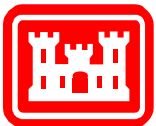


Nat. Gas Engine-Driven Air Compressor (NGEDAC) Technology Demonstration

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US Army Corps
of Engineers

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Natural Gas Engine-Driven (NGED) Air Compressor Technology

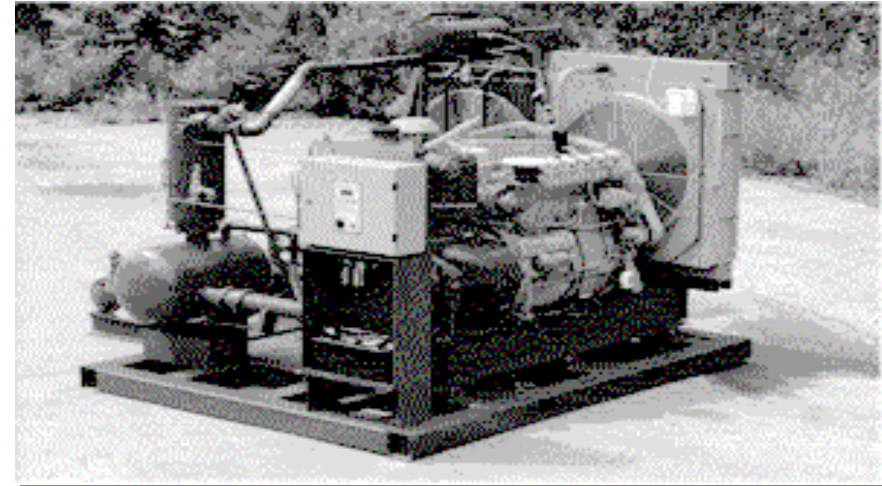
- Capital cost is higher than electric systems
- Engines require more scheduled maintenance
- Costs can be offset by:
 - Difference in prevailing utility rates
 - Efficiency at part-load operation
 - Reduction in peak demand charges
- Optional heat recovery (up to 30% total energy recovered) improves economics
- Engine-driven system sales are up 30 percent since 1994, and user interest continues to grow.



NGED Air Compressors

Market Assessment

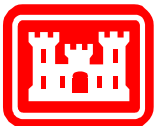
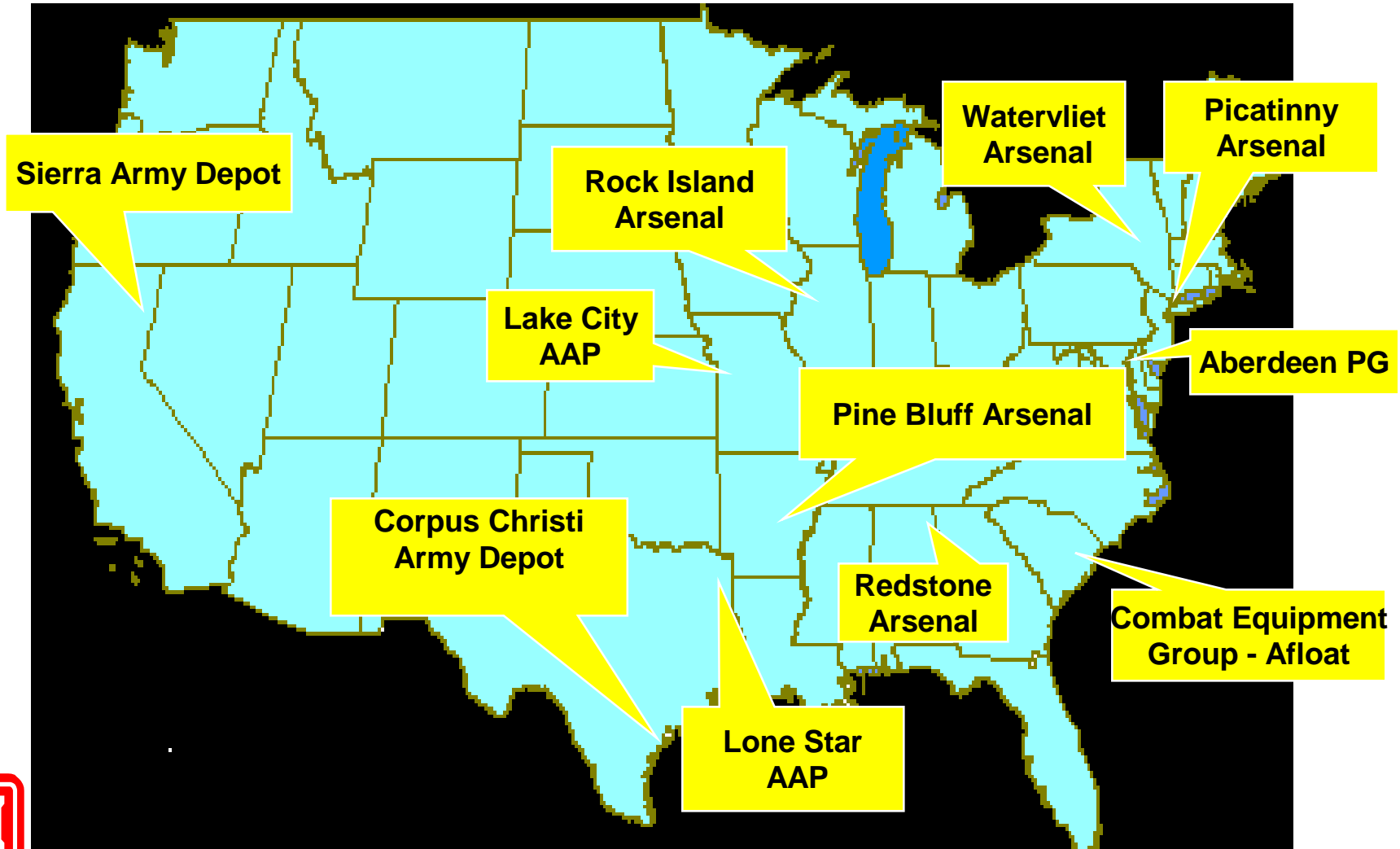
| | Hurdle Rate <u>cents/kWhr</u> |
|--------------|----------------------------------|
| One shift | 11 to 12 |
| Two shifts | 8 to 9 |
| Three shifts | 6 to 7 |



Heat recovery reduces hurdle by \$0.01/kWhr
Nat. Gas at \$4.00/Mcf

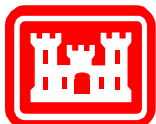


NGEDAC Demo Sites Evaluation



Comparison of Gas and Electric Powered Air Compressor

| Base | Gas | Elec. | Operating | Years | % Cost |
|--------------------|--------------------------------------|---------------------------|-----------|---------|-----------|
| Name | \$/MBtu | ¢/kWH | Hours | Payback | Reduction |
| PICA | 3.41 | 8.36 | 8760 | 4.3 | 30 |
| WVA | 4.21 | 8.31 | 8760 | 5.9 | 22 |
| SIAD | 2.80 | 8.80 | 3627 | 7.7 | 38 |
| PBA | 2.81 | 5.70 | 8760 | 12.4 | 14 |
| LSAAP | 3.00 | 4.90 | 8760 | 143 | 1.3 |
| CCAD | 3.71 | 5.60 | 8760 | 160 | 1 |
| ANAD | 3.77 | 4.04 | 6100 | +.99999 | -25 |
| | | | | | |
| Assumption: | Maintenance Cost | Capital Cost Delta | | | |
| | Elec. \$1.35/Hr | Gas Vs. Elec. | | | |
| | Gas \$2.5/Hr | | \$75K | | |
| | Using typical load and power profile | | | | |



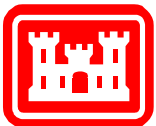
Technology Demonstration Objectives

- Cover wide range, e.g. compressor size, heat recovery, gas/elec. hybrid system, etc.
- Verify system performance, reliability and cost effectiveness
- Reduce CA costs by supply side and demand side management
- Minimize installation problems
- Minimize waste and emissions
- Optimize fuel mix
- Reduce O&M costs



NGEDAC Application Issues

- Environmental permitting
- Exhaust location/design
- Cooling tower capacity for waste heat
- Proper commissioning is critical
- Noise attenuation
- Adequate engine cooling ventilation
- Adequate combustion air supply
- Controls integration
- Increased maintenance



Nat. Gas Engine-Driven Air Compressor (NGEDAC) Technology Demonstration

- Complete 11 Site Visits – SIAD, PICA, WVA, PBA, CCAD, CEGA, LSAAP, RIA, LCAAP, RSA, and APG
 - Selected 3 Demo Sites: PICA in NJ, WVA in NY, **SIAD in CA MO**
 - Complete Conceptual Design for PICA & WVA
 - 2 Rotary Screw NGEDAC Ordered
 - GRS-125LA (630scfm/100psig/116bhp/0.98MBtu/hr) for PICA, located in power house Bldg. 506 (est. cost \$187k installed)
 - GRS-300LW (1400scfm/100psig/362bhp/2.68MBtu/hr) for WVA, located outside Bldg. 110 (est. cost \$372k installed)
- Expect to complete 3 demos in 2001



Site Assessment for NGEDAC Demo

CA Energy Cost Reduction:

%cost reduction

- **PICA** \$125k –p- \$100k –d- \$58k –g- \$26k 79
- **WVA** \$306k –s- \$277k –d- \$177k –g- \$125k 59
- **PBA** \$186k –d- \$116k –g- \$100k 46
- **CEGA** \$15k –g- \$15k 0
- **CCAD** \$126k –d- \$85k –g- \$80k –h- \$60k 52
- **SIAD** \$32K –d- \$18k –g- \$12k 62
- Incremental NGEDAC maintenance costs not included

Note:

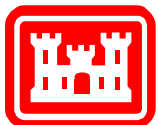
p - system pressure reduction

d – demand side management (leak repair, etc.)

g – switch to NGEDAC

s – use small compressors

h – heat recovery



Technology Transfer Mechanism

- Industrial Center: Compressed Air Consortium
 - Web site development
 - CA training
- Coordinating with AFMC and NFESC
- DOE: Compressed Air Challenge
- TM/CEGS Updates

