing of the line using HVDC is made, no assumption should be made that there would be additional costs.

The ABB Review of April 2005 (Tab E) includes an article stating:

Depending on local conditions, it is realistic that the costs for an underground high-voltage line are equal to that of traditional overhead lines.

This is just one of many similar statements that convince Sugarloaf Conservancy that an independent study is required!

HVDC lines are not conducive to establishing intermediate substations because the cost could be prohibitive and, in many cases, the intermediate HVAC connection may not be technically feasible. HVDC transmission lines are better suited for point-to-point power transfers over long distances where the need for intermediate HVAC connections to the existing power system is not expected to occur.

If Allegheny Energy has any plans to add substations in the future on the PATH line, then they owe it to the public to state it now. It is our understanding that all comments made by PATH are that they have no intentions of adding more substations in the future.

When compared to overhead construction, either underground HVAC or HVDC transmission lines create a greater environmental impact and present significant technological challenges and limitations as well as ongoing reliability and operational issues.

This statement is factually incorrect. The routing of an underground line utilizing an existing ROW would cause far less environmental damage than overhead HVAC.

Section 2.9 of the Argonne National Laboratory Report (Tab B): ENVIRONMENTAL IMPACTS OF HVDC TRANSMISSION SYSTEMS states:
The following discussion largely summarizes a paper by L. A. Koshcheev (2003) on the potential environmental impacts of HVDC lines in comparison to HVAC lines. In the paper, Koshcheev points out that an HVDC transmission system provides environmental benefits over conventional AC technology. The land coverage and the associated ROW are less for a DC transmission line. DC transmission lines require two conductors versus three for comparable AC lines. This feature reduces the visual impact and allows greater power to flow over the same ROW, thus maximizing resources. In addition, the EMF effects associated with HVAC transmission lines are not present in HVDC lines.

Typically, underground transmission construction is used only to solve specific project design constraints or when overhead installations are just not feasible.

As stated in our response to PJM comments: This is factually incorrect, as many projects have used HVDC underground as the transmission lines lose less energy and is more environmentally friendly.

Additionally, in "High Voltage Direct Current (HVDC) Transmission Systems Technology Review Paper" (Tab G) it states that:

> **In environmentally sensitive areas, such as national parks and protected sanctuaries, the lower foot print of HVDC transmission systems becomes the only feasible way to build a power link.**

Considering the diverse environmental areas and historic nature of the Frederick County area, along with its economic focus on tourism it would seem our county would be greatly benefited by the use of HVDC underground.

HVDC, either above or below ground, requires the construction of converter stations at each terminus of the DC line. These converter stations are very large and considerably more expensive than traditional AC stations and operating multi-terminal HVDC systems is complex (Tab B).

They failed to include the paragraphs at the end of this section, which state:

> **"Some of the above-listed disadvantages can be eliminated with the use of new Technologies."**

Further, the cost of the converter stations is only a portion of the project's cost. Every 765 kV AC circuit has 6 cables while only 2 are necessary for each HVDC circuit. Also, less land must be taken by Eminent Domain as existing ROW can be used for underground HVDC.

The high cost of conversion equipment limits the breakeven cost for DC to AC to 31 miles for submarine cable and 375 to 500 miles for overhead cables (Tab B). The entire PATH project which is only approximately 285 miles in length is significantly shorter than even the minimum breakeven point.

Why are they talking about submarine cable? PATH failed to include a positive statement in the same paragraph, which states:

> **"the lower cost of the HVDC cable outweighs the cost of the converter electronics. In addition, as noted above, conversion electronics permit managing the power grid by controlling the magnitude and direction of power flow. Thus, HVDC links can increase the stability in the transmission grid."**

Technology is constantly changing and reducing the costs of HVDC underground. Industry experts have said the only way to determine the cost of HVDC underground vs. HVAC overhead is to conduct a study.

Underground lines (AC or DC) have an increased socioeconomic impact because of greater costs (Tab B).

PATH continues to take statements out of context. The paragraph following the statement above is:

> **"On the other hand, impacts in a number of resource areas would be reduced as compared to aboveground lines. Visual impacts would be greatly diminished, except where aboveground support facilities are located. Land use impacts could be reduced due to the absence of aboveground structures. Bird strikes would be eliminated. ROW clearance and maintenance and all of its attendant impacts would be greatly reduced. Health and safety impacts would be reduced overall due to a reduction in line failures due to accidents or acts of nature."**

The primary benefit of burying transmission lines is reduced visual impact. However, many other environmental impacts are increased (Tab B).

In the Argonne National Laboratory Report Section 2.9 (Tab B), there is a discussion in depth of environmental impacts over six pages. The following statements were made regarding the overhead HVDC lines. However, PATH neglects to quote their final statement in Section 2.10, which would be even more dramatic regarding underground HVDC:

> **HVDC transmission lines have reduced impacts compared to HVAC transmission lines for many environmental impact measures. These advantages may appear as lower costs for mitigating such impacts when installing HVDC lines compared to HVAC lines. If land use is taken as an overall measure of the comparative environmental impacts of HVAC and HVDC transmission lines of the same relative capacity, HVDC line impacts are roughly two-thirds of those of HVAC lines. Thus, a transmission system that incorporates HVDC power transmission will, as a whole, have reduced impacts compared to one that exclusively employs HVAC transmission lines (Koshcheev 2003).**

Also, the following is found in Section 2.9 ENVIRONMENTAL IMPACTS OF HVDC TRANSMISSION SYSTEMS (Tab B):

> **The following discussion largely summarizes a paper by L. A. Koshcheev (2003) on the potential environmental impacts of HVDC lines in comparison to HVAC lines. In the paper, Koshcheev points out that an HVDC transmission system provides environmental benefits over conventional AC technology. The land coverage and the associated ROW are less for a DC transmission line. DC transmission lines require two conductors versus three for comparable AC lines. This feature reduces the visual impact and allows greater power to flow over the same ROW, thus maximizing resources. In addition, the EMF effects associated with HVAC transmission lines are not present in HVDC lines.**

The Federal Energy Regulatory Commission (FERC) has approved the cost recovery mechanism for this project based on overhead HVAC construction and, in accordance with FERC orders, those costs will be recovered on a socialized basis across the entire PJM Region on basis that the entire Region benefits from enhanced reliability of PJM's backbone transmission system. However, it is not clear who would be required to pay the additional costs of underground HVDC construction required or requested by a state or local government when such construction is not required for reliability purposes and the primary benefits of reduced visual impact does not inure to the benefit of the entire Region.

As previously stated: Until an independent study of the routing of the line using HVDC is made, no assumption should be made that there would be additional costs. However, this paragraph taken from the High Voltage Direct Current (HVDC) Transmission Systems Technology Review Paper is of interest (Tab G):

> **In the past, when the transmission service was part of a government owned, vertically integrated utility, the land acquisition and obtaining rights-of-way was relatively easier, and very often was done under the principle of "Eminent Domain" of the State. With liberalization, transmission service provision is by and large in the domain of corporatized, sometimes privatized, entities. Land acquisition and/or obtaining rights-of-way is now a significant portion of the project's costs. Once these costs are included in their entirety in the economical analysis of HVDC versus AC alternatives, it would be seen that HVDC is much more economical in this regard, since it requires much less land/right-of-way for a given level of power.**

However HVDC would be more reliable according to Section 1.3 of the Argonne National Laboratory Report (Tab B),

> **"Fast-acting emergency control systems on HVDC transmission lines can further increase the stability and reliability of the power system as a whole."**

The Pepco Holdings, Inc. (PHI) materials provided by Sugarloaf acknowledge that the HVDC option for the Chesapeake Bay submarine crossing for the MAPP project is more costly as compared to a submarine AC crossing. However, PHI believes there are reliability and environmental benefits to its application of HVDC to this underwater crossing of the Chesapeake Bay (Tab C). These benefits are not present for the PATH project.

There is a substantial cost difference between HVDC Light cable and submarine cable. Also the overall distance of the MAPP HVDC portion of the project is only 70 miles in comparison to almost 300 miles for the PATH project. It is misleading to state that the reliability and environmental benefits for the MAPP project to not apply to the PATH project. In Mr. William M. Gausman's letter he makes these points that HVDC -

Will substantially increase reliability
Will increase market efficiency
Will significantly increase the power flow potential across the line
Will alleviate significant congestion
Will reduce the project's footprint
Will minimize the environmental impacts
Will facilitate the siting & construction

The points above could easily apply to the PATH project if HVDC underground were used.

HVDC should be considered where there is a need to transfer power in the range of 5,000 to 6,000 MW over 1,000 km (621 miles). In such cases, 800 kV DC overhead transmission is the appropriate choice (Tabs F, J, L, M and N). Because of the significantly shorter length and smaller transfer capacity of the PATH project, HVDC is not an applicable technology.

One only has to look at the current list of projects listed by IEEE shown in TAB "S" to see that the above statement is incorrect. Each project must be evaluated on its merits. Global statements cannot be made.

Per the ABB sales brochure (Tab E), the largest HVDC underground system currently in service has a power transfer capacity of 330 MW and a 350 MW system is under construction. Based on this information, twelve 350 MW systems (24 cables) would be required to provide the same power transfer capacity of the 765 kV overhead installation proposed for the PATH project. To accommodate these cables, massive conversion stations would be required at both ends of the DC line. A right-of-way width of approximately 100 feet would need to be cleared and maintained void of trees along the entire length of the underground line to allow for permanent access.

The above ABB sales brochure was published in April 2005 and demonstrates why an independent study is required. PATH does not even refer to Tab S, which lists almost all projects approved to 2008, the most recent available from IEEE. Note: The MAPP project, just approved, is not listed yet. PATH simply

does not have the expertise and/or the will to properly evaluate HVDC technology.

Although not included in the notebook, on the ABB website the following is stated:

> **HVDC Light® increases the reliability of power grids, and the technology extends the economical power range of HVDC transmission down to just a few tens of Megawatts (MW). In the upper range, the technology now reaches 1,200 MW and ±320 kV.**

Multiple lines can be run underground in order to achieve the same power capability as will be transmitted on the proposed PATH HVAC transmission line. It should also be noted that there is substantially less loss on a DC line and this must be taken into consideration. The idea that 24 cables would be necessary is inaccurate. It is more likely that 2 – 3 circuits (2 cables for each circuit for DC in comparison to 6 for each 765 kV AC circuit) would be required. This number of circuits required to meet the design criteria would also be determined by an independent study.

Such additional studies would likely cause a delay in obtaining authorization to construct the project, which in turn would delay the enhancement of electric reliability to Maryland and the associated energy market benefits.

This is the same type of statement Allegheny made for the Urbana Loop project. If their statements were accurate, there would have been brownouts and blackouts in Urbana starting in June 2006. Instead of resisting and promoting inaccurate facts, if they conducted a study now, no significant delay to the PATH project would occur. In fact the delay will occur if the MPSC denies their application for HVAC and they are forced to re-evaluate the PATH project using HVDC.

From an operational standpoint, prolonged outages are required to repair underground cable failures, and this could jeopardize the reliability of the transmission system.

Although it would take longer to repair a damaged underground line, the likelihood of an underground line being damaged is substantially less than an overhead line. Technical articles provided in our notebook clearly show that the power community has recognized HVDC as a reliable technology.

In addition, the environmental impact of undergrounding is significant - underground cables require extensive excavation that could severely impact streams, wetlands and other sensitive areas.

The same type of equipment that is used to bury fiber optic equipment is used today. Technical reviews on the merits of HVDC underground clearly show that there is positive impact on the environment in comparison to overhead HVAC.

ABB's Article "Reliable electrical transmission over long distances, using ABB cable systems" (Tab I) states:

> **The cost for burying cables in the ground is usually calculated as somewhat higher than aerial lines with a corresponding technical capacity. However, there has been a considerable narrowing of the gap over the last few years. The lifespan for our cable solution has turned out to be greater than previously calculated and the cost of interruptions due to storms affects the calculation positively, to the advantage of the land-cable solution. In addition, the cost of right of way is less and the buried cable alternative has a more positive effect on both forestry and agriculture, as well as on cultural and leisure activities in the area affected. Our opinion is that the buried-cable alternative, from a social-economic perspective, creates a win-win-situation for both the consumer and the producer.**

Multiple above-ground stations would be required along the line route with permanent access required along the full length of the line for maintenance and repairs.

> **This statement is factually incorrect. Although there would be stations at the generating plant and the end point of Kemptown, Maryland, the PATH project could start at the Amos power plant in West Virginia and go to Kemptown, Maryland without the need for an additional station along the route if HVDC were used. This is not the case with HVAC. PATH has stated there will be "a new mid-point substation in the vicinity of eastern Grant County, northern Hardy County, or southern Hampshire County, near existing PATH alternative routes." Access to the transmission line would be no different that overhead HVAC.**

We have given consideration to the possibility of constructing the project as underground HVAC and have determined that such construction is not appropriate for this project. No transmission line of this length, voltage or capacity has ever been placed underground, nor has the technology been commercially developed at this voltage level. Even if the technology was available, the project cost would increase dramatically – as much as 10 times or more – and the time to complete the project would increase substantially. Moreover, with regard to the Commission's specific concern, the right-of-way needed for underground construction, as discussed above, would be approximately 100 feet rather than 20 feet as has been suggested to the Commission by others.

> **Sugarloaf Conservancy has never suggested burying HVAC and any comments made in this paragraph above have no relevance to HVDC technology.**

This is the end of the PATH response portion.

With regard to HVDC: Conclusions from Light & Invisible: Underground Transmission with HVDC Light (Tab E) state:

> **Increased environmental pressure on overhead transmission lines is both raising total costs and increasing the risk for substantial project delays.**

New HVDC technology in the form of HVDC Light® has made underground options technically feasible and economically viable. This is especially so if the new grid investment is driven by security of supply issues. The conventional view that an underground link will cost 5 – 15 times its overhead counterpart must be revised. Depending on local conditions, it is realistic that the costs for an underground high-voltage line are equal to that of traditional overhead lines.

HVDC Light application: Underground power links is not in our notebook. Found on the web recently it states:

The cost for an underground cable used to be about ten times the cost of an overhead line. But not any more! The cost of an HVDC Light® link now approaches the cost of an overhead line if all factors are taken into account. It is now possible to build a long electric power transmission underground and avoid public opposition and long uncertain approval processes!

Sugarloaf Conservancy is very disappointed that PATH has chosen to spend the time it has before the filing to nitpick our information rather than actively researching it and determining whether it really would serve us all better than HVAC. We wish PATH would respond to our specific comments as we have responded to their statements here. HVDC is the right technology for today and the future. It is our hope that instead of continuing to make inaccurate and misleading statements, PATH should reconsider and hire knowledgeable independent consultants to evaluate HVDC for the PATH project.

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