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THE HARRISBURG COGENERATION STORY

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INTRODUCTION

Someone would not necessarily come to a District Heating and Cooling conference if their main intent was to learn about cogeneration. There is really nothing new about cogeneration. It has been around for as long as the electric and steam power businesses have been around. The only thing that may be a little different about this technology today is that cogeneration may be utilized in a fast food store. However, the type of cogeneration I'll be addressing will not be found in a McDonalds.

With this in mind, the purpose of my talk is to share with the conference attendees some of our experiences with cogeneration in Harrisburg, and more importantly, the real thrust of this talk is aimed at heightening an awareness of why the combined use of cogeneration and district heating makes more sense now than ever before. Those of you who are involved with operating a district heating system, which utilizes cogeneration, know what I am getting at. Those who don't should consider or even reconsider its application in their existing or proposed system. Not only is the combined use of cogeneration and district heating over-all a very efficient and cost effective process, but it is also a desirable combination when it comes to environmental issues such as emissions, acid rain, global warming, and ozone depletion.

HARRISBURG STEAM WORKS, LTD.

Harrisburg Steam Works (HSW) was formed in 1984 to acquire the assets of the Harrisburg district steam heating system from the

Pennsylvania Power & Light Company (PP&L). The Harrisburg steam loop has been serving customers since 1888. PP&L provided steam service from the Walnut Street Steam Heating Plant to customers in Harrisburg since 1926. HSW purchased the steam system assets from PP&L in December, 1985. At the same time closing was held for a cogeneration project to be constructed at the Walnut Street Plant.

The HSW Walnut Street Steam Heating Plant currently provides district steam to approximately 380 residential, commercial, and industrial customers for space heating, domestic hot water heating and process requirements in downtown Harrisburg. Steam is generated in gas and oil-fired boilers and supplemented by low-cost steam purchased from the City's incinerator operation and an on-site cogeneration plant. The cost saving, fuel flexible cogeneration system was constructed by Paxton Creek Cogeneration Associates (PCCA) at the site of the existing HSW steam plant and put into service in 1986. The cogeneration facility is a dual-fuel diesel cogeneration plant producing thermal energy and electricity. The cogeneration project displaces HSW oil-fired steam generation with cogenerated steam produced as a by-product from the waste heat from diesel electric generation. Thus, the HSW steam customers benefit from an additional low cost, fuel efficient heat source. The HSW steam heating plant presently contains four gas and oil fired steam boilers, and occupies approximately five acres of land in downtown Harrisburg. The plant was substantially upgraded in 1972 through the addition of three modern package steam boilers and two new 980,000 gallon fuel

oil storage tanks. The combined capacity of the four HSW boilers, together with the diesel waste heat recovery units, is 435,000 lbs per hour. The peak hour steam demand during the 1988/89 winter heating season was approximately 200,000 lbs. per hour.

THE PAXTON CREEK COGENERATION PROJECT

The Paxton Creek Cogeneration Associates (PCCA) project consists of two 6300 kw stationary dual-fuel diesel engine generators with waste heat recovery units that operate with an overall operating efficiency ranging from 50 to 80 percent. The waste heat recovery units generate 150 psig steam for use by Harrisburg Steam Works. Annual steam production of 175 million pounds represents approximately 40 to 50 percent of the total annual steam requirement for the Harrisburg steam heating distribution system. Additional thermal energy is supplied by PCCA to Harrisburg Steam Works for boiler feedwater heating and is estimated to be 40×10^9 Btu's annually. Budgeted electricity sales to PP&L are 98×10^6 kilowatt hours per year. The primary fuel for the Project is natural gas with diesel fuel used as a pilot fuel for ignition. The cogeneration project consumes approximately 850,000 mcf of natural gas annually. Natural gas is purchased under terms of a long term (ten year) contract with gas being delivered from dedicated acreage in western Pennsylvania and transported by an interstate gas pipeline company and the UGI system.

The diesel engines are designed to operate in the dual fuel mode (gas and oil) or on straight diesel fuel. Diesel fuel consumption

will range from 600,000 to 900,000 gallons per year depending upon gas supply and engine maintenance considerations.

EXHIBIT 1 presents a material balance for Harrisburg Steam Works, Ltd. and the Paxton Creek Cogeneration project.

Harrisburg Energy Company (HEC) , an unregulated affiliate of Harrisburg Steam Works, Ltd. is the General Partner of Paxton Creek Cogeneration Associates, a limited partnership. HEC, in cooperation with its consulting engineer, Brinjac, Kambic and Associates, prepared the detailed engineering and construction specifications for the project. MMR/Foley was the prime contractor with Herre Brothers, MATX and H. B. Alexander & Sons as subcontractors. Construction began in December 1985 and was completed in September 1986 at a cost of approximately $13 million. To date, the engines have generated 278 x 10^6 kilowatt hours and 465 million pounds of steam. For the year 1988, the capacity factor of the cogeneration facility was 91%, with an average thermal efficiency of 58%.

EQUIPMENT SELECTION

When we were evaluating the prospect of purchasing the Harrisburg District Heating System, a business which had been on a steady decline, it became obvious that future profitability would hinge on finding a way to stabilize and ultimately reduce steam rates which had been escalating at over 7% per year over a five year period.

Our first job was to look for savings in production costs. One of the steam supply sources was low cost cogenerated steam from the City of Harrisburg's Waste-to-Energy Incinerator; however, this steam was only available in spring, summer, and fall months and, therefore, was not significant in terms of the overall steam requirement of the system. Our solution was to expand the availability of low cost steam with cogeneration. Diesel electric generators with waste-heat recovery units were our preferred choice. The diesel technology was selected because of its durability, reliability and ability to match both our minimum steam demand parameter and the power company's ability to accept electrical output of the project. The steam output of the two waste heat recovery boilers is approximately 25,000 lbs per hour. This is only one-eighth of the system's peak steam demand of 200,000 lbs per hour; however, when the cogeneration plant produces capacity factors of about 90%, total steam output becomes a substantial quantity. Or, from the consumer's perspective, 40% of steam sales are cogenerated at a rate which is less expensive than would otherwise be possible for steam produced in our gas and oil fired boilers.

"THE DEAL"

At this point, in describing our cogeneration project, people ask questions about the different contracts and agreements, financing, electricity prices, fuel, etc., that would surround the cogeneration project. But really those items are the topic of a whole other talk, and these talks have been given on numerous

occasions here and at other conferences by investment bankers, financial advisors and attorneys who work on these types of projects all the time. However, from the prospective district heating operator's viewpoint, the real nuts and bolts of "the deal" can be broken down into some fairly basic axioms.

Harrisburg had a steam system in need of a low cost source of steam. Low cost steam for the downtown could be provided by building a cogeneration facility at the plant site. Without the existing steam system, there is no cogeneration project. And conversely, since the cogeneration project provides 40% of the steam system's requirements at a lower cost than otherwise possible, without the cogeneration project, there may be no steam system in the years ahead. This is what constitutes the deal. The steam system and the cogeneration project are mutually dependent, neither one stands alone. The cogeneration project has an electric contract with the power company and a ten (10) year gas contract with a gas producer. The cogeneration project also has a ten (10) year thermal energy sales contract with the steam company. It is the thermal energy sales pricing, ie. the price of BTU's being sold to HSW, that really makes this deal. If this price is not low enough, the deal never happens regardless of electricity prices for the cogeneration project, because the steam system will not buy BTU's from the cogeneration project unless those BTU's cost less than can be produced using fossil fuel in the steam system's boilers.

Although I stated earlier that I would not focus on the contractual and financing aspects of these types of projects, I would be remiss if I didn't at least indicate the level of effort required to mitigate risk and also, indicate the number of contracts required for a project like the Harrisburg deal. EXHIBIT II presents a listing of those areas that were addressed to mitigate project risk. As can be seen, we covered technological aspects of the project, fuel supply, the energy marketplace, managerial talent of the project team, construction contract, bonding and contingency reserves, and operating and maintenance considerations for operating the project. EXHIBIT III shows the project team for the Paxton Creek Cogeneration project consisting of no less than fifteen (15) individual entities from the General Partner to those handling the financing, accounting, engineering, principal equipment vendor, legal, construction, and gas supply. EXHIBIT IV is a list of contracts associated with the PCCA partnership. EXHIBIT V is a similar listing of contracts that HSW entered into as the purchaser of the steam.

EFFICIENCY AND EMISSIONS

If someone was to pick up any of the International District Heating & Cooling Association Member marketing brochures, one of the first things you would find would be the list of benefits afforded by district heating. Invariably, those benefits include: "less polluting energy source" or "improved air quality through better emissions control at a central plant" or "less polluting than individual small stacks." Until recently these

benefits received little attention from customers and prospective customers of the district heating loop, with the exception of governmental entities who obviously would consider things over bottom line cost. Times are changing regarding the importance of the environment and what is being done to protect it; as witnessed recently by the President's clean air message. I believe the level of awareness that exists nationally, particularly in urban areas, will magnify the environmental benefits available from district heating and, particularly, cogenerated district heating and how this technology can contribute towards our long term solution for emission problems.

In Harrisburg we have a cogeneration source which provides half of the steam used in the district heating loop. The thermal efficiency of the cogeneration plant runs between 50% and 80%, depending upon the time of year. During winter months it operates at an efficiency of 80%. As can be seen on Exhibit VI, the Paxton Creek Cogeneration plant in Harrisburg runs at an annual thermal efficiency of 58%. This is my favorite exhibit -- it shows that with cogeneration, such as we have in Harrisburg, you can simultaneously produce electricity and steam for heating of buildings, and do this about 75% more efficiently than you could produce electricity alone in most of the conventional fossil power plants in the country.

At this point it is easy to fall into the numbers game trap and, therefore, I offer a word of caution on the relative nature of

"efficiencies" we use in the district heating business. The 58% thermal efficiency achieved with the diesel cogeneration plant in Harrisburg should only be compared to a thermal efficiency measure used in connection with the production of electricity or the thermal efficiency of other cogeneration projects. Some outside this room might equate this efficiency measure with that of the boiler efficiency achieved by a gas fired boiler in a building you are trying to add to your district heating system. You can't! Since the heat rate achieved with our diesels will compete with that achievable by any large conventional fossil power plant, you can state unequivocally that all waste heat recovered by the cogeneration equipment and all the buildings that receive the heat from those BTU's, received this heat without burning any additional fuel and without any additional impact on the atmosphere whatsoever!

CONCLUSIONS

To summarize the Harrisburg cogeneration story, by adding a diesel fired cogeneration plant to the Harrisburg district heating loop, HSW has been able to offer existing and prospective customers of the downtown steam heating system a highly competitive form of energy which is locally produced and environmentally superior to other available alternatives. I believe there are other potential "Harrisburg's" out there, some with district heating loops, some who might be contemplating a district heating loop. Either way, by combining cogeneration with district heating, you just may be able to provide buildings in your downtown with a low cost district heating/cogeneration alternative and make a significant contribution towards a better environment at the same time.

EXHIBIT 1

HARRISBURG STEAM WORKS
PAXTON CREEK COGENERATION

AVERAGE ANNUAL ENERGY FLOW DIAGRAM

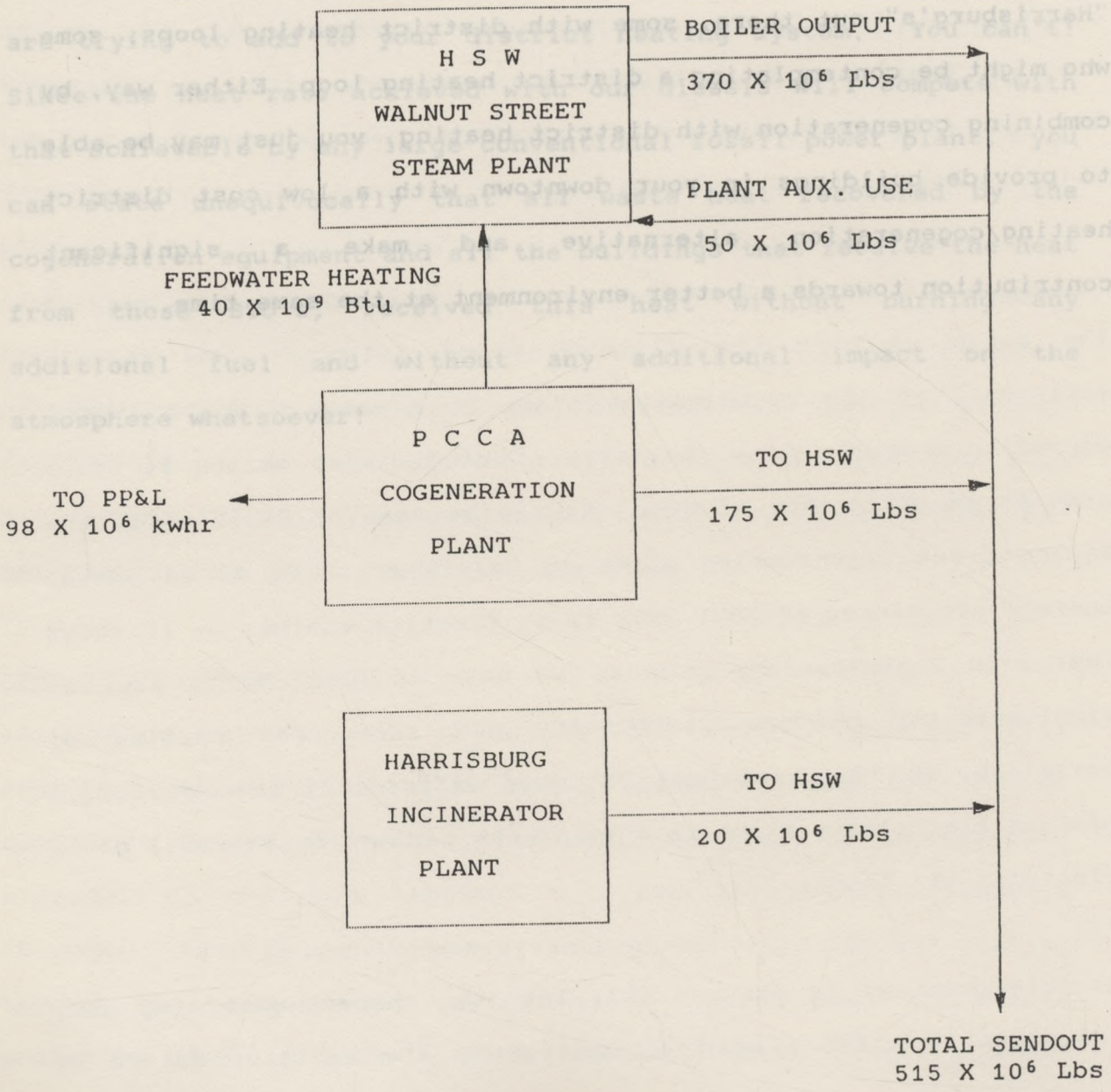

EXHIBIT 2

PROJECT RISK ASSESSMENT

TECHNOLOGICAL	SLOW SPEED DIESELS, PROVEN UNFIRED HEAT EXCHANGERS HIGH AVAILABILITY 90%
FUEL SUPPLY	CONTRACT NATURAL GAS INTERRUPTIBLE UGI GAS (BACKUP) #2 FUEL OIL, 1,000,000 GALLONS STORAGE (BACKUP)
MARKET	FIRM PURCHASE OF OUTPUT ENERGY ELECTRICITY STEAM
MANAGERIAL	ENGINEERING, CONSTRUCTION, MARKETING AND FINANCIAL BACKGROUND PPL TRANSITION STAFF
CONSTRUCTION	FIRM PRICE CONTRACT WITH PERFORMANCE BONDS AND CONTINGENCY RESERVES
OPERATING AND MAINTENANCE	VENDOR PROGRAMS TRAINING SPARE PARTS INSURANCE MAINTENANCE ALLOWANCES INSTRUMENTATION DEBT SERVICE RESERVE FUND

EXHIBIT 3

PAXTON CREEK COGENERATION ASSOCIATES

PROJECT TEAM

GENERAL PARTNER	HARRISBURG ENERGY COMPANY
INVESTMENT BANKER	BUTCHER & SINGER, INC.
BANK LOAN	PSFS
ACCOUNTING	LAVENTHOL & HORWATH
INDEPENDENT ENGINEER	BURNS AND ROE, INC.
CONSULTING ENGINEER	ENTECH ENGINEERING ASSOC./ TECHNICON ENTERPRISES
MAJOR EQUIPMENT VENDOR	COOPER ENERGY SERVICES
ENGINEERING & CONSTRUCTION	H. P. FOLEY/BRINJAC, KAMBIC & ASSOCIATES
GENERAL COUNSEL	KOZLOFF, DIENER, PAYNE & FEGLEY
TAX COUNSEL TO PARTNERSHIP	BASKIN & STEINGUT, P.C.
GAS SUPPLY	UGI CORPORATION MERIDIAN COLUMBIA GAS

EXHIBIT 4

PAXTON CREEK COGENERATION ASSOCIATES

CONTRACTS

GAS PURCHASE AGREEMENT (MERIDIAN EXPLORATION)

POWER PURCHASE CONTRACT (PP&L)

THERMAL ENERGY AGREEMENT (HSW)

SITE LEASE (HSW)

OPERATING AND MANAGEMENT SERVICES (HSW)

CONSTRUCTION CONTRACT (FOLEY)

EXHIBIT 5

HARRISBURG STEAM WORKS

CONTRACTS

PURCHASE AND SALES AGREEMENT (PP&L)

MANAGEMENT SERVICES AGREEMENT (PP&L)

COGENERATION OPERATING, AND SERVICE AGREEMENT (PCCA)

SITE LEASE (PCCA)

THERMAL ENERGY AGREEMENT (PCCA)

OFFICE LEASE (HEC)

EXHIBIT 6

ENERGY EFFICIENCY OF COGENERATION PLANT EXCEEDS ELECTRIC-ONLY POWER PLANT