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ENGINEER
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ABOUT THE COVER:

Phillip Murray Bridge (South 10th Street Bridge) – Downtown Pittsburgh, PA, Allegheny County. This three span cable suspension bridge built in 1933 has an overall length of 1275' from abutment to abutment. The bridge carries Tenth Street over the Monongahela River. The photograph was taken from the base of one of the south anchorage vaults. The overall structure was rehabilitated in 1993 and part of the rehabilitation was to repair deteriorated main cable strands between the splay casting and the nested I-bar anchorage grillage. The repair entailed cutting the deteriorated strand groups to connect to a redesigned anchorage at the I-bar grillage and resocketing the cut strands to the new anchorage. This structure is owned and maintained by Allegheny County and Jim Reith is the County worker.

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Guest Editorial

Joe Grata
Transportation Writer
Pittsburgh Post-Gazette

Joe Grata

Who, me? You're asking me to be guest editor for the winter edition of Pittsburgh Engineer magazine? Me, a newspaper transportation beat reporter regarded as being uncivil toward civil engineers so many times over the past 36 years?

"We had second thoughts, too," Dave Teorsky lightheartedly (I think!) confessed during one of the weekly conference calls that also always included ESWP Publications Chair Dan Tis and his insight. "We never did this before, but Dan Cessna recommended you. He thought you'd be fair."

Dave and the two Dans implied that serving as guest editor was an honor bestowed in the past upon important people, like Allegheny County Executive Dan Onorato and Pennsylvania Transportation Secretary Allen Biehler. I guess they ran out of important people. They didn't say there would be no pay or that editing sometimes highly technical submissions would be proper punishment for a common wordsmith who has needled professional engineers and government policymakers.

"ESWP hoped for a Rhodes Scholar; they got a roads scholar."

After giving the notion some thought, and after my Pittsburgh Post-Gazette editors approved the idea with the stipulation I don't compromise lofty journalism standards that engineers expect from us, I accepted the invitation. ESWP hoped for a Rhodes Scholar; they got a roads scholar.

How many transportation reporters get a chance to edit stuff submitted by people they cover, like PennDOT District 11 Executive Dan Cessna?

He kicks off the list of contributors to this magazine edition that touches not only on important transportation challenges but some of the other infrastructure, e.g., power generation and distribution; water and sewer systems; oil and natural gas transmission pipelines; communications networks. They're lifelines too often out of sight and out of mind until the lights go out, the phone goes dead or the spigot runs dry.

"Amazingly, the nation that can.... rocket people into space doesn't provide the money needed to bring structurally deficient bridges...up to proper engineering and safety standards."

Mr. Cessna explains the challenges of balancing the urban region's highway and bridge needs with available resources. Amazingly, the nation that can split atoms, transplant hearts and rocket people into space doesn't provide the money needed to bring 346 structurally deficient bridges in Allegheny County up to proper engineering and safety standards.

PennDOT is nevertheless advancing some major projects which, when completed, will make a big difference in how traffic flows in and around Pittsburgh. Mr. Cessna outlines them as part of his comprehensive look at where we've been and where we're going.

"...innovative assessments and monitoring may uncover a problem before the unmentionable happens."

Don Fusilli, now principal of The Telum Group, makes a case for spending smart, not necessarily fast, when it comes to bridges. By employing new technologies for inspection and evaluation, bridge owners may not have to rehab or replace spans as soon as they do based on visual inspections. On the other hand, innovative assessments and monitoring may uncover a problem before the unmentionable happens.

Duquesne Light Co., the main power provider in Pittsburgh, is spending $500 million to refurbish and upgrade aging underground systems dating back to the days of Reddy Kilowatt, whom some of you will remember as the stick-figure cartoon character who promoted energy use in the mid-20th century. Today, the utility shows how far it has come since building one of the world's first permanent central power stations in the mid-19th century on a 50-by-90-foot lot on what's now Oliver Avenue, Downtown.

With The Post-Gazette's permission, we're reprinting an article about a related "world's first." That would be my colleague Don Hopey's look back to Dec. 2, 1957, when the first commercial nuclear reactor in the U.S. began generating electricity along the Ohio River in Beaver County.

"When I write...I strive for three "E" goals: Engage. Enlighten. Entertain. Hopefully, we've achieved those same elements in Pittsburgh Engineer."

And did you realize that Western Pennsylvania provides key underground storage of natural gas for the entire Northeast? A former colleague, Dan Donovan, now with Dominion, takes you on a word journey through the site, and the process, in an informative piece that shows how one billion cubic feet of stored gas a day can be retrieved from underground in Westmoreland County and returned to a 9,040-mile pipeline system.

We were unsuccessful in recruiting someone to write a piece on the region's water infrastructure. It's a major asset for the region not only because it's plentiful but also because much of the raw water is already "mountain pure" when drawn from ground, rivers and protected lakes.

Maybe the reluctance is because of competition involving major players like the Pittsburgh Water Authority, Westmoreland County Water Authority and privately-owned Pennsylvania American Water Co. Maybe it's because of some embarrassing and disruptive waterline breaks. Maybe we didn't contact the right people. Maybe next time.

When I write the "Getting Around" transportation columns for Sunday editions of the PG, I strive for three "E" goals: Engage. Enlighten. Entertain. Hopefully, we've achieved those same elements in Pittsburgh Engineer.

In the end, this long-time journalist wants what the Engineering Society wants. That is, a better Western Pennsylvania for all of us.

Pittsburgh Post-Gazette Staff Writer Joe Grata has covered the transportation beat for nearly four decades. He writes weekly a column, "Grata's Guide: Getting Around," which appears in the Sunday editions of The Post-Gazette.

Grata joined The Pittsburgh Press in March 1971 and the PG in January 1993. A journalism major at Penn State University, Grata has received nine Keystone Press Association awards and other honors, including a "Distinguished Service Award" from the Pittsburgh Chapter, Pennsylvania Society of Professional Engineers, in 1998.

Grata is a lifelong resident of the Belle Vernon area, where he has served as a member and officer of the school board, the municipal authority, BVA Boosters Club executive board and other organizations. He also founded and served as president for six years at CAS Emergency Medical Services that served 13 municipalities in the Mon Valley.

At Penn State, Grata was special assistant to athletic director Jim Tarman for five years. He was sports editor of The Daily Collegian student newspaper, and he hosted weekly radio sports shows.

By his own estimates, Grata has written about 10,000 by-lined articles during his career, ranging from copyrighted pieces and magazine articles to columns and breaking news. Some have been used nationally

Urban Transportation Challenges:
Balancing System Operations and System Preservation

H. Daniel Cessna, P.E.
District Executive, Engineering District 11-0,
Pennsylvania Department of Transportation

Construction of our nation's vast interstate system was the primary focus of transportation agencies from the 1950s through the 1980s. While this system is largely complete, transportation infrastructure investments nationwide since then have generally focused on system preservation and major rehabilitation of the interstates and the National Highway System (NHS). However, many regions -- some with considerable growth -- see infrastructure capacity expansion projects as the solution to increased congestion.

The challenge facing transportation officials is to balance capital investments adding new capacity with the fundamental need to maintain and preserve the existing highway and bridge infrastructure. This is often difficult to achieve. To be successful, we must make sound investment decisions within current fiscal constraints.

> *"Most regions in the Northeast, have a backlog of infrastructure maintenance deficiencies that need to be addressed to keep our transportation system useable and safe"*

Most regions, especially those in the Northeast, have a backlog of infrastructure maintenance deficiencies that need to be addressed to keep our transportation system useable and safe. Addressing these issues can quickly deplete all transportation funding. Metropolitan Pittsburgh and suburban Allegheny County, comprising a land area of 747 square miles and 1.2 million residents, are part of PennDOT District 11, which also includes Beaver and Lawrence counties. This region, not unlike others, is striving to preserve its existing assets and networks while making critical decisions regarding enhancements to system operations and safety. We suffer from heavy daily commuter and event-driven congestion; however, our current program is comprised mainly of projects targeted to rebuild, rehabilitate and simply preserve assets. Our situation is not unique as we pursue wise investment strategies that leverage funding, using a portion for rehabilitation and reconstruction and a much smaller portion for key investments to improve operations and increase capacity.

Recently, PennDOT District 11 has been advancing a vigorous system preservation program, essentially upgrading our interstates and major expressways -- restoring them to "like new" condition by resurfacing fair-condition sections and reconstructing very poor and deteriorated sections. These projects are dramatically improving ride quality. In addition to restoring highway surfaces, major preservation and rehabilitation work is ensuring that our bridges are being given significant life extensions, allowing for uninterrupted, unrestricted commerce. Resurfacing and bridge preservation and replacement efforts are advancing equally as well on our lower level networks.

Although improvements to our highway infrastructure are apparent, statistics below illustrate why it is paramount that we continue to address the maintenance needs of our transportation system.

Allegheny County has a large population of Structurally Deficient (SD), state-owned bridges. Measured by bridge deck area, 21.22% carry an SD rating. Counting actual bridges, a very high 29.52% are SD. It is important to note that an SD rating doesn't mean a bridge is unsafe, but it does indicate significant deterioration exists and high cost investment is necessary in the near future, either to upgrade or replace the bridge.

District 11 Allegheny County Bridge Statistics

Total	Structurally Deficient (SD)	% of total
1,172 Bridges	346 Bridges	29.52%
11,549,477 square feet of deck area	2,451,000 square feet of deck area	21.22%

Similarly, motorists traveling through the region will still experience many poor sections of state-owned highway. In Allegheny

District 11 Allegheny County Roadway Statistics

# of Segment Miles	Interstate		Other NHS		Non-NHS ADT>2,000		Non-NHS ADT<2,000	
	Miles	%	Miles	%	Miles	%	Miles	%
Excellent	44	35%	53	16%	121	16%	7	4%
Good	23	18%	140	41%	277	36%	20	10%
Fair	35	28%	104	30%	215	28%	46	23%
Poor	25	20%	44	13%	154	20%	124	63%
Total:	127		341		767		197	

County alone, 20% (25 miles) of our interstate system is rated poor in ride quality as measured by the International Roughness Index (IRI). Fortunately, these sections are budgeted for improvements over the next several years. Additionally, 13% (44 miles) of other NHS routes are in poor condition. Most of these will be programmed for improvement as well over the next several years. Unfortunately, a significant backlog of poor miles of highway exist on the lower level networks and many are not programmed due to higher priority needs on higher level networks.

"A significant backlog of poor miles of highway exist on the lower level networks and many are not programmed due to higher priority needs on higher level networks"

On a positive note, we are improving safety on our roadways. Through various programs funded by state and federal dollars, PennDOT District 11 continues to make strides toward meeting the statewide goal of 1 fatality per 100 million vehicle miles traveled by 2008. Although one fatality is one too many, our average rate for the past 5 years is 1.01, while the statewide average for that same time period is 1.48. In fact, we have had the lowest rate for more than 10 years. We accomplished this by initiating a combination of low-cost safety improvements, higher cost betterments and capital funded projects and by including safety features in all other projects. In the last five years, the number of crashes per year in District 11 has decreased from 15,406/year (2002) to 13,929/year (2006), even while vehicle miles traveled increased. The number of fatal crashes also decreased, 121 to 116, during the same period.

The high hills, deep valleys and vast network of waterways in our region that create the awesome character we enjoy provide significant challenges for transportation engineers and dramatically increase the costs of transportation infrastructure when compared with other regions with fewer features. In addition, every major rain or freeze- thaw cycle reminds us of the numerous geologic challenges we face. Many of our highways were carved into hillsides years ago. Weathering conditions over time have created weak spots on the hillsides supporting our roadways, with one quick slide or rockfall causing havoc for mobility. In Allegheny County we have a backlog of at least 40 active slide locations at any one time. In a good year, we can address five areas. New surprises always present themselves, causing us to re-examine and reprioritize our maintenance efforts.

Even with the significant highway and bridge backlogs, several major, high-profile projects have been advanced. The selection of these projects, which will enhance system operations, was critical in order to provide motorists and the region with the maximum benefit. Those listed below are currently under construction or planned in the near future:

•The Parkway West/I-79 "Missing Ramps" project, currently under construction in Robinson Township, will add key connections by establishing a full, high-speed interstate-to-interstate connection. When finished, motorists will be able to directly travel from the Parkway West (I-279) inbound to I-79 northbound and from I-79 southbound to the Parkway West outbound. While these connections were not included when the interstates were constructed, changing land patterns and land use have since created high demand for them. The ramps will remove a significant amount of traffic from a commercial stretch of Steubenville Pike (PA Route 60).

•The Route 28/I-279 South Connector in the City of Pittsburgh will allow free-flow travel from PA Route 28 South to I-279 South, eliminating the need to exit and travel through three traffic signals on East Ohio Street on the North Side. This connection will significantly improve mobility through the region and improve access to a commercial section of the North Side by eliminating thru traffic from local traffic.

•West End improvements in Pittsburgh will reconfigure and eliminate the confusing traffic circle at the intersection of Routes 19, 51 and the West End Bridge. This intersection is used by 36,800 motorists daily, providing an essential western entrance and exit for the city. The free-flow movement of motorists through this valley is complicated by the presence of an elevated section of Norfolk Southern Railway mainline tracks. Currently, highway connections comprising the "circle" exist under the railroad tracks at two locations. The addition of a third connection and the installation of a traditional signal-controlled intersection will significantly improve operations, route continuity and safety, thereby allowing for more efficient mobility and access to the interstate system.

•For the past 40 years, many ideas and plans have been considered to complete a 2-mile section of PA Route 28 between the Heinz Plant Pittsburgh and Millvale. Route 28 is an expressway to the north and connects to an interstate and the North Side. We are advancing plans that will eliminate bottlenecks at the 31st Street and 40th Street intersections. We anticipate creating significant intersection improvements at 40th Street to allow free-flow movement for southbound traffic (northbound is currently free-flow) and to create a grade-separated Single Point Urban Interchange (SPUI) at the 31st Street Bridge. Completion of these projects, expected to be performed in multiple phases beginning in 2009, will enable free-flow traffic from Kittanning in the north to Pittsburgh International Airport and areas west, significantly improving mobility throughout the region.

While it is easy for some to quickly tout the "potential economic benefits" of a capacity expansion project or the development of a new connection between two places, transportation officials are challenged to balance those desires with the huge financial demands of advancing a system preservation program. These investments hold everything together and allow our transportation system to be available each day, contributing to the overall economic development of our region. The negative impacts are enormous for commerce when an existing link must be closed or restricted due to the loss of a bridge structure that must be load rated or worse yet, closed. This weighs heavily on us as we advance a program that places high priority on bridge preservation, restoration and replacement.

We must continue to allocate sufficient resources to preserve and maintain roads and bridges in good condition while investing significant resources to restore and replace structurally deficient bridges and poor sections of highway. The challenge remains clear: Focus on projects that truly provide maximum operational and safety benefits while not overwhelming the financial balance of our program away from system preservation.

H. Daniel Cessna, P.E., was appointed District Executive for the Pennsylvania Department of Transportation, Engineering District 11-0 on May 13, 2005. District 11 encompasses 2,167 miles of roads and 1,773 bridges in Allegheny, Beaver and Lawrence Counties in addition to the Fort Pitt, Liberty, and Squirrel Hill Tunnels in Allegheny County. District 11 has 805 employees and an annual operating budget of $300 million.

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Innovation and Infrastructure Can – and Must – Learn to Co-Exist

Donald P. Fusilli, Jr., P.E., J.D.
The Tellum Group

More than 77,000 bridges in the U.S. are rated structurally deficient by Federal Highway Administration standards, meaning they're not necessarily dangerous but a matter of growing concern.

Unfortunately, bridge owners haven't objectively separated the truly dangerous bridges – like the collapsed I-35W bridge in Minnesota – from those with less severe issues in order to improve overall structural management, insure lowest life-cycle costs and enhance public safety.

Visual inspections following National Bridge Inspection Standards remain the FHWA's method of evaluating the condition of our aging bridges, an approach first put into place under President Nixon. To its credit, the FHWA sponsored a study in 2001 that found the NBIS visual condition assessment process is highly variable, subjective and non-repeatable. The FHWA is now proposing a long-term program to upgrade bridge condition assessment methods, but it won't deliver meaningful results for at least five years or longer. Bridge owners can't afford to wait that long.

Two separate industry reports issued over the past two years cite the American Association of State Highway and Transportation Officials (AASHTO) endorsing preservation as the highest priority for U.S. transportation needs and structural monitoring as a means to support safely extending bridge life span. Yet state transportation departments have not enthusiastically adopted advanced, second generation condition assessment technologies, including structural health monitoring, because of budget constraints, lack of understanding and resistance to changing condition assessment methods.

"The need exists for better techniques to inspect and maintain the vital infrastructure across the nation...But many states seem reluctant to adopt the new ways of approaching the problem."

Is there no middle ground here? The need obviously exists for better techniques to inspect and maintain the vital infrastructure across the nation, particularly such high-profile and high-impact structures as bridges. But many states seem reluctant to adopt the new ways of approaching the problem.

Innovation and infrastructure must co-exist with greater effectiveness if we as a nation are to maintain our ability to support trade, commerce, tourism and our American way of life.

Because overall transportation funding is not likely to be sufficient for decades, owners need to think and manage differently. While investing in needed capacity expansion to reduce congestion, fuel use and urban air pollution, they must simultaneously address approximately 70,000 bridges deemed functionally obsolete as well as the 77,000 structurally deficient bridges. This rosy scenario won't happen without better information.

"Because overall transportation funding is not likely to be sufficient for decades, owners need to think and manage differently"

A "spend smart, not fast" approach using advanced, second generation, condition assessment technologies should be considered as the basis for future federal transportation funding for structurally deficient bridges.This type of approach can be found across the country among breakthrough-thinking entrepreneurs working to solve tough problems in new ways.

At InspectTech, a Pittsburgh-based engineering software company, a program called BridgeInspect has helped a number of major municipalities – including the cities of Philadelphia and Balti-

more, and counties across the state of Maryland – access deeper levels of salient information from bridge inspections. These higher-range analyses, when placed in the hands of a more targeted group of decision-makers, have led to better results in planning and executing bridge repairs and rehabilitation projects. InspectTech provides mobile inspection and asset management solutions, enabling customers to more effectively collect, manage, and analyze inspection reports. Its software lowers the total cost of inspections, enhances reliability, greatly improves the richness of data collected (pictures, video, audio, GPS coordinates etc.) and improves productivity of both inspectors and managers.

In the same context, Atlanta-based LifeSpan Technologies offers 21st Century asset assessment technology as a means to safely extend the life of structural assets like bridges, perhaps for decades. The key to supporting these difficult decisions is more accurate condition assessments using tools that include highly precise sensing devices, wireless communication and the Internet, allowing owners to access near real-time information on structural condition. Such information lowers operational risks and may even allow prudent upgrades of asset condition, in addition to safely extending bridge life.

In one notable instance, LifeSpan helped show a major northeastern U.S. toll road officials how to safely delay a costly project to replace steel deck truss members on a bridge following recommendations by a third-party visual inspection.

Using innovative dual-channel sensors to capture data, coupled with a calibrated finite element analysis, LifeSpan worked with the owner to ascertain the in-service performance of the bridge. Based on this objective performance data, the owner learned the bridge was

indeed structurally sound and safe for travel and that it would not be necessary to spend nearly $1 million to refurbish the span. The owner also learned of another problem not delineated in the visual inspection report, clearly demonstrating the benefits of diagnosing the real problem before pursuing repairs or retrofits based solely on visual inspections.

Both the Pennsylvania Department of Transportation and the Pennsylvania Turnpike Commission have turned to InspectTech and LifeSpan Technologies to address specific bridge or related inspection matters.

As more state transportation departments appreciate the value derived from new ways of gathering, processing, analyzing and acting on more objective information regarding the condition of bridges and other key infrastructures, the typical fallback objections of lack of funding, lack of interest and lack of action will no longer be acceptable.

Donald P. Fusilli, Jr., P.E., J.D., is Principal of The Telum Group, LLP, a national concern offering insight and leadership direction in lifecycle planning to engineering and energy firms. Fusilli also has served as President and CEO of Michael Baker Corporation.

Moving the massive new 350 MVA transformer up Liberty Avenue into the company's Arsenal substation.

Preparing the Power

Duquesne Light Company Lights The Way

Joseph Vallarian
Media & Public Relations Supervisor
Duquesne Light Company

Infrastructure. It has been a buzzword in everyone's ear lately: the tragic bridge collapse in Minnesota, a spate of watermain breaks in the Pittsburgh area, and the push of local and national governments to evaluate the infrastructures that we rely upon every day.

At Duquesne Light Company, we took a proactive approach to ensure that our customers continue to be connected to a safe, secure and reliable source of electricity by embarking upon an ambitious, $500 million infrastructure improvement program.

Begun in 2005, this significant investment has improved the wires, transformers, substations, poles and other equipment that make up the Duquesne Light system. While the company has always systematically analyzed and maintained its infrastructure, and while much of this equipment has served residents of Allegheny and Beaver counties well for decades, it had begun nearing the end of its useful operating life.

In beginning the upgrade process, Duquesne Light identified six key areas: improving capacity to serve growing electricity needs in Oakland; refurbishing the aging underground systems that power sections of Pittsburgh and the expanding North Shore commercial district; adding contingency plans to feed power to the downtown network; completing the conversion of older distribution circuits to higher-voltage circuits that use newer technology to maintain reliability; upgrading transmission lines to improve the flow of electricity and balance the power load throughout the two-county service territory; and, upgrading underground lines and other related equipment in older suburban housing plans.

Duquesne Light workers upgrade a URD system.

With the expansion of area hospitals and universities, Oakland has seen tremendous growth over the last few years. Along with this development comes increased need for more electricity. So, as part of the infrastructure improvement program, Duquesne Light identified projects to keep these customers connected. A few highlights in the area include revamping the Fifth Avenue underground utility duct line, running from Oakland through Shadyside and into Point Breeze. The duct bank and cables were all replaced, providing a new "backbone" for the delivery of electricity in the area.

Three of the major substations in the area – Arsenal, Oakland and Highland – also were upgraded during the infrastructure improvement program. The Oakland substation received three new 100MVA (megavolt-ampere) transformers that increased the substation's capacity by 33 percent. Arsenal substation in Lawrenceville received a total makeover, rebuilding almost from the ground up. Nearly all the old equipment was removed and replaced with new 138KV and 345KV equipment, including the installation of a massive 350MVA transformer. The company will install its first forced cooling system at Arsenal and Brunot Island to increase capacity of the existing underground transmission lines.

This cooling system, called an HPFF (high-pressure fluid-filled underground transmission line), consists of 8-inch pipe with a special coating to prevent rust. The pipe is encased in heat-dissipating concrete and holds insulated copper transmission cables. Once these pipes are sealed, they are filled with special insulating oil that's kept under pressure by pumping stations at both ends. The oil, used as an insulator and pumped into the pipe when necessary, also can be cooled by chillers to help prevent overload situations.

Highland currently is undergoing similar improvement work, with older equipment being replaced with higher-capacity equip-

ment.The second phase of this project calls for building overhead transmission lines between Highland and the Logan's Ferry substation in Plum. The company also will install 345KV equipment and a 450MVA transformer at Logan's Ferry.

What makes the work in these three substations so interesting is the "backbone" that has now been laid to connect them. The 138KV and 345KV lines running between the three provide the means to increase transmission capacity, improve reliability and bolster contingency plans for the eastern part of our service territory.

Other work includes construction of a new substation in Oakmont and upgrading substations in Monroeville, Rochester, Indiana Township, Ross Township, Springdale Township and Crescent Township. With these upgrades, crews installed new breakers, switches and protective relays that improve reliability and maintenance costs.

In the future, Duquesne Light is planning to rebuild the Sewickley substation, construct an addition to the Legionville substation, and perform upgrades to the Hopewell and Brunot Island substations.

The company soon will begin construction of a 4.9 mile, 138KV transmission line to connect the North and Wildwood substations. The vast majority of the work will involve converting an existing 23KV line to 138KV, along a route that runs through North Park and along Peebles Road, Ringeisen Road, Duncan Avenue, and Thomas Run Road.

"Rehabilitating these underground residential distribution systems was deemed necessary because many of these housing plans were built in the 1960s and the equipment was nearing the end of its useful operating life."

On the distribution side, some of the more recent infrastructure projects were the extension of a circuit across Route 60 near the Montour Run and Moon exits in Findlay Township, the conversion of 4KV circuits to more reliable 23KV circuits in Ambridge, East Liberty and Robinson Township, and the work in older suburban housing plans.

Rehabilitating these underground residential distribution systems was deemed necessary because many of these housing plans were built in the 1960s and the equipment was nearing the end of its useful operating life.

The systems consist of underground cables that carry power from above ground, pad-mounted transformers within a housing development. Over the course of time, the equipment located underground in fiber vaults become subject to the caustic effects of road salt, lawn chemicals and water and can cause more frequent outages.

Some of the housing developments that have undergone upgrades include Bon Meade and Londonberry, both in Moon Township; Kinvara in McCandless Township; Fox Hall in O'Hara Township; and, Sunset Hills in Economy Borough.

Duquesne Light workers upgrading equipment at the company's Brunot Island substation

In the early 1880s, Pittsburgh was carving a leadership position in the fledgling electricity industry. One of the world's first permanent central power stations was built on a 50-by-90-foot lot on what now is Oliver Avenue in downtown Pittsburgh.

Duquesne Light's rebuilt Arsenal substation.

Today, Duquesne Light continues its leadership role in by investing the $500 million to upgrade the region's electric infrastructure, ensuring all of our customers – and the businesses and communities we serve – are connected to a safe, reliable source of energy well into the future.

Past and Present issues of The Pittsburgh ENGINEER can be read on-line at www.eswp.com/publications.

With 9,040 miles of pipeline, Texas Eastern connects Texas and the Gulf Coast with high demand markets in the northeastern United States, supplying fuel for electric generation facilities and helping to meet peak-day demands. Texas Eastern can transport 6.2 billion cubic feet per day and offers 75.1 billion cubic feet of gas storage.

Natural Gas Infrastructure

Oakford Storage Area

Dan Donovan
Dominion
Manager, Media Relations, Gas Companies

For more than a half century, Western Pennsylvania has been the largely unnoticed home to a valuable part of the regional and Northeast U.S. natural gas infrastructure with the Oakford Storage Area operated by Dominion Transmission Inc. and co-owned by Dominion and Texas Eastern.

"Delmont was developed as a major storage facility for... utilities along Texas Eastern's 9,040-mile pipeline network that extends to New York and New England."

Located in Westmoreland County along Route 22 near Delmont, it was developed as a major storage facility for Pittsburgh and Cleveland as well as utilities along Texas Eastern's 9,040-mile pipeline network that extends to New York and New England.

In the late 1940s, there was a tremendous growth in the number of people who wanted to use gas for home heating, putting a severe strain on the supply capabilities of gas companies that previously relied on local Appalachian wells. Two large pipelines from the Southwest, called the "Big Inch" and the "Little Inch," were built to bring new supplies to the Northeast. As big as they were, the pipelines still did not bring enough additional flowing supply to meet the peak demands of the winter heating season.

Underground storage in existing, depleted natural gas fields had already been proved feasible on a small scale, so utilities looked to see if they could stockpile natural gas in large quantities in depleted fields. That way they could bring the natural gas to the Northeast during the warm summer months and store it to meet the high requirements for the following winter.

The Oakford Storage Area, today operated by Dominion, is a large depleted field in proximity to the pipelines. It became a logical place for an underground natural gas storage field.

In 1960, there was a capacity of 2.8 trillion cubic feet of gas in 217 natural gas storage pools in the U.S.. Today, more than 400 storage facilities have a total capacity of approximately 8 trillion cubic feet of gas. Pennsylvania is among the nation's leaders in the number of storage pools, active wells, compressor stations and total horsepower at storage facilities. Preparation of the Oakford Storage area was begun in 1949. It was put into partial service in 1950. But it was not until 1956 that the project was completed and put into full operation.

Today, the total storage capacity of the Oakford Storage field is 132 billion cubic feet. The field actually consists of storage areas in two separate sands – the Murrysville Sand at a depth of approximately 1,400 feet and the Fifth Sand at approximately 2,200 feet. The Murrysville Sand is the larger of the two areas and stores gas at a lower pressure than the Fifth Sand, which serves as a reserve or peaking pool to supply gas when cold weather creates a demand in excess of what the Murrysville pool can handle.

Gas is pumped into the Fifth Sand either directly from the pipeline system or from the Murrysville Sand above. Because of the higher pressure used, more gas can be stored in the Fifth Sand than in the same size area of the Murrysville Sand.

An unusual feature of the Murrysville portion of this storage area is that all gas is injected into and withdrawn from the pool at the northern end at the Oakford Compressor station. Pressure in this area is the highest in the pool, gradually dropping from this point south. Only the northern half of the pool is used at this time for storage.

Any gas that migrates south is collected at a Jeannette Station and a Lincoln Heights Station, and returned to Oakford, where it is either re-injected into storage or delivered to market.

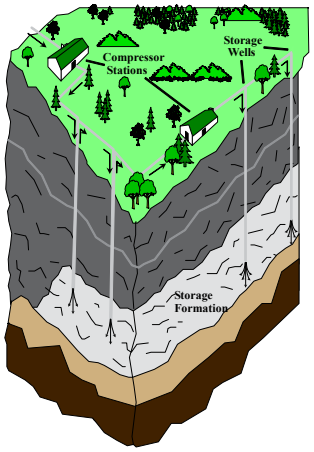
The gas migrates slowly, taking about three months to move the 7.5 miles south from Oakford to Jeannette.

Preparing an old gas well for storage purposes usually involves re-drilling the well to a point below the maximum depth of the porous storage sand. It is then either plugged up to the surface and abandoned, or a new casing is put in and the well is prepared to be used for injecting and removing gas from storage pools.

The Oakford Storage Area is Dominion's largest concentration of compressor horsepower. Oakford Station is equipped with 12 GMW10 Cooper Bessemer engines that are fueled by natural gas and three Cooper Bessemer KM-4 electric driven compressors. Together, they provide a total of 43,800 horsepower.

After being stripped of all readily removable parts, each engine weighed about 93 tons when delivered. The power units on the 12 compressors are identical but the compressors they drive are of two types. The low stage compressors have 24 ¾-inch diameter compressor pistons. The higher stage compressors have 13 ¾-inch or 14-inch pistons which pump smaller quantities of gas but can reach three times higher pressures with the same horsepower.

South Oakford Station has two 6,350 horsepower Cooper-Bessemer engines and two 5,500-horsepower Cooper-Bessemer LM-5 electric driven compressors. The compressor stations at Oakford are to a great extent self-sufficient since they both have their own source of water and their own power generating equipment. To insure dependability, a constant check is kept on the engine performance during the cold weather season. Each summer, as part of a continuing preventive maintenance program, the engines and compressors are partially torn down and inspected and any necessary reconditioning or repairs are made.



The engines operate at full capacity during the heating season from November through March, pumping gas from storage. They are used again during the summer to supply gas to electric generating facilities during peak load periods as well as to restore volumes and pressures to the Fifth Sand peaking pool.

The transmission pipeline that supplies gas for storage operates at sufficient pressure to fill the Murrysville sand pool to its normal capacity without additional compression. The newest compressor station operating at the Oakford Storage area is South Oakford Station.

South Oakford was built in 1972. Additional horsepower added in 1995 is specially designed to increase average daily withdrawal rates from the Murrysville sand. This permits maximum withdrawal of additional gas to be taken in a shorter period of time to meet the peak heating demands of December, January and February.

The Oakford Storage Complex can move one billion cubic feet of storage gas a day to the transmission system in the peak heating season.

MANAGING SEWER OVERFLOWS WITH NEW TECHNOLOGY

John Findley, P.E.
ALCOSAN Mechanical Engineer

Changes in the federal Clean Water Act continue to provide wastewater engineering challenges across the U.S., and the Pittsburgh region is certainly no exception.

For us, a federal consent decree has mandated that more stormwater be conveyed to the Allegheny County Sanitary Authority (ALCOSAN) and that a higher amount of pollutants be removed. With only one wastewater treatment facility, albeit a large one located in the Woods Run section of the city, engineers are faced with finding the right technology and building the appropriate facilities to meet the federal directive.

How ALCOSAN operates provides context into the complex challenge in meeting those goals. ALCOSAN's service area spans almost 300 square miles, incorporating 95 miles of interceptors that convey sewage from combined and separate sewer systems owned and operated by municipalities. The interceptors generally follow the course of the Allegheny, Monongahela and Ohio rivers and their major tributaries. Almost 200 million gallons of wastewater are treated daily at ALCOSAN from a service population of 900,000. Over 300 regulator structures provide relief of the collection system during periods of wet weather, when flows overwhelm conveyance and treatment capacity. Consequently, excess flow is discharged via overflows directly to the three rivers and their tributaries.

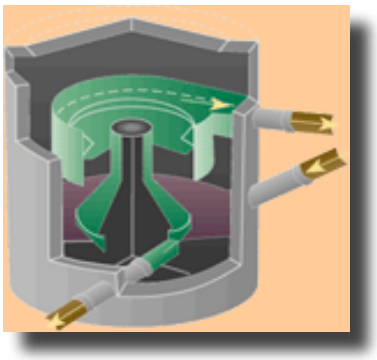
In April 1999, ALCOSAN completed a wet-weather concept plan as a step toward compliance with the National Combined Sewer Overflow Control Policy. Goals of the plan focused on eliminating the combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) consistent with the new policy. The plan proposed expansion of our wastewater treatment plant and construction of a network of parallel interceptors and satellite storage and treatment facilities to capture 85 percent of the total wet-weather flow in the combined sewer areas in an average rainfall year. In 2007, ALCOSAN completed negotiation of the consent decree that sets forth a series of planning, design and construction requirements to be accomplished in accord with an extensive schedule of milestones.

In anticipation of the consent decree requirements, engineers began to examine whether end-of-pipe treatment could be provided farther up the ALCOSAN interceptor system, and if so, what technology exists and how it would perform. ALCOSAN and consultant teams from Chester Engineers and Metcalf & Eddy began working in 2006 on the planning phase of an Overflow Control Facilities demonstration project. The goals are to provide solids removal of at least equivalent primary treatment to meet combined sewer overflow policy requirements; demonstrate and pilot the implementation process for these facilities through extensive public involvement; and, conduct up to two years of demonstration testing to document performance of the selected technologies.

The next challenge was location. Sites were narrowed based on amount of flows and current and future recreational activity. The resulting criteria narrowed the selection to two places -- the Homestead Run area along the Monongahela River and the Girty's Run/Herr's Island back channel area along the Allegheny River. Three potential sites were then identified at each location. Hydraulic modeling analysis was performed to generate design flows on which to base sizing of the facilities. Field sampling and bench scale-testing was

performed to generate data on the characteristics of actual wet weather events in each watershed. Plan and profile layouts were prepared for each technology, site and flow condition under consideration.

A broad range of wet-weather treatment technologies was developed for control of the CSO discharges from the two sites. These technologies include tunnel storage, storage tanks, swirl/vortex concentrators rated at 10,000- and 30,000-gpd/sf, detention/treatment, ballasted flocculation and screening/disinfection. Also, the operation of the overflow control facility was evaluated at various levels that included zero, one, two, four and seven allowable untreated sewage overflows in an average rainfall year. When all of the factors listed above were tabulated, over 400 potential combinations of technologies on the possible site locations had to be evaluated!



Schematic diagram of overflow control facility

The next step was to prepare a cost estimate for each technology, level of control and flow condition for the sites under consideration. The estimates were developed for both initial construction and annual operation and maintenance. Construction costs were developed with data obtained from actual costs of similar completed projects across the country. Annual operation and maintenance costs were estimated based on the annual CSO volumes to be handled, the number of activations per year and the annual hours of facility operation. Using these parameters, costs were then developed for labor, chemicals, parts and maintenance and utilities.

Non-monetary evaluations were conducted to facilitate comparisons of the technology and site alternatives. Non-monetary factors were defined to facilitate comparisons that could not be fully reflected in terms of cost.

The alternatives and site evaluations to address the overflow situations are expected to conclude this year, when the projects will then proceed to final design and then to construction. The results will be used to help guide the extensive wet-weather pollution control efforts required of ALCOSAN under terms of the federal consent decree. Stay tuned.

Save the Date!
ESWP 124th Annual Banquet
Wednesday, February 20, 2008 at the Sheraton Station Square Hotel

A 1957 view of the Shippingport Atomic Power Station, looking north with the Ohio River in the background. The facility was the country's first commercial nuclear reactor.

Photo courtesy of FirstEnergy

50 years on, 'Atoms for Peace' is remembered

Don Hopey
Pittsburgh Post-Gazette

Fifty years ago today, the nuclear age dawned in southwestern Pennsylvania.

At 4:30 a.m. Dec. 2, 1957, the first commercial nuclear reactor in the United States, built on a seven-acre site along the Ohio River in Shippingport, Beaver County, gained full power, or, as the scientists like to say, achieved "initial criticality."

It would take until Dec. 18 to plug the electricity produced by splitting atoms into the region's power grid. But for nearly 25 years thereafter, the plant lit up area homes and furthered atomic research.

Jointly developed by the Department of Energy and Duquesne Light Co., the plant was part of President Dwight D. Eisenhower's "Atoms for Peace" program.

"It was the world's first large-scale nuclear-powered electric-generating system, and also a scientific and research station," said Scott Waitlevertch, a spokesman for FirstEnergy's Beaver Valley nuclear power station, which operates adjacent to the old Shippingport facility. "There were several core designs over the years that went in, and that allowed them to really look into the technology."

Adapted from a reactor originally intended for use on an aircraft carrier, the original Shippingport pressurized-water reactor, designed by Westinghouse Electric Corp., cost $72.5 million and ran on 93 percent enriched uranium. Construction of the facility, which was mostly underground for safety and security reasons, was overseen by Adm. Hyman Rickover, the "father of the modern nuclear Navy."

The reactor was tiny by today's standards, producing 68 megawatts of electricity, enough to light about 68,000 homes. The nuclear fission the reactor produced heated water to produce steam, which drove the turbines that produced electricity.
By comparison, FirstEnergy's Unit 1 and Unit 2 nuclear reactors produce about 1,779 megawatts of power.

The last reactor used by the facility, from 1977 to 1982, was an experimental breeder reactor, Mr. Waitlevertch said, that produced not only electricity but also more nuclear fuel, thus the "breeder" component of the reactor.

"Shippingport was like a submarine on land," said Richard Hecht, 58, who started as a test engineer at the old Shippingport plant 34 years ago. He's now FirstEnergy's engineering training coordinator, but misses the old reactor and the small,

tight-knit family of employees there.

"I have fond memories of that place. They ran a tight ship. Admiral Rickover made sure of that, but we knew everyone who worked there," said Mr. Hecht. He even met his future wife, a clerk in the radiation-protection department, there.

The Shippingport plant was closed in 1982. Its reactor vessel was shipped to the Hanford low-level radioactive waste disposal facility in Richland, Wash., via the Mississippi River and the Panama Canal. The riverfront site was cleaned at a cost of $98 million, in 1985 dollars, and released for unrestricted use in November 1987.

"The Shippingport plant was closed in 1982...although government officials said at the time it was safe enough to be used as a children's playground...it is surrounded by a security fence"

Although government officials said at the time it was safe enough to be used as a children's playground, the site, as a result of the terrorist attacks of Sept. 11, 2001, is surrounded by a security fence and used mainly by Canada geese.

"It's sad to look at that field and a shame we lost some of our history when the reactor was shipped out and the buildings taken down," said Darleen Kopp, 64, who worked at the Shippingport reactor as a nurse for six years and now performs the same duties for FirstEnergy.

Still around is Jim Russell, who helped build the Shippingport reactor as a 17-year-old laborer, operated it as a supervisor and worked on its shutdown and decommissioning.

"I was hired on Sept. 25, 1957, and one of the first jobs I had was to pick up the spent welding rods around the omega seal that connected the head to the reactor vessel," said Mr. Russell, 68. "So that's how I can say I worked on the construction."

Asked about his memories of the morning when the reactor was fired up and attained full power, he paused, then laughed.

"I was there," he said, "but I was 17 years old and interested in girls. It was just a job for me. I was mystified by it."

The Shippingport anniversary occurs at a time when the federal licenses for the two nuclear reactors operated by FirstEnergy Nuclear Operating Co. on land adjacent to the site of the original reactor are up for renewal.

Earlier this month, the Akron, Ohio-based electric company announced its Beaver Valley Power Station had met the Nuclear Regulatory Commission's preliminary requirements to extend the permit for its Unit 1 reactor until 2036 and its Unit 2 reactor until 2047. A decision on the permits is not expected until the last half of 2009.

A Panel of Engineer Entrepreneurs gathered at the Pittsburgh Engineers' Building to discuss their experiences.

Engineers as Entrepreneurs

A Panel Discussion

Chriss Swaney

Little entrepreneurial outfits have the fresh ideas. Venture capital companies have the bucks. So why not join forces?

That was one scenario debated at a December 4 luncheon panel discussion that explored the success of "Engineers As Entrepreneurs."

Dan Tis, Alicia Avick and Charles Toran, Jr. of the Engineers' Society of Western Pennsylvania (ESWP) fielded questions from Carnegie Mellon University's Jonathan Cagan about entrepreneurship.

Cagan, a professor in mechanical engineering and co-author of two books about how ordinary people create extraordinary products, prodded the panelists to be candid about the road to entrepreneurial success. "Engineers have the right tools to be entrepreneurial because they have a high tolerance for hard work," said Cagan, who also teaches innovative product design courses at Carnegie Mellon.

And if there is any trait that runs through the success stories of the three ESWP panelists, it is a refusal to give up. They didn't care how hard it was; they didn't mind the hardships and achingly hard work it took to get a successful business up and running. And they never fooled themselves how fast they could do it or how much money they'd make right away. They just kept going. With Zen-like certainty, their refusal to believe in reality as it appeared at the time, changed reality.

"It's a leap of faith. It is hard to leave that steady paying job, but you have so much more opportunity when you start your own business," said Tis, founder of S/D Engineers, which was recently sold to a large global company.

Tis started his career with Dravo Corp. as an engineer and later became a project manager. He worked for Eichleay Engineers, Rust Engineering and was vice president and general manager of Raytheon's Pittsburgh office. In addition to starting S/D Engineers, Tis has ownership interests in three Pittsburgh-based companies: Loftus Engineers, Core Technologies and SE Technologies; an engineering company in the Chicago area; a software development company; an electrical construction company and an Israeli technology development company. "You must have access to capital to be successful and that begins by securing a sound banking relationship," said Tis.

But Tis is not the only ESWP member to pass through the straits of business success. Both Avick and Toran have proven they too have "The Right Stuff" to be entrepreneurs. "I think engineers bring wonderful problem-solving skills to the entrepreneurial doorstep," said Avick, who started Advantus Engineers in 2004. Her company provides HVAC controls consulting services to firms and owners requiring additional knowledge in this specialized area. "We also provide a variety of services including mechanical design, green building services and construction administration," said Avick, a registered professional engineer in Pennsylvania and a United States

Alicia Avick

Green Building Council LEED accredited professional. From 2001 to 2005, she worked as a building automated systems sales engineer for the Carrier Corp.

Like most successful entrepreneurs, Avick said she thrives on independence. The confidence that flows from ownership of an idea creates the drive to endure often dire consequences of that independence. "You have to be prepared for non-success due to a recession or other economic downturns. You have to find a way to stay afloat in the early stages of your business," said Toran, owner and manager of SCI-Tek Environmental Services Co. – an

John Cagan, Panel Moderator

engineering and consulting firm with major contract work for the U.S. Army, ALCOSAN and the Pittsburgh Public Schools. Before starting his own company, Toran worked in the Resource Energy Systems Division of Westinghouse Electric Corp. and Waste Management Inc.

And more and more people like Tis, Toran and Avick have learned how to "stay afloat." With more people going into business for themselves nowadays, the number of U.S. firms without paid employees rose to 20.4 million in 2005, according to the U.S. Census Bureau. That's 78 percent of the nation's 26 million businesses. This category of non-employer businesses, which are often part-time ventures, generated more than $950 billion in revenue in 2005.

"It's the great American dream for people to control their own destinies," said Cagan, whose latest co-authored book, "The Design of Things To Come," describes how today's innovations are driven by customer emotion, self-image and fantasy. Cagan also has developed team-based tools and computer-based technology to improve the process of design conceptualization.

Charles Toran

Indeed, many of today's fastest growing entrepreneurial startups have partnered their way to success. Global competition, coupled with the supersonic pace of innovation, has compelled large companies to play every angle to survive and thrive. IBM, Ford and

Dan Tis

General Motors have found that to cut costs or keep up with technological shifts they need the help of little guys. Small, entrepreneurial dynamos, free of the bureaucracy that hampers many big companies, often hit on new products, markets or designs first.

The ESWP panel also said that other factors behind the rise of tiny, entrepreneurial firms include technology advances, greater demand for services, and an aging population with skills and resources to launch new ventures.

The number of entrepreneurial businesses grew by 25.5 percent from 2000 to 2006, according to the Small Business Administration. That's more than triple the rate of medium to large companies, which grew only 7.6 percent during the same period.

Society News

Alex G. Sciulli, P.E.
ESWP 2007-08 President

Dear Fellow Member:

The Engineers' Society of Western Pennsylvania (ESWP) is wrapping up a very successful 2007. Our membership is comprised of approximately 800 individuals, who represent more than 400 different firms. Within those numbers, we are pleased to have the continued support of more than 75 corporate members – a "who's who" from around our region. Our premiere technical conferences were well attended and we presented a number of excellent programs that averaged more than 75 people per event. Our social events were enjoyed by all who participated, and our fine private club, while under-utilized, remains the pride of the membership.

Our Business of Brownfields Conference had more than 300 registrants, and was held for the first time at the David L. Lawrence Convention Center (DLCC). Surveys from our attendees indicated high levels of satisfaction with the technical program and the location. We are planning to return again in 2008 (April 23-24) at the same location and we promise to deliver another high quality technical conference. Now in its 14th year the Business of Brownfields is thought to be the original conference on this still-emerging industry.

Our International Bridge Conference (IBC) was held in June with more than 1,100 attendees. For the first time it its 24-year history, a "Featured Country" program was included in the conference, and resulted in more than 100 visitors from China who presented their bridge program. Attendees came from more than 40 different states, and 15 different international countries, making it truly international. In 2008, the 25th Annual IBC will be held at the DLCC (June 1-3), and promises to deliver the biggest and broadest bridge conference in the country. The expanded space will allow for more exhibits, technical sessions, workshops, and seminars.

Our International Water Conference (IWC) was held outside of Pittsburgh (in Orlando, Florida) for only the second time in its 68 year history and continues to impress the attendees. Record attendance in the continuing education workshops, and a sold out exhibit hall, plus three days of concurrent technical sessions made the IWC a valuable learning experience for those in the industrial water treatment industry. In 2008, the IWC will be held in San Antonio, Texas (October 26-30) in a strategic attempt to introduce IWC to the Southwest U.S.

Our Program Committee presented many of our region's most influential leaders at a very successful luncheon program format throughout the entire year. All of these events were well attended, many with more than 100 members and guests. This is a great opportunity to introduce others to membership in ESWP, and the committee has many interesting programs planned in the first quarter for 2008.

Our membership club in the Pittsburgh Engineers' Building, while still home to many of our local technical societies meetings, is not as well utilized as we need it to be. Playing host to many holiday functions during the month of December indicates that we are ready to serve the membership in greater volumes, but we need your help in patronizing the dining room. When making plans for lunch in town, please consider your club.

We also have our traditional programs for you, the member. On February 20, 2008, we will honor the Engineer and Project of the Year, and our William Metcalf Award, presented for a lifetime of accomplishment and named in honor of ESWP's first President. This year's Metcalf honoree is Gerald Holder, U.S. Steel Dean of Engineering at the University of Pittsburgh.

Looking ahead, our strategic planning by the ESWP board continues to guide the way for our educational outreach. We are in the early-production stages with WQED-Multimedia Producer Rick Sebak to produce an engineering themed program as part of his Pittsburgh History series. Our fundraising needs for this program have been quite successful. We have secured a significant grant from a local foundation, and received the support from our corporate members. Look for more updates on this initiative throughout 2008.

We continue to work with the Carnegie Science Center (CSC) to produce an engineering themed stage production that will be offered to visitors at that world class facility. The CSC estimates that more than 50,000 students per year will view "Engineering Our World" and it is our hope to

offer this dynamic program for five years. We remain committed to debut this program in 2008, and are actively seeking funding to do so.

The Future Cities Competition among Pittsburgh schools remains vibrant. ESWP is proud to continue our role with the CSC to sponsor this middle-school program. Participating students, teachers, mentors, and volunteers all agree that this exciting, hands-on competition enhances many of the necessary skills for the engineers of tomorrow. Interest in the program remains strong with more than 33 schools competing in the Pittsburgh Region.

The Chain Reaction Contraption Competition (formerly known as the Rube Goldberg Competition) is the high school program that ESWP co-sponsors with CSC and Westinghouse Electric Corporation. Interest in this program also remains strong. We are also joining in the sponsorship of a Pittsburgh Chapter of the A.C.E. Mentoring program. A.C.E. (Architecture, Construction and Engineering) provides apprenticeship opportunities to high school students with an interest in the design and construction professions.

ESWP does present a number of scholarships to support students' university-level interest in technical areas. In addition to these scholarships, we do present student awards at both the IBC and IWC to encourage continued excellence in these respective fields.

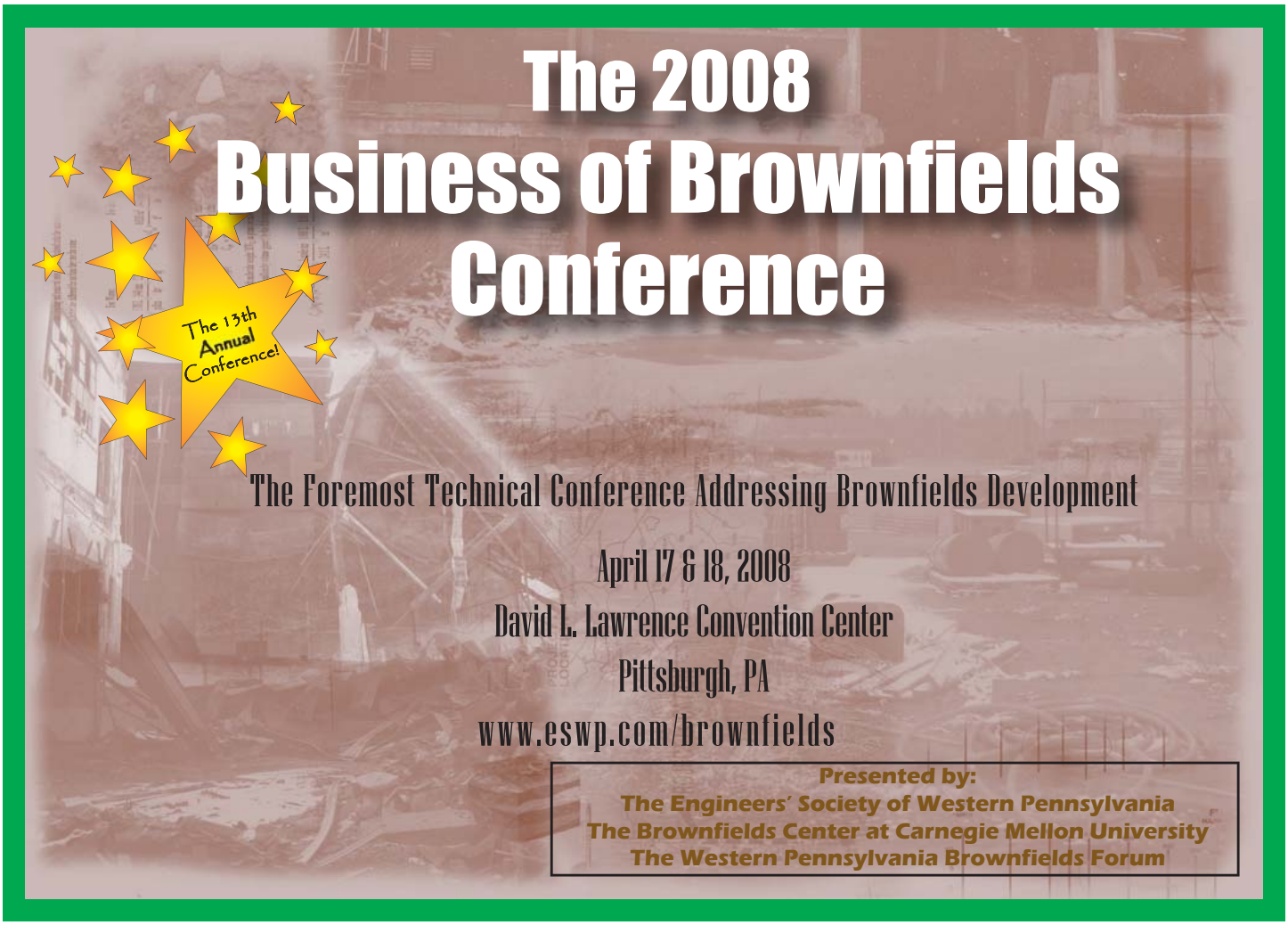
Additional information on all of these programs, conferences, and events can be found on the ESWP web site (eswp.com). And remember that these programs are accomplished largely on a volunteer basis through the resources of the ESWP membership. If you would like to become more involved in any of these activities, please contact our offices.

ESWP remains a bright, vibrant, and strong organization serving and supporting the engineering and technical community. However, none of these programs can be accomplished without your continued support. Thank you to the many members of our Society for their dedicated hard work throughout the year to keep ESWP moving in a positive direction.

Wishing You a Happy New Year,

Alex G. Sciulli

Alex G. Sciulli, P.E.
ESWP President 2007-08



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