# NEPA COMPLIANCE SURVEY
# # 240

| Project Information | | | |
|---|---|---|---|
| **Project Title:** | WisperGen Sterling Generator | **Date:** | 09-30-09 |
| **DOE Code:** | | **Contractor Code:** | |
| **Project Lead:** | Joe Rochelle | | |

| **Project Overview** | |
|---|---|
| 1. What are the environmental impacts?<br>2. What is the legal location?<br>3. What is the duration of the project?<br>4. What major equipment will be used if any (work over rig, drilling rig, etc.)? | The producing well for the test will be 58-S-10 located in the SWSE Section I0-T38N-R78W. The well was drilled in 1994 to a depth of2184'to test the iobrara and Steele shale. The well was plugged back and completed in the Shannon formation from 360' to 464'. The well has 7" casing set at 530'. The well is produced with a National 25 pumping unit. The pumping unit currently has a 3 horsepower motor. The motor will be replaced with a 1.5 horsepower; motor with the following information: 1160 rpm, insulation F, volts 208/230/460, amps 4.8, 4.9, 2.45 , service factor 1.15, and continuous rated motor. The well is produced with a time clock and comes on at 12:00 noon and offat2:00 PM.<br>The gas supply for the project will come from the casing on 58-MX-10.<br>The Wispergenerator will be located 100' from 58-S-1 0 and 100' from 58-MX-1 O. An umbilical gas supply line will be installed from 58-MX-I 0 a distance of 100' to the generator. The generator will use approximately I mcf per day. An SO electrical line will be installed from the generator to 58-S- 1O. Since the test is expected to last for one year, the gas line will be buried. The SO electrical line will be protected and flagged |

**The table below is to be completed by the Project Lead and reviewed by the Environmental Specialist and the DOE NEPA Compliance Officer. NOTE: If Change of Scope occurs, Project Lead must submit a new NEPA Compliance Survey and contact the Technical Assurance Department.**

| | Impacts Anticipated? | | | If YES, then complete below |
|---|---|---|---|---|
| **Water Quality** | **Yes** | **No** | **NA** | **If the anticipated impact might be unacceptable, recommend mitigation measures:** |
| **Does the proposed project present potential for impacts on water resources or water quality?** | ☐ | ☒ | ☐ | |
| **Does the project affect surface water quantity or quality under both normal operations and accident conditions?** | ☐ | ☒ | ☐ | |
| **Does the proposed project affect groundwater quantity or quality under both normal operations and accident conditions?** | ☐ | ☒ | ☐ | |
| **Will the project area include "Waters of the State?"** | ☐ | ☒ | ☐ | |
| **Will the project area require a Corps of Engineers permit?** | ☐ | ☒ | ☐ | |

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| | Impacts Anticipated? | | | If YES, then complete below. |
|---|---|---|---|---|
| **Geology & Soils** | **Yes** | **No** | **NA** | **If the anticipated impact might be unacceptable, recommend mitigation measures:** |
| **Does the proposed project present potential for impacts related to geology or soils?** | ☐ | ☒ | ☐ | Best Commercial Practices will be used to prevent erosion on location |
| **Does the proposed project alter, excavate or otherwise disturb land area consistent with other land use and habitat area?** | ☐ | ☒ | ☐ | |
| **Is the proposed project likely to impact local seismicity?** | ☐ | ☒ | ☐ | |
| **If the project involved disturbance of surface soils, are erosion and storm water control measures addressed?** | ☐ | ☒ | ☐ | |
| **Air Quality** | **Yes** | **No** | **NA** | **If the anticipated impact might be unacceptable, recommend mitigation measures:** |
| **Does the proposed action present potential for impacts on ambient air quality under both normal and accident conditions?** | ☐ | ☒ | ☐ | |
| **Are potential emissions (gases and/or airborne particulates including dust) outside of the normal scope for oil field operations?** | ☐ | ☒ | ☐ | |
| **Does the project present risk to human health and the environment from exposure to radiation and hazardous chemicals in emissions?** | ☐ | ☒ | ☐ | |
| **Is the project subject to New Source Performance Standards?** | ☐ | ☒ | ☐ | |
| **Is the project subject to National Emissions Standards for Hazardous Air Pollutants?** | ☐ | ☒ | ☐ | NOx emissions were reviewed by DEQ on first test with wispergen system. |
| **Is the project subject to emissions limitations in an Air Quality Control Region?** | ☐ | ☒ | ☐ | |

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| | Impacts Anticipated? | | | If YES, then complete below. |
|---|---|---|---|---|
| **Wildlife and Habitat** | **Yes** | **No** | **NA** | **If the anticipated impact might be unacceptable, recommend mitigation measures:** |
| **Does the proposed action present potential for impacts on wildlife or habitat?** | ☐ | ☒ | ☐ | |
| **Does the project impact state or federally listed threatened and endangered species?** | ☐ | ☒ | ☐ | |
| **Human Health Effects** | **Yes** | **No** | **NA** | **If the anticipated impact might be unacceptable, recommend mitigation measures:** |
| **Does the proposed project present potential for effects on human health?**<br>**e.g.: Hanta virus, radiological exposure, or chemical exposure (must provide MSDS)** | ☐ | ☒ | ☐ | |
| **Transportation** | **Yes** | **No** | **NA** | **If the anticipated impact might be unacceptable, recommend mitigation measures:** |
| **Does the proposed project involve transportation of radiological sources or hazardous materials (including explosives)?** | ☐ | ☒ | ☐ | |
| **Waste Management and Waste Minimization** | **Yes** | **No** | **NA** | **If the anticipated impact might be unacceptable, recommend mitigation measures:** |
| **Are pollution prevention and waste minimization practices needed in the proposed project?** | ☒ | ☐ | ☐ | Best Management Practices will be followed to prevent erosion. |
| **Does project plan establish procedures in compliance with local, state and/or federal laws and guidelines affecting the generation, transportation, treatment, storage or disposal of hazardous and other wastes?** | ☒ | ☐ | ☐ | A JSA was performed prior to beginning of the work each day. SOPs were reviewed for compliance to state and local regulations. |

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| | Impacts Anticipated? | | | If YES, then complete below. |
|---|---|---|---|---|
| **Cultural Impact** | **Yes** | **No** | **NA** | **If the anticipated impact might be unacceptable, recommend mitigation measures:** |
| **Is there potential for impact on cultural (historic) resources?** | ☐ | ☒ | ☐ | This area was reviewed by an archeologist |
| **Community Impact** | **Yes** | **No** | **NA** | **If the anticipated impact might be unacceptable, recommend mitigation measures:** |
| **Will the proposed project introduce significantly adverse auditory, visual, or other impact?** | ☐ | ☒ | ☐ | |
| **Will the proposed project adversely affect the community's use of public land/resources?** | ☐ | ☒ | ☐ | |
| **Will the proposed project adversely affect the community's access to private land?** | ☐ | ☒ | ☐ | |

**NOTE: Topography Map and Wetlands Map are required to be attached. Attach applicable SOPs for Risk Assessment Level 2 & 3 and specific test procedures.**

| | | |
|---|---|---|
| **Are permits required? If YES, list below:** | **Yes** ☐ | **No** ☒ |
| | | |

**Section below to be reviewed by Environmental Specialist and DOE NCO.**

| **Adequate Mitigation Measures Provided?** | | | | **Adequate Mitigation Measures Provided?** | |
|---|---|---|---|---|---|
| | Yes | No | | Yes | No |
| Water Quality Impacts | ☒ | ☐ | Transportation Impacts | ☒ | ☐ |
| Air Quality Impacts | ☒ | ☐ | Waste Management Impacts | ☒ | ☐ |
| 'Wildlife and Habitat Impacts | ☒ | ☐ | Cultural Impacts | ☒ | ☐ |
| Geology and Soils Impacts | ☒ | ☐ | Community Impact | ☒ | ☐ |
| Human Health Impacts | ☒ | ☐ | **Categorical Exclusion** | ☒ | ☐ |

**Approvals**

| | | |
|---|---|---|
| **Comments and Conditions:** | The final SWEA (EA 1584) is hereby incorporated by reference and on this basis the following CX complies to the criteria: This project is a continuation of an existing testing program and referenced on NEPA Compliance form #211. B3.7 Siting, construction and operation of a new infill exploratory and experimental (test) oil, gas, and geothermal well, which are to be drillewd in geological formations that have existing operating wells. B5.2 Modifications to oil, gas, and geothermal facility pump and piping configurations, manifolds, metering systems, and other instrumentation that would not change design process flow rates or affect permitted air emissions. | |
| **Contractor ESS&H** | S. Shire [signature] | Date 10-2-09 |
| **Comments and Conditions:** | Based on my review of information conveyed to me and in my possession (or attached) concerning the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1A), I have determined that the proposed action fits within the specified class of actions, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review. | |
| **DOE NEPA Compliance Officer** | Michael G Taylor CXS B3.7 + B5.2 | Date 10/2/09 |



Revised on: 11/12/2008

**Artificial Lift: Stirling-cycle generators in production operations**

***Technology first developed in 1816 is employed as a highly effective solution for well-pumping and other power requirements in remote well locations.***

Article By Bryan Dotson, BP America Production Co.; and Loren Madden, Whisper Tech Ltd.

Published Aug 1, 2008

Higher oil and gas prices, along with environmental concerns, have increased the incentive to use electric-driven equipment at producing wells. In many cases, wells are located far from a traditional electric utility, and a remote power source is required. There is a growing demand for electric power sources in the range of 1/2 to 1.5 kW to run a variety of systems including well pumping, chemical injection, cathodic protection, and telemetry. These applications demand a reliable and economic power source. Power generation based on the Stirling-cycle engine offers a solution to this growing requirement.


Sectional views of the four cylinder Stirling engine heat and power system. (Figures courtesy of WhisperGen Ltd.)

How it works

When a Stirling-cycle engine is mentioned, people often say, "Yes I've heard of that, but what is it, exactly?" The engine dates to 1816, when the Reverend Robert Stirling developed the first Stirling-cycle engine.

The Stirling-cycle engine operates on the principle that heated gas expands and cooled gas contracts. Figure 1 shows sectional views of a four-cylinder Stirling-cycle heat and power system. The heat to the engine is provided by a burner. Various burners allow different models of the Stirling-cycle engine to operate on
a variety of fuels including diesel, kerosene, natural gas, and liquefied petroleum gas.

Heated nitrogen gas is expanded in the top, hot heat exchanger and is then moved to the lower, water-cooled part of the cylinders where it contracts. Cooling water removes heat from the cold cylinder. The heat gained via the water can be captured in a thermal store and then used for heat trace, space heating, and maintaining battery bank temperatures.

The Stirling-cycle engine has no valve gear, and no air or fuel is taken into or out of the cylinder. These characteristics allow it to operate in a very clean and quiet manner. Rapid heating and cooling, plus the expansion and contraction of the nitrogen gas, causes pistons within the cylinders to move. The vertical motion of the pistons is transferred to the rotary motion of the alternator. In short, the Stirling-cycle engine is an external combustion engine that offers advantages over traditional internal combustion engines: lower maintenance cost, low emissions, and the recovery of heat for process uses.

Pilot project

A pilot project consisting of three Stirling-cycle generators was conducted in Wyoming in 2007-2008. This project was initiated by BP America in partnership with Whisper Tech Limited, based in New Zealand. The product trialed was the DC (direct current) WhisperGen heat and power system, a Stirling-cycle micro-cogeneration unit that produces 800 watts electrical and 19,000 BTU/hr (5.5kW/hr) thermal outputs.

One of the Stirling-cycle generators was installed driving a conventional beam pump at the US Department of Energy's (DOE) Rocky Mountain Oilfield Testing Center (RMOTC). The other two units were installed for telemetry power service on well pads in the Wamsutter, Wyo., gas field.

The pilot demonstrated that a Stirling-cycle generator can pump a small well and provide power even in cold weather conditions. A simple fuel control and conditioning system provided reliable operation and used the thermal output of the Stirling generator.

DC-buffer concept vs. AC generators

Matching the power generation to the load is an important consideration for economy and reliability. As a practical example, many beam pumps are oversized and operate on timers. A two-hp (1.5 kW) pump that operates only one hour per day only needs 60 watts of continuous power.

The 800-watt Stirling-cycle generator supplies 24V DC battery charging at 35 amps/hr. The system monitors and charges a battery bank when the bank reaches the programmable depletion percentage. The energy from these batteries can power DC loads or can be inverted to give AC (alternating current) if required. Typically, AC generators are sized to meet the maximum electrical demand at any one time. If the peak load will be 3 kW, a traditional generator with more than 3 kW capacity must be installed. In this system, however, the battery functions as a buffer between intermittent electrical consumption and electric production. Therefore, an 800-watt Stirling-cycle generator is capable of meeting the peak consumption loads of much larger units. The question is not what the peak load will be but what energy will be consumed in 24 hours.

Fuel gas supply

To achieve reliability using fuel gas from a producing well, the gas must be available, and it must be conditioned so that it does not damage the generator. Traditionally, a fuel gas separator (or scrubber) is located very close to the generator. In practice, this arrangement is often inadequate due to physical constraints on the location of the scrubber and the routing of the fuel gas line downstream of the scrubber.

For this project, we designed a fuel gas conditioning system that was robust and capable of application to multiple sites without modification. We elected to use a heat exchanger and heat tracing on the fuel supply line from the existing casing head or fuel gas scrubber to maintain the gas temperature above the dew point all the way to the burner tip.

## Results of pilots

In February 2007, the Stirling-cycle generator was installed at RMOTC to supply power for a National 25 pumping unit driven by a 3 hp AC motor. The Stirling-cycle generator maintained a 460 amp/hr battery bank to supply three-phase 208V AC power to the motor via an inverter. The Stirling-cycle generator has been running for approximately one year doing over 3,200 fired hours and has required only minor maintenance.

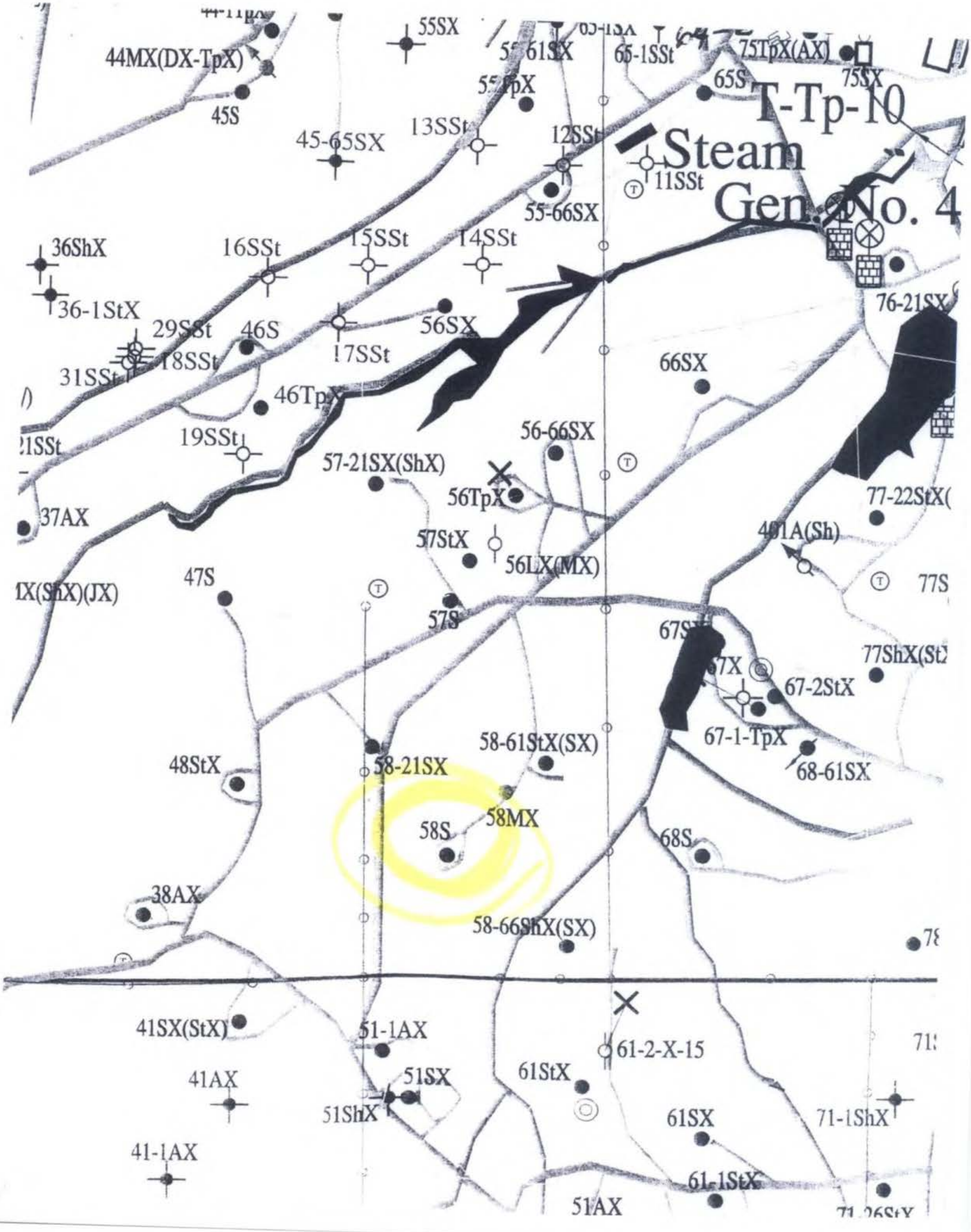
At the Wamsutter gas field in Wyoming, two Stirling-cycle generators (Figure 2) were installed, each on a multi-well pad requiring about 400 watts of continuous power. Due to resource limitations and gas supply component failures, these trial units have run for 750 and 950 hours. The operating problems that have occurred have been primarily related to the fuel supply system, emphasizing the importance of a properly installed gas conditioning and pressure regulation design.

## Expected future developments

As the Stirling-cycle generator used in this field trial is further developed, the next version of the product will have higher electrical and heat outputs. The time period between servicing points will be extended, and the overall product life will increase. The company that produces these Stirling engines is also currently supplying an AC grid-connected heat and power system for residential applications in Europe. By 2010 this AC grid-tied domestic product will be mass manufactured in Europe. With the DC version sharing many core components, the purchase cost per unit is expected to decrease, and the units will be available in large volumes.

## Conclusion

Stirling-cycle generators can be applied to low-power applications in the oil field. In applications where a small amount of process heat and power are required, the Stirling-cycle generator is a viable option, and the micro-cogeneration system is an ideal solution. High reliability and low maintenance will make this technology an important option for remote low-power generation.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61SX
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75TpX(AX)
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65S
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13SSt
45-65SX
12SSt
Steam
11SSt
Gen. No. 4
55-66SX
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15SSt
14SSt
29SSt
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