Liquefied Natural Gas Conversion Systems
for Plant Startup and Shutdown
and Natural Gas Curtailment at CT Stations

Experience the Power of Partnership
EAPC Industrial Services and North Dakota LNG have partnered to provide liquefied natural gas startup conversion systems to displace fuel oil.
EAPC INDUSTRIAL SERVICES
ENGINEERING FOR HEAVY INDUSTRY

EAPC Industrial Services is a multi-disciplinary consulting firm with offices in Grand Forks, Fargo, Bismarck, Minot, and Williston, ND; Sioux Falls, SD; Bemidji and St. Paul, MN; and Fort Collins, CO.

EAPC has performed hundreds of power generation projects for multiple clients throughout the upper Midwest.

ISO 9001:2008 CERTIFICATION
EAPC expects to complete this ISO Certification by end of Q1 2016 which will formalize our culture of constant improvement and quality in our project management and execution process.

HSE QUALIFICATIONS
EAPC is certified under ISNetworld (ISN# 400-217037)
NCMS NON-DOT Qualified

EAPC has 145+ employees providing services in the following areas:
Engineering: Chemical, Mechanical, Electrical, Civil, Structural
Architecture
Procurement
Construction Management
Maintenance Planning
Forensics
Wind Energy Consulting
Business Excellence: LEAN Methodologies, Leadership Training
NORTH DAKOTA LNG
THE PREMIERE UPPER MIDWEST LNG PRODUCER

North Dakota LNG is part of Prairie Companies, a portfolio of growth-oriented businesses that support the energy industry in North Dakota. A pioneer in liquefied natural gas (LNG) production, North Dakota LNG provides turn-key alternative fuel solutions for customers at any point in the LNG logistics supply chain, resulting in lower costs, and reduced emissions and environmental impact.

CORE OPERATIONS
North Dakota LNG is a two-phase liquefied natural gas (LNG) production plant that can produce more than 70,000 gallons per day.

SAFETY FIRST, ALWAYS
Like other Prairie Companies operations, safety is the number one priority for North Dakota LNG. Strict safety and operating procedures guide the operation.

LNG APPLICATIONS
Potential LNG power generation industry applications include boiler startups and shutdowns, heating boiler operations, backup generator operations, and combustion turbine backup fuel supply.

ENVIRONMENTALLY FRIENDLY
Natural gas is the cleanest fossil fuel and supports the country’s drive for clean energy. There is an abundant supply due to horizontal drilling and fracturing.

TRANSPORTATION & LOGISTIC SERVICES
Together with Prairie Field Services, a sister transportation company, we monitor your fuel to ensure we are always meeting your on site requirements and dispatch as needed.
ENGINEERING THE CONVERSION

UTILIZING LNG OR NG TO REPLACE FUEL OIL FOR PLANT STARTUPS

New EPA MATS Rule: Startup Definitions

This requires all back-end emission control systems to be in service at the end of the startup period. (Baghouse, Scrubbers, ESPs)

1. Startup ends 4 hours after the generation of electricity begins to the grid or station service
2. Startup ends within 1 hour of coal being fired in the boiler

These new MATS rules limit the ability of some power plants to meet the new startup guidelines without causing damage to the back-end emission control systems.

EAPC has completed fuel oil to natural gas conversions for boiler startups on two 450 MW units.

Since most power plants do not have a reliable source of natural gas within a close proximity, LNG is a great solution to replace the current fuel oil systems used for startups and shutdowns as well as for natural gas curtailment issues at combustion turbine facilities.
This West Virginia coal fired power plant experienced continued curtailment issues during startups. They installed a mobile LNG system consisting of 18 LNG trailers and 3 gas fired vaporizers. This system supplied 450,000 SCFH required for startup.

EAPC Industrial Services provided engineering and design services at Basin Electric Power Cooperative’s Antelope Valley Station to convert two 450 MW units from fuel oil to natural gas for boiler startups.

NEW SYSTEM REQUIREMENTS
• New natural gas vertical manifolds in all four corners of the boiler
• Associated supply piping, control valves, isolation valves, venting system
• 4 new burners and 32 igniters with associated control system
• Electrical area classification evaluation

CASE IN POINT
EXAMPLES OF LNG AND NATURAL GAS USED FOR STARTUPS AND SHUTDOWNS IN THE POWER GENERATION INDUSTRY
CONVERSION ADVANTAGES

REDUCED ENVIRONMENTAL IMPACT
LNG vs. Fuel Oil

<table>
<thead>
<tr>
<th></th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td>20-30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td></td>
<td></td>
<td>Up to 75%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOx</td>
<td></td>
<td></td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHG's</td>
<td></td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOC's</td>
<td></td>
<td></td>
<td>55%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>Ground Water Contamination Risk = 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OPERATIONAL RELIABILITY
Igniters and warm-up guns start immediately. No issues with flame outs or plugged tips. Positive ignition and light-off every time.
Boiler startups and unit tie-on meet pre-arranged schedules with system dispatch or designated ISO or RTO for your area.
Master boiler trips can be avoided during unit upsets.
LNG can be utilized to supplement fuel demands when coal quality becomes an issue without having to reduce load.
Downstream emissions control systems “Baghouse” can be put in service immediately and warm-up slowly throughout startup without any impact to the bags.

REDUCED O&M
Pump and relief valve repairs
OT for E&I throughout startup to deal with scanner issues
Fuel oil tank cleaning due to decomposition and algae
Fuel oil spill cleanup
Scanner replacement and/or rebuilds
Oil ring replacement
Potential air heater fires

REDUCED COSTS
30-40% reduction on startup costs compared to fuel oil
Lost production due to extending startups related to fuel oil firing issues
O&M costs related to fuel oil handling and firing for startups
Lost production due to coal quality issues
## THE NEED TO KNOW
### DESIGN CONSIDERATIONS

### GAS CONSUMPTION
- Average Flow Rate (SCFH)
- Hours/Day Operation
- Peak Flow Rate (SCFH)
- Peak Duration/Duration Frequency

### DAYS/HOURS STORAGE REQUIRED

### OUTLET GAS PRIORITIES
- Max/Min Pressure
- Max/Min Temperature

### ENVIRONMENT
- Temperature
- Humidity
- Wind
- Earthquake Zone

### AVAILABILITY OF ON-SITE ENERGY
- Steam
- Hot Water
- Electrical

### HORIZONTAL VS VERTICAL TANKS

### PROPERTY SETBACKS

### LEVEL OF AUTOMATION

### ODORIZATION

### SAFETY SYSTEMS

### NUMBER OF UNITS

### BOILER SIZE IN MW

### NUMBER OF BURNERS AND IGNITERS PER BOILER

### AREA CLASSIFICATION ASSESSMENT
THE POWER OF PARTNERSHIP

The EAPC and North Dakota LNG partnership brings together a seasoned engineering firm with over 15 years of experience working with power generation clients throughout the upper Midwest and a large scale LNG producer with industry expertise, production facilities, and transportation infrastructure.

This partnership provides power generation companies a proven option for boiler startups.

An LNG system can match or exceed current fuel oil startup system capacities while eliminating EPA MATS startup limitations and O&M issues related to fuel oil used for startups.

These same LNG systems can also be a great option for natural gas fired generating stations. Many combustion turbine facilities experience curtailment issues. An LNG backup system would provide a seamless transition while eliminating the environmental and O&M issues related to using fuel oil as backup.
3100 DeMers Avenue
Grand Forks, ND 58201
701.775.3000
www.eapc.net
Paul Prout PE, Vice President
701.775.3009
paul.prout@eapc.net
Bruce Ogden, Director of Business Development
701.460.7218
bruce.ogden@eapc.net

10387 68th Street NW
Tioga, ND 58852
701.609.1196
www.northdakotalng.com
Amber Kinney, Director of Business Development
303.304.4724
akinney@northdakotalng.com