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RESULTS OF SMALL GAS TURBINE FOR DISTRIBUTED GENERATION STRATEGIES WORKSHOP

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ABSTRACT

This paper summarizes the proceedings of the 1995 workshop in San Francisco, CA on "Small Gas Turbines for Distributed Generation" and the planned winter of 1996 follow-on workshop. The working definition for distributed generation used in the workshop was modular generation (generally 1-50 MW) in various applications located on electric customers sites or near load centers in an electric grid. The workshop was sponsored by the Electric Power Research Institute (EPRI), the Gas Research Institute (GRI), the U.S. Department of Energy (DOE) and Pacific Gas and Electric (PG&E). The objectives were to:

- review historical operating experience, market trends and the current state of the art of small gas turbine based options (1-50 MW size range);
- characterize benefits, motivations, application requirements and issues of small gas turbines in distributed generation strategies amongst "stakeholders";
- identify what further efforts, technology or otherwise, should be pursued to enhance future opportunities for small gas turbine "stakeholders"; and
- define "stakeholder" interest in future forums for coordination and discussion of improved distributed generation strategies based on small gas turbines.

The workshop was attended by over 42 electric or gas utilities, 12 independent power companies and a broad cross section of equipment suppliers, Architect and Engineers (A&E's), Research Development and Demonstration (RD&D) programs, government organizations, international utilities and other interested parties. The total workshop attendance was over 140. Small gas turbine technologies, user case histories, operating experiences, electric and gas system requirements, distributed generation economic theory, regulatory issues and general industry perspectives were reviewed. Industry input was gathered through a formal survey and four break-out sessions on future small gas turbine user needs, market requirements and potential hurdles for distributed generation.

Presentations by suppliers and users highlighted the significant commercial operating experience with small gas turbines in numerous electric utility and non-electric utility "distributed" generation applications. The primary feedback received was that there is significant and growing market interest in distributed generation strategies based on small gas turbines options. General consensus was that small gas turbine systems using natural gas would be the technology of choice in the United States for much of the near-term distributed generation market. Most participants felt that improved gas turbine technology, applications and distributed generation benefit economic evaluation models could significantly enhance the economics of distributed generation. Over 30 utility or other users expressed support for the formation of a small gas turbine interest group and an equal number expressed interest in hosting or participating in demonstration projects. A strong interest was indicated in the need for a follow-on workshop that would be more applications focused and provide a forum for coordinating research activities. Current plans by EPRI, GRI and DOE will be to include the follow-on as part of a planned workshop on "Flexible Gas Turbine Strategies" in the fall of 1996.

I. HISTORICAL MARKET PERSPECTIVE

In the 1960's, small gas turbines emerged after the New York black-out as a major option for retail customer emergency generation and utility peaking power. U.S. small gas turbines markets (<50 MW) grew rapidly in the 1980's as the result of PURPA, high utility retail rates in some areas and low cost natural gas resulting from deregulation of the gas industry. Most PURPA applications involved baseload cogeneration by non-utility generators, predominantly gas utilities seeking new gas markets and increased gas system utilization. Operational reliability of these cogeneration units has been high. The global market for small gas turbines in the early 1990's was over 6000 MW annually, or about 25% of the total market for gas turbines. About 88% of the small gas turbine market was in 5-50 MW size range. Reciprocating engines were generally thought to be competitive with

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small gas turbines for natural gas firm applications <5 MW (reciprocating engines are also competitive in larger isolated oil fired applications) and economically superior in applications <1 MW.

As the result of the Energy Policy Act of 1992, the U.S. electric industry is restructuring. Electric utilities, seeking to improve competitiveness, are now implementing or investigating commercial distributed generation strategies to lower the cost of traditional grid services and/or as the basis of improved customer service options. Presentations at the workshop by Florida Power Corporation, Sacramento Municipal Utility District and San Diego Gas and Electric highlighted these trends. Similar strategies of locating new utility generation at customer sites or near-by substations are also being pursued by many other utilities, e.g., Tucson Electric, Virginia Power, Georgia Power and Pacific Gas and Electric. Motivations presented for electric utility interest in distributed generation strategies include the low cost of natural gas, high costs of new electric transmission and distribution capacity, lower capital investment risks, and accelerating deregulation of wholesale markets. Other motivations include, increasing grid asset utilization, deferring grid upgrades, improving local reliability, customer retention, high retail electric rates, economic development and improving customer service. In the future, small gas turbines in distributed generation strategies could become the focal point for integrating various local energy services with merchant electric and gas wholesale services, further blurring the traditional boundaries between the electric and natural gas industries.

II. INVESTIGATIONS OF DISTRIBUTED GENERATIONS SYSTEMS BENEFITS

Investigations by national research organizations have been underway since the late 1980's on quantifying the electric system, gas system and customer service benefits of distributed generation. PURPA cogeneration units were generally not designed to optimize distributed benefits to the electric grid. Distributed benefits are not formally considered today in most selection processes for new generation.

Benefit assessment methodologies and modeling tools are being developed and tested to allow improved planning and development of future distributed generation strategies. Large numbers of electric and gas utilities are conducting R&D case study assessments and experiments of distributed generation on their system to better understand, quantify and validate distributed generation benefits on their specific systems. Particular interest exists in "niche" distribution substation and customer stand-by generation peaking applications that will result in significant near-term electric transmission and distribution cost savings. These methodologies, models, case study lessons learned and application RD&D offer the potential to significantly improve the economics of future distributed generation strategies based small gas turbines. Maximizing distributed benefits will require significant coordination between electric and gas system delivery planning (and operation) and gas turbine project siting, sizing and design considerations. These "system integration" functions could also offer a significant source of "value added" by the traditional electric and gas local distribution utilities to their mutual market benefit. Only limited coordination appears to have occurred to date between the "distributed benefit assessment" research community and the small gas turbine RD&D community.

III. TECHNOLOGY PERSPECTIVES

Small gas turbine products are available now from a diversity of suppliers which will meet the needs of those interested in near-term distributed generation strategies. Some small gas turbine technology characteristics could have increased value if distributed benefits are used in future project evaluations, e.g., on-peak power augmentation and portability. There is significant room for improvement in both small gas turbine technology and application which could further enhance the economics of distributed generation. Several lines of RD&D are being pursued to improve small gas turbines for distributed generation strategies. Application RD&D is being conducted on improving remote dispatch, reducing electric grid and gas system interconnection costs and reducing installation and operating costs. Low cost, ultra-low NOx control systems are a major area of current application RD&D by the national research community and gas turbine suppliers. Intercooled and recuperative gas turbine cycles could open up new intermediate load applications and improved cogeneration strategies. Fleet small gas turbine strategies are being discussed which could offer many economies of scale for reducing capital, O&M and natural gas costs. Gas turbine suppliers indicate that definition of "standard units" for standard applications by buyers could significantly lower the cost of small gas turbine units.

IV. POTENTIAL CONSTRAINTS AND ISSUES

Potential constraints and hurdles to the development of the distributed generation market for small gas turbines include:

1) Current market deferral of new generation by electric utilities because of regulatory uncertainties, market uncertainties and associated investment risks;

2) Environmental regulations (e.g., NOx controls and monitoring) and project development regulatory costs (e.g., siting and permitting) can impose significant overhead burdens in small projects;

3) Lack of definition of industry standards for distributed gas turbine applications and low order volumes drive up capital costs for small gas turbine equipment;

4) Lack of adequate "tools" for quantifying distributed generation benefits and costs in planned projects and monitoring how these benefits and costs may change over time;

5) Lack of funding for small gas turbine technology and application RD&D needed to provide adequate basis for inclusion in business plans by users; and

6) Distributed benefits may be even more difficult to quantify and be fully realized in restructured and competitive electric markets.

V. BREAK-OUT SESSION AND SURVEY RESULTS

The feedback received indicated the workshop met a significant need as a forum for diverse electric and gas market "stakeholders" to discuss small gas turbines and distributed generation strategies. A strong interest was expressed by the participants in further information exchanges on the subject between the electric and gas industries, the small gas turbine manufacturers and international research organizations. Over 30 utility or other users expressed support for the formation of a small gas turbine interest group and an equal number expressed interest in hosting or participating in a demonstration project. Applications presented described a wide range of unit sizes and business strategies with interest varying significantly between:

1) electric and gas utilities, large and small electric utilities, marketing/distribution and supply sides of utilities, domestic and international markets, and natural gas pipeline and local distribution companies; and

2) regions of the country with or without substantial low cost gas supplies, with high or low retail rates, with strong or weak pressures for deregulation and with or without needs for new capacity in the near-term.

VI. NEXT STEPS

EPRI, GRI and DOE will conduct a series of workshops on future gas turbine markets, products and RD&D needs in 1996. The series willserve as an input into the DOE Advanced Turbine Systems (ATS) Program. The recommendations of the workshop series will be presented at the DOE ATS Review in October of 1996 in Washington. The follow-on to the Small Gas Turbine for Distributed Generation Workshop will be included in a workshop tentatively titled "Flexible Gas Turbine Strategies" being planned for September of 1996. In addition to small gas turbines for distributed generation, the workshop will address intermediate load, portability, on-peak power augmentation and other related subjects. Parties interested in obtaining the full proceedings of the Small Gas Turbine for Distributed Generation Workshop, should contact one of the authors.