



# NDCEE

National Defense Center for Energy and Environment



**DoD Executive Agent**

Office of the  
Assistant Secretary  
of the Army  
(Installations and  
Environment)

## Geothermal Energy Demonstration at Fort Indiantown Gap

Michelle Golesich, NDCEE/CTC  
Heidi Kaltenhauser, NDCEE/CTC

The NDCEE is operated by:  *Concurrent Technologies Corporation*

**Technology Transition – Supporting DoD Readiness, Sustainability, and the Warfighter**

## Report Documentation Page

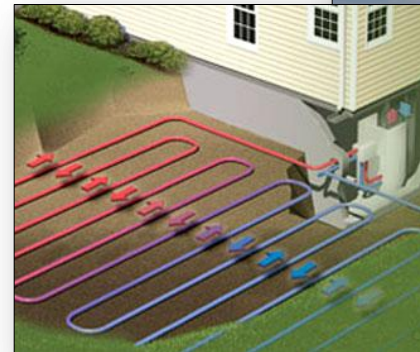
*Form Approved*  
*OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>JUN 2010</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2010 to 00-00-2010</b>	
4. TITLE AND SUBTITLE <b>Geothermal Energy Demonstration at Fort Indiantown Gap</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>National Defense Center for Energy and Environment (NDCEE), Concurrent Technologies Corporation, 100 CTC Drive, Johnstown, PA, 15904</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>Presented at the NDIA Environment, Energy Security &amp; Sustainability (E2S2) Symposium &amp; Exhibition held 14-17 June 2010 in Denver, CO. U.S. Government or Federal Rights License</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

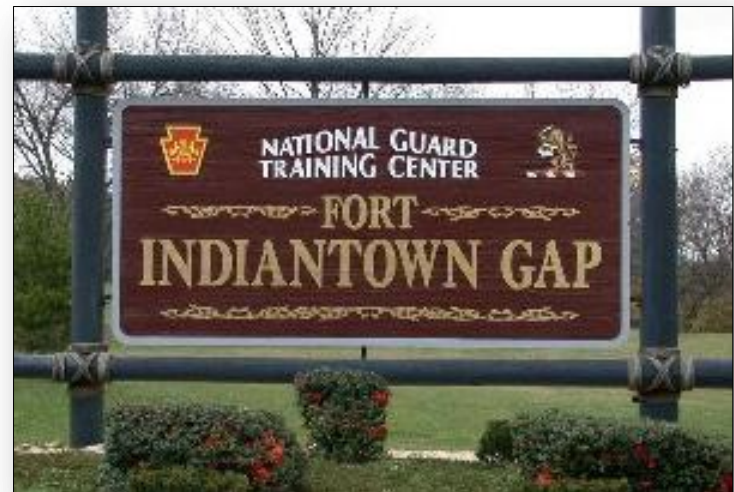
# National Guard Energy Awareness

- Pennsylvania National Guard (PANG) is seeking to:
  - Reduce energy consumption
  - Reduce use of fossil fuels
  - Become energy independent
  - Increase use of sustainable energy technology
- Challenges faced by PANG include:
  - Higher energy costs as a result of price rate increases
  - Outdated facilities, 50+ years
  - Lack of funding for repairs and renovations.



# Demonstration Site

- Fort Indiantown Gap (FTIG) was chosen as the location for an alternative energy technology demonstration.
  - Largest PANG installation
  - 17,000 acres and 140 training areas and facilities
  - Provides year-round training for military forces, law enforcement agents, and civilians



# Demonstration Site (continued)

- Selected buildings 4-201 & 4-202 for demonstration
  - 4-201 selected for geothermal installation
  - 4-202 selected for energy consumption baseline comparison



- Identical design/construction – provides good energy comparison
- Open floor plan – each is approximately 4,890 square feet in size
- Recently constructed – May 2008
- Features updated energy-efficient fixtures – programmable thermostats
- Used for Soldier Readiness Processing (SRP) by units departing and returning from military deployments

# Technology Assessment

- Conducted technology assessment in October 2008.
- Identified alternative technology options.

<i>Technology</i>	<i>System Description</i>	<i>Rate</i>	<i>Payback (yrs)</i>	<i>30-Year NPV</i>
Photovoltaic	5-kW Regular System	DOE Projected Fuel Price Indices for Propane	>30	(\$68,455)
		End of Rate Cap (Conservative Estimate)	>30	(\$64,820)
		End of Rate Cap (Aggressive Estimate)	>30	(\$60,325)
Concentrator Photovoltaic	25-kW Concentrator System	DOE Projected Fuel Price Indices for Propane	>30	(\$246,390)
		End of Rate Cap (Conservative Estimate)	>30	(\$222,380)
		End of Rate Cap (Aggressive Estimate)	>30	(\$192,691)
Wind Turbine	5-kW System	DOE Projected Fuel Price Indices for Propane	>30	(\$88,329)
		End of Rate Cap (Conservative Estimate)	>30	(\$83,660)
		End of Rate Cap (Aggressive Estimate)	>30	(\$77,886)
Geothermal	8-ton System	DOE Projected Fuel Price Indices for Propane	11	\$44,707
		End of Rate Cap (Conservative Estimate)	13	\$30,485
		End of Rate Cap (Aggressive Estimate)	16	\$12,899
Fuel Cell	5-kW System	DOE Projected Fuel Price Indices for Propane	>30	(\$130,540)
		End of Rate Cap (Conservative Estimate)	>30	(\$104,391)
		End of Rate Cap (Aggressive Estimate)	>30	(\$72,058)

**Lowest Payback for Rate**

**Highest NPV for Rate**

Calculations do not include cost of natural gas. Full calculations were not conducted due to 5-yr life expectancy of equipment.

# Geothermal Heat Pump System

- Recommended geothermal heat pump system as the most economically viable system
  - Selected closed loop vertical well system
  - Takes advantage of seasonal temperature differences between air and ground temperature
  - Moves heat from ground to building in winter and from building to ground in summer

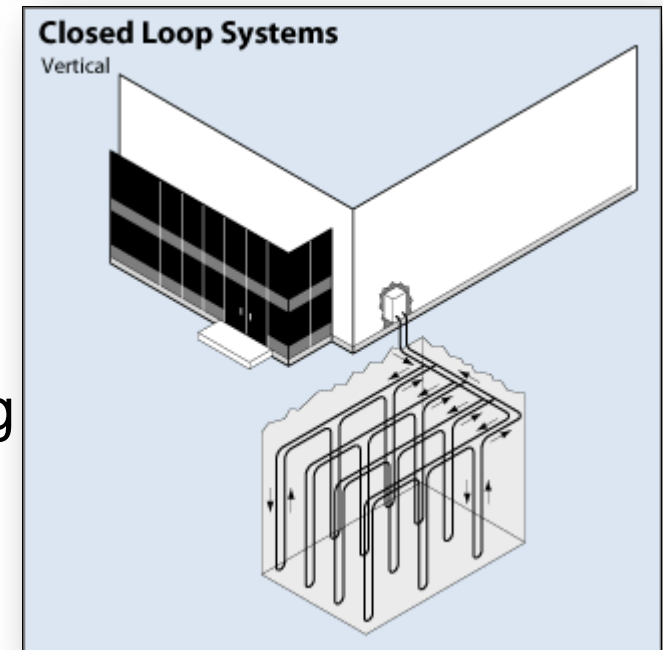


Diagram courtesy of EERE.

# Demonstration Goals

- Evaluate life-cycle cost of ground-source heat pump heating/cooling systems
  - Determine savings from reduced propane usage
- Evaluate environmental benefits of ground-source heat pump system compared to propane gas heating and electric air cooling system



# Well Drilling

- Installed 8-ton geothermal system outside of building 4-201 in April 2009



- Installation included the drilling of 6 wells at an average depth of 220 ft and piping connected to building 4-201.

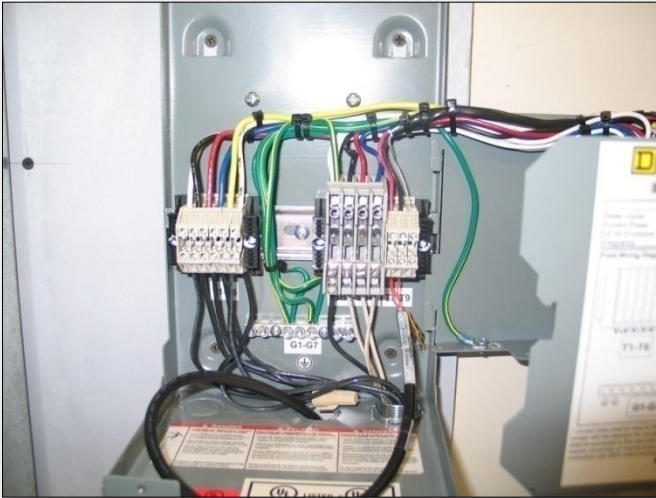
# Heat Pump Installation



- Heat pump system replaced the conventional HVAC system.
- Propane backup heater was kept in building 4-201 for use during geothermal startup.

# System Commissioning

- Entire system was commissioned in July 2009.

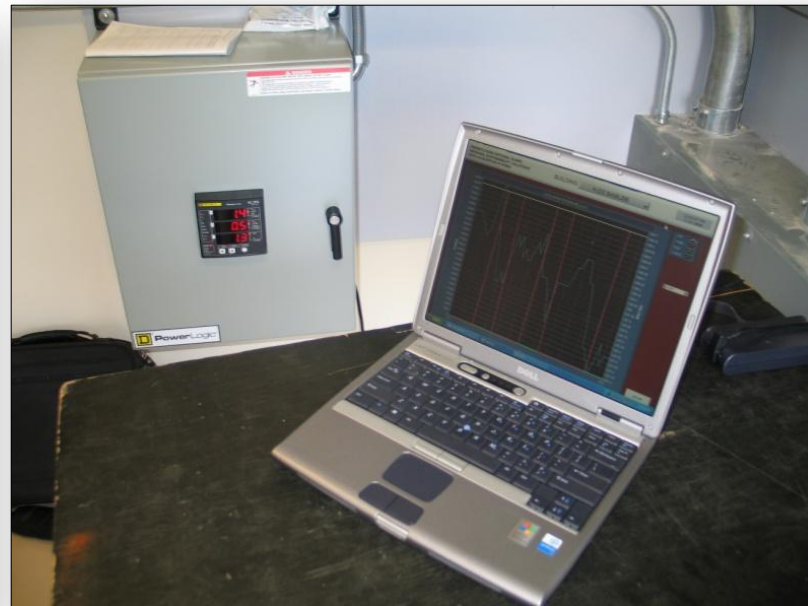


- Duct work was evaluated for proper air flow.
- Electrical panels were configured for metering/monitoring.



# Data Collection

- Data collecting software was installed on laptops placed at each location.
  - Laptops are collecting electrical information from the electrical panels in each building.

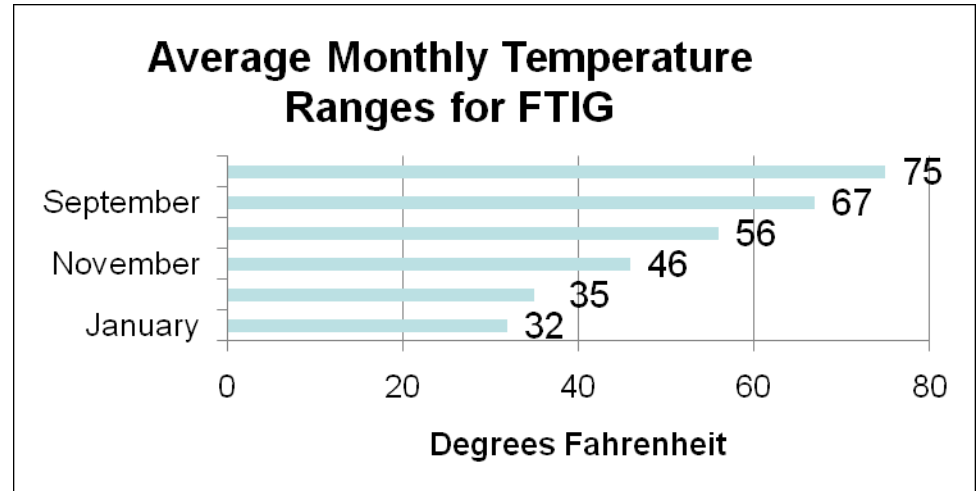


# Data Collection (continued)

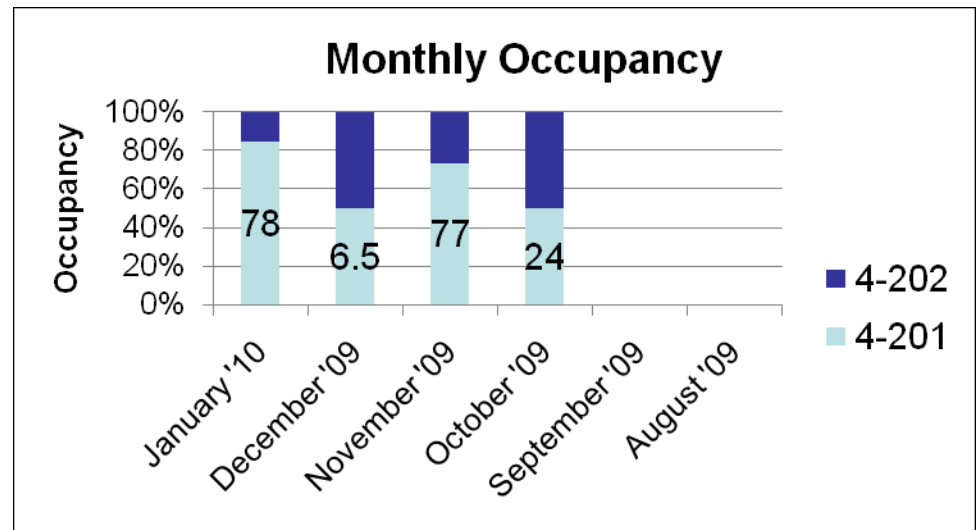
- Electrical data will record:
  - Voltage
  - Current
  - Kilowatt.
- Additional collected information includes:
  - Occupancy schedules of buildings
  - Weather/temperature information of FTIG.

# Current Results

Average monthly temperatures at FTIG:



Average occupancy of Buildings 4-201 and 4-202:



## Current Results (continued)



*As of December 2009, PANG saved over 600 gallons of propane by using the geothermal heat pump system.*

- The propane savings is even greater considering the extensive use of building 4-201 compared to 4-202.
- A more accurate volume of propane usage will be calculated at the end of the technology demonstration.

# Conclusions

- Electrical data is being collected monthly through August 2010.
- Period of performance was extended so that one full year of data could be gathered.
  - A full year of monitoring provides both summer and winter data – seasons when the geothermal heat pump will be heavily utilized.
- Upon completion of demonstration:
  - Collected data will be analyzed
  - Cost benefit analysis will be developed.
- Demonstration findings will be used by PANG and other National Guard entities to determine the feasibility of implementing the technology regionally.

# Path Forward

- Follow-on geothermal project has started at FTIG
- Include design of 3<sup>rd</sup> building similar in design to buildings 4-201 and 4-202
  - LEED Silver Certified
  - Energy efficient features
  - Installation of geothermal heat pump system
- Will use 4-201 and 4-202 as baseline comparisons
  - 4-201 – baseline
  - 4-202 – with geothermal
  - 3<sup>rd</sup> building – LEED with geothermal



Image courtesy of USGBC.



National Defense Center for  
Energy and Environment



### DoD Executive Agent

Office of the  
Assistant Secretary  
of the Army  
(Installations and  
Environment)

[www.ndcee.ctc.com](http://www.ndcee.ctc.com)

# Points of Contact

**Ms. Michelle Golesich**  
**NDCEE/CTC**

[golesicm@ctc.com](mailto:golesicm@ctc.com)

**(814) 269-2676**

**Mr. Monsoor Rashid**  
**National Guard Bureau**

[monsoor.rashid@us.army.mil](mailto:monsoor.rashid@us.army.mil)

**(703) 607-7976**

**Mr. Ray Hulings**  
**PANG**

[rhulings@state.pa.us](mailto:rhulings@state.pa.us)

**(717) 861-2158**

*This work was funded through the Office of the Assistant Secretary of the Army (Installations and Environment) and conducted under contract W74V8H-04-D-0005 Task 0501. The views, opinions, and/or findings contained in this paper are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other official documentation.*