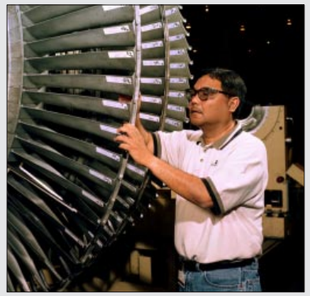
The Tradition of Excellence Continues …



## GE's New Gas Turbine System: Designed to Change the Game in Power Generation

# LMS100™

**GE Power Systems**

GE Power Systems
2707 North Loop West
Houston, TX 77008
Telephone 1-713-803-0900
www.gepower.com

GEA13640 (3M, 11/03)



**GE Power Systems**

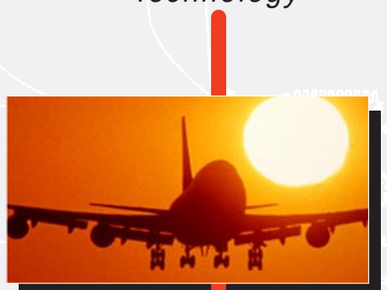
Only **GE** has the Imagination and Ability to Combine the…

# Best of Both Worlds.

# LMS100

*GE Aircraft Engines Technology*

*GE Power Systems Technology*



LM ⟶ LMS ⟵ MS

## New High Efficiency Gas Turbine
## For the Power Generation Industry

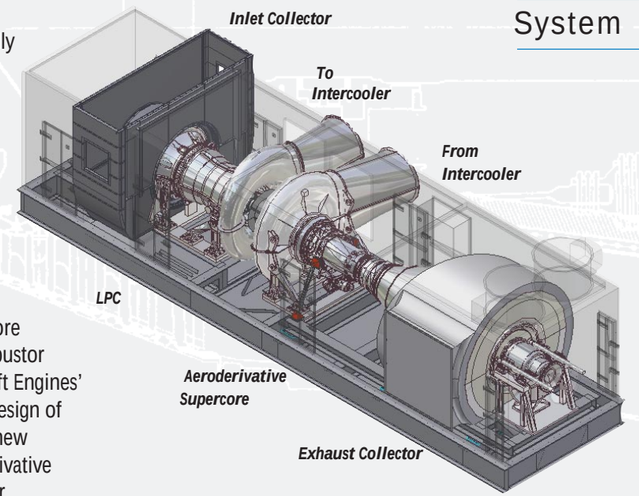
A New Beginning

GE's New Gas Turbine Power Generation System

■ The **LMS100**™ is the first intercooled gas turbine system developed especially for the power generation industry, utilizing the best of two technologies --- heavy-duty frame gas turbine and aeroderivative gas turbine technology. The **LMS100** will deliver 100MW at 46% thermal efficiency. This efficiency is 10 % higher than GE's highest simple cycle efficiency gas turbine available today. It is specifically designed for cyclic applications providing flexible power for peaking, mid-range and baseload.

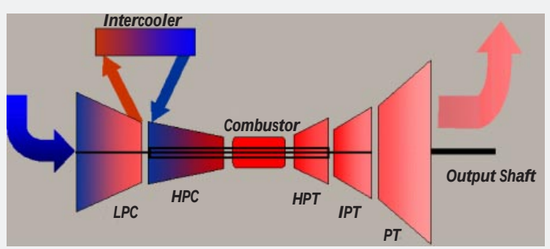
***Flexible Power: High Efficiency***

High Part-Power Efficiency, 50% Power.....39%
High Simple Cycle Efficiency……..…....46%
High STIG Efficiency……..…....50%
High Combined Cycle Efficiency……..…....54%




## Only GE Can Bring You the Best of Both Worlds

The **LMS100** features a heavy-duty low pressure compressor derived from GE Power Systems' MS6001FA heavy-duty gas turbine compressor; its core which includes the high pressure compressor, combustor and high pressure turbine is derived from GE Aircraft Engines' CF6-80C2® and CF6–80E1® aircraft engines. The design of the new 2-stage intermediate pressure turbine and new 5-stage power turbine is based on the latest aeroderivative gas turbine technology. The exhaust and aft shaft for hot-end drive are designed using heavy-duty gas turbine practices.




The compressed air from the Low Pressure Compressor (LPC) is cooled in either an air-to-air or air-to-water heat exchanger (intercooler) and ducted to the High Pressure Compressor (HPC). The cooled flow means less work for the HPC, increased overall efficiency and power output. The cooler LPC exit temperature air, used for turbine cooling, allows higher firing temperatures, resulting in increased power output and overall efficiency.

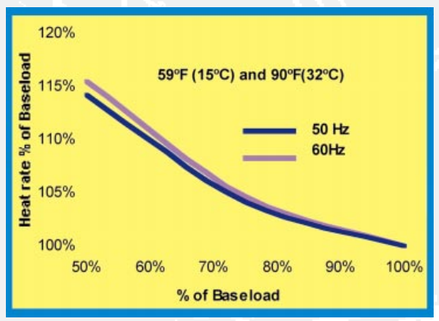
## LMS100 Addressing Industry Needs

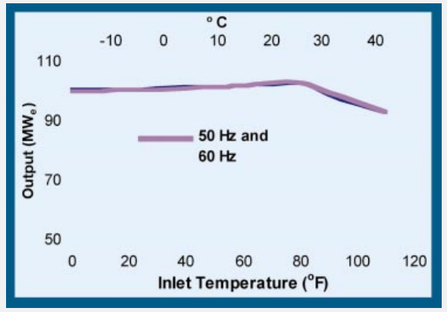
When asked to describe their requirements for future power generation facilities, customers identified the following items as high on their priority list:

- 100 MW blocks of power
- High efficiency at full and part-power
- Cycling capability
- Fast start
- Peaking capability
- Sustained hot-day power
- Fuel flexibility
- Low emissions

All agreed that a new gas turbine which met these requirements would be an important addition to their generation mix.

- The **LMS100** has been designed to specifically address all of these needs, changing the game in the power generating industry.




### The LMS100 is the Right Solution:

- Outstanding full- and part-power efficiency
- Low hot-day lapse rate
- High availability — aero modular maintenance
- Low maintenance cost
- Designed for cycling applications
  - *No cost penalty for starts and stops*
  - *Load-following capability*
- 10 Minutes to full power
  - *Improves average efficiency in cycling*
  - *Potential for spinning reserve credits*
  - *Reduced start-up emissions*
- Synchronous condenser capability

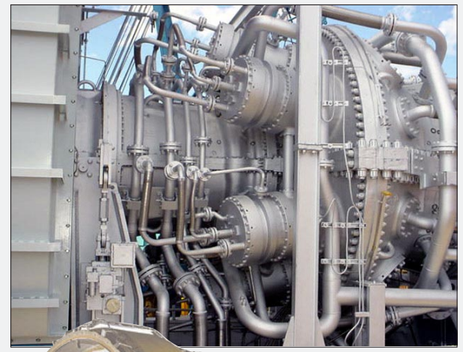
## LMS100 Product Features

The **LMS100** features an inlet and an LPC comprised of the first six stages of the MS6001FA compressor. These stages are followed by an aerodynamically designed volute which ducts the low pressure compressed air into the intercooler. This LPC provides high airflow capacity for the **LMS100** Gas Turbine System.

Cooled air from the intercooler is ducted back through another aerodynamically designed volute into the aero supercore. The high efficiency aeroderivative supercore consists of:

- a high pressure compressor (HPC) based on the CF6-80C2 aircraft engine compressor, strengthened for the high (42:1) pressure ratio of the **LMS100**;
- a combustor which can be either a standard annular combustor (SAC) or an advanced dry low emissions (DLE2) combustor;
- a high pressure turbine (HPT) derived from the CF6-80E1 aircraft engine;
- a 2-stage intermediate pressure turbine (IPT) designed to drive the LPC through a mid-shaft and flexible coupling.

Following the IPT is a 5-stage aerodynamically coupled power turbine (PT) that has been designed specifically for the **LMS100**. The exhaust frame and aft drive shaft are based on a rugged heavy-duty gas turbine exhaust design.



*Over 600 Advanced F Technology Units With Nearly 8 Million Fired Hours*

*3,786 CF6-80 Engines in Operation With More Than 103 Million Operating Hours*

*Industrial Example of a Finned Tube Heat Exchanger*

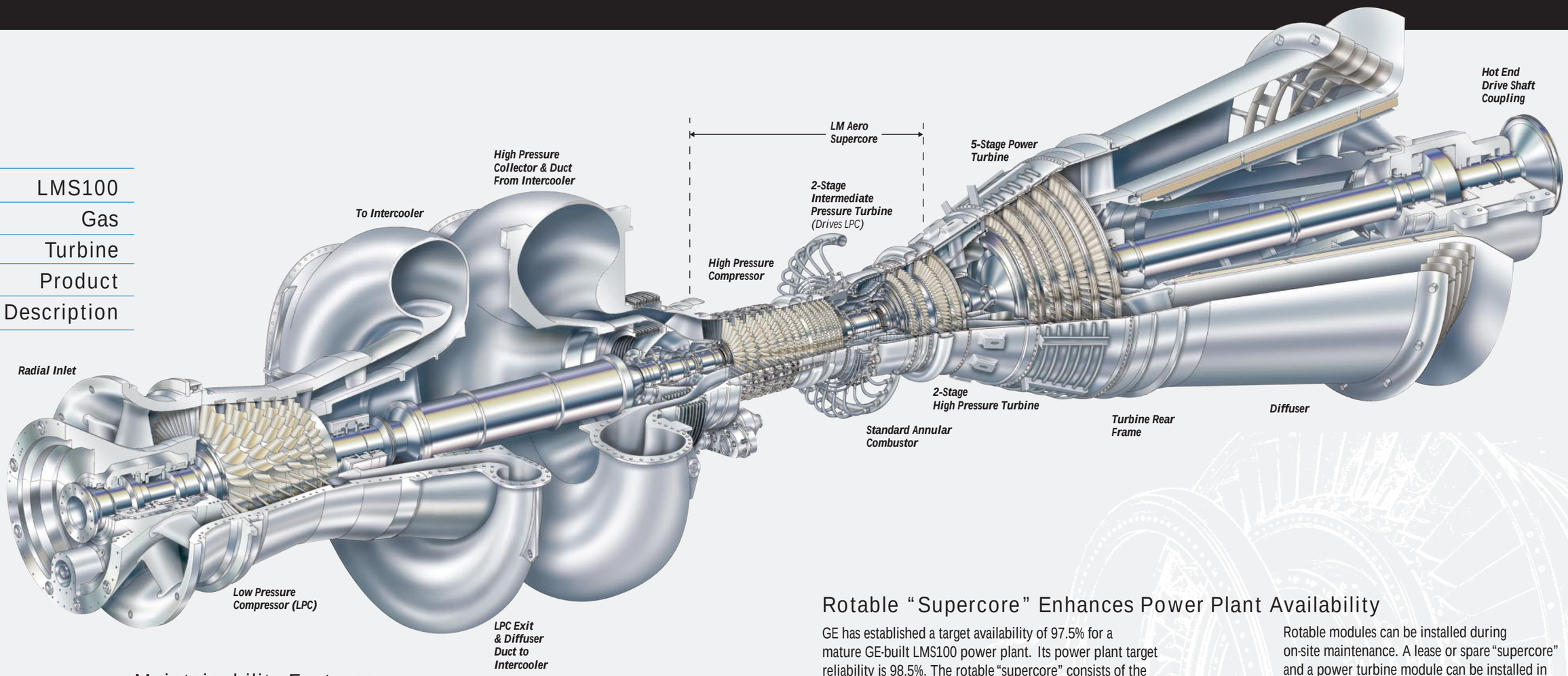
The LPC air is ducted to an air-to-air or air-to-water heat exchanger where it is cooled before being ducted to the HPC. Both designs are industry standard heat exchangers with significant operating hours in multiple industries and are designed to the API 660 and TEMA C standards.

*Industrial Example of a Tube & Shell Heat Exchanger*

# LMS100

## Designed for Availability and Maintainability.

LMS100 Gas Turbine Product Description




### Maintainability Features

- Modular construction permits replacement of the aero components without total disassembly.
- Multiple borescope ports allow on-condition monitoring without turbine disassembly.
- Condition based maintenance and remote diagnostics.
- Split casing construction of the LPC and aeroderivative compressor allows detailed on-site inspection and blade replacement.
- Hot-section field maintenance can be done in several days.
- Accessories are externally mounted for ease of on-site replacement.

### Rotable "Supercore" Enhances Power Plant Availability

GE has established a target availability of 97.5% for a mature GE-built LMS100 power plant. Its power plant target reliability is 98.5%. The rotable "supercore" consists of the HPC, Combustor, HPT and IPT modules.

Rotable modules can be installed during on-site maintenance. A lease or spare "supercore" and a power turbine module can be installed in 24 hours when depot maintenance is required.

### LMS100 Service Intervals

The expected service intervals for the LMS100 based upon normal operation include:

- On-site hot-section replacement.....25,000 fired hours*
- Depot maintenance; overhaul of hot section and inspection of all systems, power turbine overhaul ...50,000 fired hours*
- Next on-site hot section replacement .....75,000 fired hours*
- Depot maintenance.....100,000 fired hours*

**Note: These are actual fired hours; no multipliers for cycling are needed.*

### Maintenance Services

All warranty and follow-on services for the LMS100 will be provided by GE Power Systems on-site or at its several depot locations around the world. These services can include Contractual Service Agreements, Lease Engines, Spare Parts, Rotable Modules, Training and Training Tools.

## Package Design

The **LMS100** gas turbine package system was designed for reliable operation, easy access for maintenance and quick installation. The auxiliary systems are pre-assembled on a single skid and factory tested prior to shipment. The auxiliary skid is mounted in front of the turbine base plate utilizing short flexible connectors reducing mechanical interconnects by 25%. The complete gas turbine driver package can be shipped by truck.

### LMS100 Plant System Design

While the actual plant layout will be site dependent, it will contain basic elements which include an inlet, an auxiliaries skid containing a water wash system, lube oil system and starter system, a turbine skid, an intercooling system, a generator, silencers, exhaust system and a control system.

### Control System

Significant emphasis has been placed on controls design for increased reliability of the entire power plant. The **LMS100** control system will have dual channel architecture with a cross-channel data link providing redundancy which will allow multiple failures without engine shutdown. A fiberoptic distributed I/O system located outside the module will be unaffected by electromagnetic or radio frequency interference which will eliminate noisy wiring. Site interconnects are reduced by 90% compared to the typical gas turbine control system.

### Fuels

The **LMS100** SAC will be equipped with dual fuel capability so that it can burn either natural gas or distillate fuels. The **LMS100** DLE will operate on gas fuel.

### Emissions Control

The **LMS100** gas turbine system has all the advantages of an aeroderivative gas turbine in achieving low emissions. The **LMS100** gas turbine with the SAC combustor (using water or steam for NOx control) and the advanced DLE combustor (DLE2) are designed to achieve 25 ppm NOx. This represents a 7 to 18% reduction in mass emissions rate (lbs/kwh) vs. the LM6000. In locations where less than 25 ppm NOx is required a low temperature SCR can be used. The high efficiency of the **LMS100** results in exhaust temperatures below 800ºF (427ºC) which permits the use of low temperature SCRs without tempering air.

### Noise Control

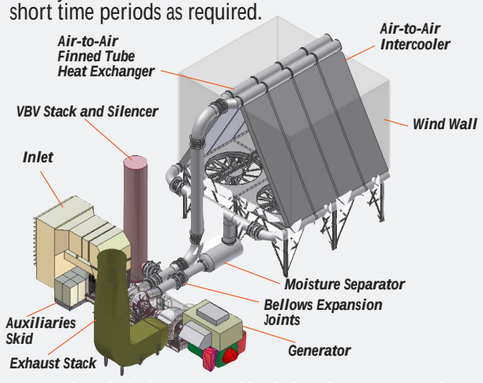
The gas turbine-generator will be rated at 85 dBA average at 3 feet (1 meter). An option for 80 dBA at 3 feet will be available.

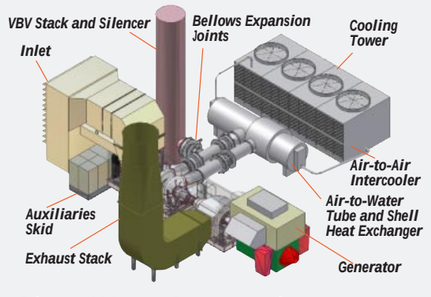
### Generator

The generator is dual rated for 50 or 60 Hz applications. Either an air-cooled or TWAC configuration can be provided.

### Air-to-Air Intercooler

In locations where water is scarce or very expensive, the basic **LMS100** power plant will contain a highly reliable air-to-air intercooler. This unit will be a tube and fin style heat exchanger in an A-frame configuration which is the same as typical steam condensing units in general conformance with API 661 standards. Similar units are in service in the Oil and Gas industry today. In high ambient temperature climates, an evaporative cooling system can be added for power augmentation. This system would use a small amount of water for short time periods as required.




### Air-to-Water Intercooler

In locations where water is readily abundant or less expensive the intercooler can be of the air-to-water type also found in many industrial applications. The intercooler would be a tube and shell type heat exchanger.

Either type of intercooler will be connected through a system of piping and expansion bellows, from the low pressure compressor volute to the intercooler and upon return to the high pressure compressor inlet volute.

## LMS100 Plant System Design

## *LMS100 is Available in a Variety of Configurations*

*Four basic LMS100 configurations are available as this product is introduced. When combined with intercooler selection and duty applications, the LMS100 will offer the customer 20 different configuration choices.*

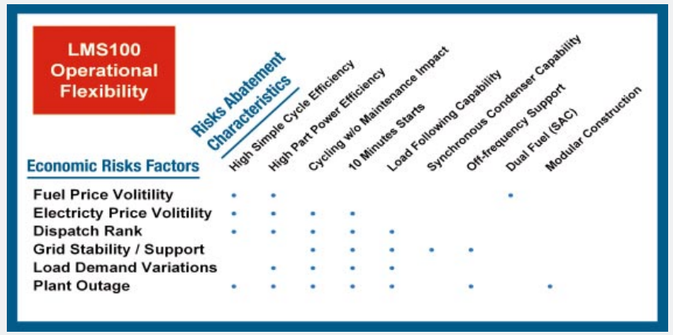
**LMS100 SYSTEM CONFIGURATIONS**

| Product Offerings | Fuel | Combustor | Diluent | Power Augmentation | NOx Level |
|---|---|---|---|---|---|
| **LMS100 SAC,** 50/60 Hz | Gas, Liquid or Dual Fuel | Single Annular (SAC) | Water | None | 25 ppm |
| **LMS100 SAC** Steam, 50/60 Hz | Gas | Single Annular (SAC) | Steam | None | 25 ppm |
| **LMS100 SAC** STIG, 50/60 Hz | Gas | Single Annular (SAC) | Steam | Steam Injection | 25 ppm |
| **LMS100 DLE,** 50/60 Hz | Gas | DLE2 | None | None | 25 ppm |

# Competitive Over A Wide Output Range.

# LMS100

## LMS100 Applications For Power Generation




The attributes of the **LMS100** make it a versatile power generation system offering customers increased operational flexibility in a wide variety of applications:

■ **Simple Cycle / Peaking & Mid-Range**…high efficiency, low first cost, sustained hot day power, 10-minute starts and no maintenance penalty for cycling, yield the ideal peaking solution. Throw in high part-power efficiency and load following capability to get high dispatch capability for mid-range applications.

■ **STIG** …steam injection for power augmentation provides significant efficiency and power improvements, as well as flexibility. With variable STIG, an operator can inject all of the steam into the gas turbine or pass the steam to process to take advantage of electricity prices or process steam value.

■ **Combined Cycle** …the low exhaust temperature leads to lower cost exhaust system materials, smaller steam turbines, condensers and generators, leading to a lower steam plant installed cost. Another benefit from the lower exhaust temperature is more power from duct firing (up to 30MW).

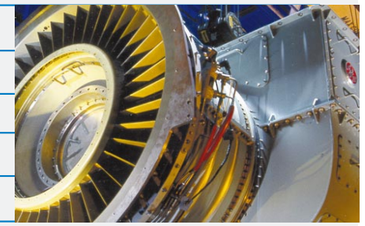
■ **Combined Heat & Power** …the high power-to-steam ratio allows the **LMS100** to meet the steam demand served by 40-50MW gas turbines while delivering more than twice the power. Using both exhaust and air-to-water intercooler energy, an LMS100 plant can reach >85% thermal efficiency.

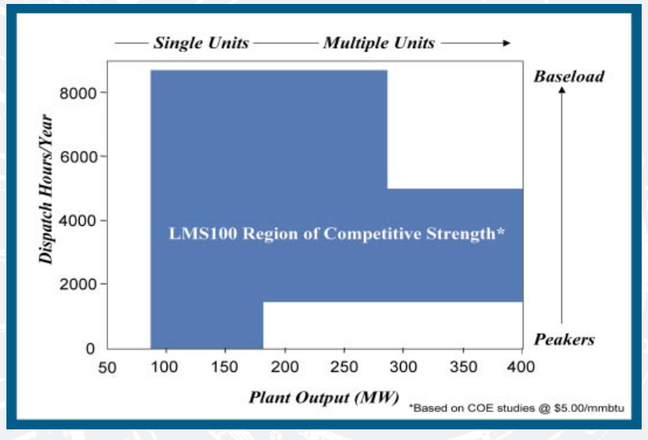
■ **50Hz and 60Hz Applications** …the **LMS100** can operate at 50Hz and 60Hz operation without a gearbox, reducing system complexity, plot size and cost, while increasing reliability.

■ **Off-Frequency Operation** …the **LMS100** will operate with very little power variation for up to 5% reduction in grid frequency, allowing grid support in times of high demand and load fluctuations.

When your power generation need exceeds 100MW, the **LMS100** can provide an economic solution in a multi-unit arrangement by providing high efficiency power with unmatched flexibility.

## LMS100 Provides Outstanding Customer Value in 80+ MW Applications





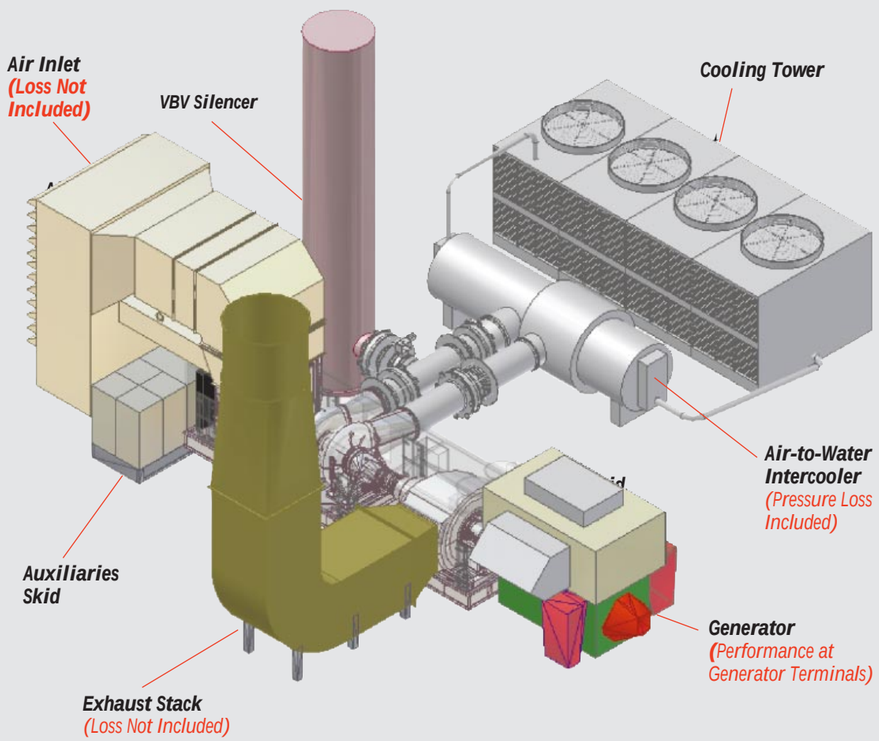
# LMS100 ISO Performance Data

## Simple Cycle Gas Turbine 60Hz Applications

| Model | Output (MWe) | Heat Rate (BTU/KWH) | Efficiency % |
|---|---|---|---|
| DLE | 98.7 | 7509 | 46 |
| SAC (w/Water) | 102.6 | 7813 | 44 |
| SAC (w/Steam) | 102.1 | 7167 | 48 |
| STIG | 112.2 | 6845 | 50 |

***Conditions:***

Performance at the generator terminals
NOx = 25 ppm
59ºF, 60% Relative Humidity
Losses: 0"/0" inlet/exhaust
Fuel: Spec. Gas (LHV = 19000 BTU/lb)





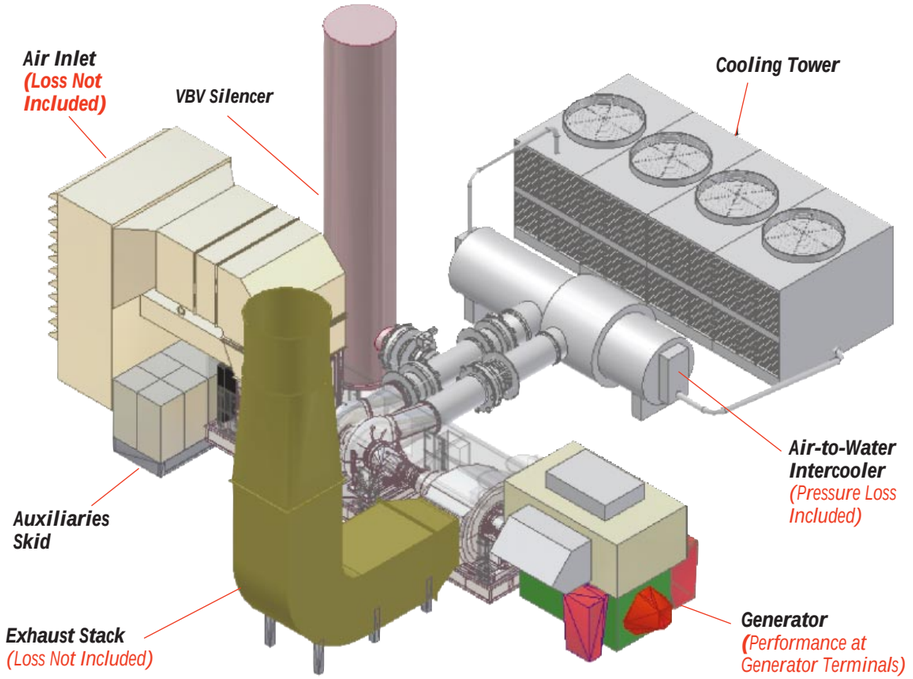

# LMS100 ISO Performance Data

## Simple Cycle Gas Turbine 50Hz Applications

| Model | Output (MWe) | Heat Rate (KJ/KWH) | Efficiency % |
|---|---|---|---|
| DLE | 99 | 7921 | 45 |
| SAC (w/Water) | 102.5 | 8247 | 44 |
| SAC (w/Steam) | 102.2 | 7603 | 47 |
| STIG | 110.8 | 7263 | 50 |

***Conditions:***

Performance at the generator terminals
NOx = 25 ppm
15ºC, 60% Relative Humidity
Losses: 0mm/0mm inlet/exhaust
Fuel: Spec Gas (LHV = 44.2MJ/KG)




GEA13640-1 (11/03)

GE Power Systems

# *SOUND TECHNOLOGIES*

***CORPORATE OFFICE & MANUFACTURING: 310 Commerce Sq. Michigan City, Indiana 46360***
***Telephone (219) 879-2600 Fax: (219) 879-2611***

**SOUNDTECH's GAS TURBINE NOISE CONTROL**
**EVALUATION PROGRAM FOR EXPRESS INTEGRATED TECHNOLOGIES**

| | | | |
|---|---|---|---|
| **PROPOSAL NO.** | **P08-0303** | **REV 0** | **SECTION C** |
| **FILENAME** | **P08-0303** | | **PAGE 1** |
| **CLIENT** | **EXPRESS INTEGRATED TECHNOLOGIES** | | |
| **PROJECT** | **C08-106** | | |
| **DATE** | **03/13/2008** | | |

**DESCRIPTION** DETERMINATION OF CASING RADIATED PWL's WITH STACK SILENCER YES

**NUMBER OF UNITS** 1

| | | OCTAVE BAND CENTER FREQUENCY (Hz) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | LENGTH | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 80000 |
| SOURCE PWL's (in-duct) | | 140 | 132 | 134 | 139 | 141 | 133 | 130 | 130 | 118 |
| SOURCE PWL's (stack) | | 134 | 129 | 133 | 139 | 141 | 133 | 130 | 130 | 118 |
| CATALYST IL | 5.00 | 5 | 5 | 6 | 6 | 7 | 8 | 8 | 9 | 9 |
| STACK SIL | 10.6 | 1 | 3 | 8 | 16 | 22 | 22 | 16 | 11 | 4 |
| PANEL IL | NONE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

CORRECTED TO DIFFUSE FIELD N
USE NUMBER OF TOPS 2
USE NUMBER OF SIDES 2

| RECTANGULAR DUCTS | DESIGNATION | PANELS ? | (W) INLET | (H) INLET | (W) OUT | (H) OUT | (L) | SqFt | TOP SqFt | SIDE SqFt | TOTAL SqFt |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4000 SIDES | 3/8-PL | N | 9.0 | 12.7 | 9.0 | 16.4 | 7.5 | 132 | 76 | 109 | 219 |
| 4000 TOP & BTM | 3/8-PL | N | 9.0 | 12.7 | 9.0 | 16.4 | 7.5 | 132 | 76 | 109 | 152 |
| 4100 SIDES | 3/8-PL | N | 9.0 | 16.4 | 9.0 | 21.7 | 10.5 | 173 | 107 | 201 | 402 |
| 4100 TOP & BTM | 3/8-PL | N | 9.0 | 16.4 | 9.0 | 21.7 | 10.5 | 173 | 107 | 201 | 213 |
| 4200 OUTSIDE | 1/4-PL | N | 9.0 | 21.7 | 17.4 | 21.7 | 23.9 | 287 | 316 | 520 | 520 |
| 4200 TOP & BTM | 1/4-PL | N | 9.0 | 21.7 | 17.4 | 21.7 | 12.0 | 287 | 147 | 275 | 294 |
| 4300 SIDES | 1/4-PL | N | 17.4 | 21.7 | 20.0 | 27.9 | 8.7 | 464 | 199 | 217 | 435 |
| 4300 TOP & BTM | 1/4-PL | N | 17.4 | 21.7 | 20.0 | 27.9 | 8.7 | 464 | 199 | 217 | 398 |
| 4400 SIDES | 1/4-PL | N | 20.0 | 27.9 | 23.0 | 34.7 | 9.7 | 673 | 255 | 306 | 612 |
| 4400 TOP & BTM | 1/4-PL | N | 20.0 | 27.9 | 23.0 | 34.7 | 9.7 | 673 | 255 | 306 | 510 |
| 4500 SIDES | 1/4-PL | N | 23.0 | 34.7 | 23.0 | 34.7 | 11.7 | 798 | 268 | 405 | 810 |
| 4500 TOP & BTM | 1/4-PL | N | 23.0 | 34.7 | 23.0 | 34.7 | 11.7 | 798 | 268 | 405 | 536 |
| 4600 SIDES | 1/4-PL | N | 23.0 | 34.7 | 23.0 | 34.7 | 11.7 | 798 | 268 | 405 | 810 |
| 4600 TOP & BTM | 1/4-PL | N | 23.0 | 34.7 | 23.0 | 34.7 | 11.7 | 798 | 268 | 405 | 536 |
| BREACH | 1/4-PL | N | 23.0 | 34.7 | 12.6 | 34.7 | 7.4 | 617 | 132 | 315 | 893 |

STACK HT. = 90.0 USE 135.0 DEGREES OF TOTAL CIRCUMFERENCE

| | | | (O.D.) | (H) | Fr | Wt | | |
|---|---|---|---|---|---|---|---|---|
| S1 | 3/8" | N | 14.2 | 45.6 | 85.3 | 21.655 | 157.625 | 762 |
| STACK SIL-1 | 1/4" | N | 14.2 | 10.6 | 85.3 | 16.55 | 157.625 | 177 |
| S2 | 1/4" | N | 14.2 | 33.8 | 85.3 | 16.55 | 157.625 | 563 |

SILENCER PRESSURE DROP

| BASIS | | |
|---|---|---|
| AMBIENT TEMP = | 0 | ° F |
| MASS FLOW RATE = | 1,715,470 | LB/HR |
| TEMPERATURE = | 753.6 | ° F |
| MOLECULAR WEIGHT = | 29.45 | LB/LB-MOLE |
| AMBIENT PRESSURE = | 14.30 | PSIA |

EXPECTED SILENCER PRESSURE DROP = 0.8 " W.G.

*SOUND TECHNOLOGIES.*

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*Telephone (219) 879-2600 Fax: (219) 879-2611*

**SOUNDTECH's GAS TURBINE NOISE CONTROL**
**EVALUATION PROGRAM FOR EXPRESS INTEGRATED TECHNOLOGIES**

| | | | |
|---|---|---|---|
| **PROPOSAL NO.** | **P08-0303** | **REV 0** | **SECTION C** |
| **FILENAME** | **P08-0303** | | **PAGE 2** |
| **CLIENT** | **EXPRESS INTEGRATED TECHNOLOGIES** | | |
| **PROJECT** | **C08-106** | | |
| **DATE** | **03/13/2008** | | |

| | OCTAVE BAND CENTER FREQUENCY (Hz) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CASING RADIATED PWL's | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | **dBA** | **dBC** |
| COMPONENT | | | | | | | | | | | |
| 4000 SIDES | 109 | 98 | 97 | 98 | 94 | 85 | 82 | 79 | 58 | | |
| 4000 TOP & BTM | 108 | 97 | 96 | 97 | 93 | 84 | 81 | 78 | 57 | | |
| 4100 SIDES | 111 | 100 | 99 | 100 | 96 | 87 | 84 | 81 | 60 | | |
| 4100 TOP & BTM | 108 | 97 | 96 | 97 | 93 | 84 | 81 | 78 | 57 | | |
| 4200 OUTSIDE | 112 | 101 | 100 | 101 | 97 | 88 | 85 | 82 | 61 | | |
| 4200 TOP & BTM | 109 | 98 | 97 | 98 | 94 | 85 | 82 | 79 | 58 | | |
| 4300 SIDES | 103 | 95 | 96 | 98 | 94 | 85 | 82 | 79 | 58 | | |
| 4300 TOP & BTM | 102 | 94 | 95 | 97 | 93 | 84 | 81 | 78 | 57 | | |
| 4400 SIDES | 103 | 95 | 96 | 98 | 94 | 85 | 82 | 79 | 58 | | |
| 4400 TOP & BTM | 102 | 94 | 95 | 97 | 93 | 84 | 81 | 78 | 57 | | |
| 4500 SIDES | 103 | 95 | 95 | 97 | 93 | 84 | 81 | 78 | 57 | | |
| 4500 TOP & BTM | 101 | 93 | 94 | 96 | 91 | 82 | 79 | 76 | 55 | | |
| 4600 SIDES | 101 | 93 | 93 | 95 | 90 | 81 | 78 | 75 | 54 | | |
| 4600 TOP & BTM | 99 | 91 | 91 | 93 | 89 | 79 | 76 | 73 | 52 | | |
| BREACH | 100 | 92 | 92 | 94 | 89 | 79 | 76 | 72 | 51 | | |
| LOWER PORTION STACK | 96 | 91 | 90 | 90 | 84 | 75 | 72 | 71 | 58 | | |
| MAIN STACK SILENCER | 92 | 86 | 84 | 84 | 77 | 62 | 59 | 58 | 47 | | |
| UPPER PORTION STACK | 96 | 89 | 83 | 76 | 63 | 49 | 52 | 55 | 49 | | |
| **TOTAL CASING RADIATED PWL's** | **118** | **108** | **108** | **109** | **105** | **96** | **93** | **90** | **69** | **106** | **118** |

**FAR FIELD SOUND PRESSURE LEVEL**
**NOT TO EXCEED: 59 dBA at 400 FT**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL SPL @ RECEPTOR FROM UNIT 1 CASING | | | | | | | | | | | |
| ACTUAL DISTANCE | 400 | FEET | | | | | | | | | |
| TOTAL CASING PWL's | 118 | 108 | 108 | 109 | 105 | 96 | 93 | 90 | 69 | | |
| DIVERG. & ABSORP. | 50 | 50 | 50 | 50 | 50 | 51 | 51 | 53 | 56 | | |
| **CASING RADIATED SPL's @ RECEPTOR** | **68** | **58** | **58** | **59** | **55** | **45** | **42** | **37** | **14** | **55** | **68** |
| SPL @ RECEPTOR FROM UNIT 1 STACK EXIT | | | | | | | | | | | |
| ACTUAL DISTANCE | 409 | FEET | | | | | | | | | |
| SOURCE PWLs | 134 | 129 | 133 | 139 | 141 | 133 | 130 | 130 | 118 | | |
| CATALYST IL | 5 | 5 | 6 | 6 | 7 | 8 | 8 | 9 | 9 | | |
| STACK SILENCER DIL | 1 | 3 | 8 | 16 | 22 | 22 | 16 | 11 | 4 | | |
| DIRECTIVITY 90 ° | 2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | | |
| DIVERG. & ABSORP. | 50 | 50 | 50 | 50 | 51 | 51 | 51 | 53 | 56 | | |
| **STACK EXIT SPL's @ RECEPTOR** | **76** | **68** | **65** | **61** | **54** | **43** | **43** | **44** | **33** | **57** | **75** |
| **TOTAL SPL's AT 400 FT FOR EXHAUST SYSTEM** | **77** | **68** | **66** | **63** | **57** | **47** | **46** | **44** | **33** | **59** | **75** |

*SOUND TECHNOLOGIES*

*CORPORATE OFFICE & MANUFACTURING: 310 Commerce Sq. Michigan City, Indiana 46360*
*Telephone (219) 879-2600 Fax: (219) 879-2611*

**SOUNDTECH's GAS TURBINE NOISE CONTROL**
**EVALUATION PROGRAM**

| | | | | | |
|---|---|---|---|---|---|
| **PROPOSAL NO.** | **P08-0303** | **REV** | **0** | **SECTION** | **C** |
| **FILENAME** | **P08-0303** | | | **PAGE** | **3** |
| **CLIENT** | **EXPRESS INTEGRATED TECHNOLOGIES** | | | | |
| **PROJECT** | **C08-106** | | | | |
| **DATE** | **03/13/2008** | | | | |

**EVALUATION OF NEAR FIELD SOUND LEVELS**
**NOT TO EXCEED 85 dBA AT THREE FEET (3'-0") FROM SURFACE, FIVE FEET (5'-0") ABOVE GRADE**

EQUIPMENT DESCRIPTION: **EXHAUST STACK EXIT NOISE** NUMBER OF UNITS CONTRIBUTIN 1

| | | |
|---|---|---|
| SPECIFIED (HORIZONTAL DISTANCE) | 3 | Feet |
| STACK HEIGHT: | 90 | Feet |
| ACTUAL DIRECTIVITY: | 178 | Degrees |
| Enter Directivity (less than actual): | | |
| Options: 0, 45, 60, 75, 90, 105, 120, 135 Degrees: | 135 | Degrees |
| Actual distance from top of stack to receiver: | 85 | Feet |

| | Octave Band Center Frequencies (Hz) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 31.5 | 63 | 125 | 250 | 500 | 1K | 2K | 4K | 8K | **dBA** |
| Source PWL's | 134 | 129 | 133 | 139 | 141 | 133 | 130 | 130 | 118 | |
| CATALYST IL | 5 | 5 | 6 | 6 | 7 | 8 | 8 | 9 | 9 | |
| **SILENCER DIL's** | 1 | 3 | 8 | 16 | 22 | 22 | 16 | 11 | 4 | |
| Directivity | 3 | 4 | 6 | 8 | 10 | 13 | 16 | 18 | 20 | |
| Hemis. Div. w/ Absorption | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 38 | |
| Silenced SPL's | 88 | 81 | 77 | 73 | 66 | 54 | 54 | 56 | 47 | |
| Add For (N) Units | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Total Near Field SPL's | 88 | 81 | 77 | 73 | 66 | 54 | 54 | 56 | 47 | **68** |

EQUIPMENT DESCRIPTION: **WORST CASE NEAR FIELD CASING RADIATED SPL's**
ENTER CROSS-SECTIONAL CONFIGURATION and FLOW AREA at POINT of EVALUATION

| | | | | |
|---|---|---|---|---|
| RECTANGULAR (R) or CIRCULAR (C): | | | R | |
| IF CIRCULAR, ENTER INSIDE DIAMETER (FEET) | | | N/A | I.D. |
| IF RECTANGULAR, ENTER INTERNAL WIDTH & HEIGHT (FEET) | 8 | WIDE | 12 | HIGH |
| RESULTANT CROSS-SECTIONAL FLOW AREA | | 100 | SQUARE FEET | |

| | | Octave Band Center Frequencies (Hz) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 31.5 | 63 | 125 | 250 | 500 | 1K | 2K | 4K | 8K | |
| Source PWL's | | 140 | 132 | 134 | 139 | 141 | 133 | 130 | 130 | 118 | |
| IL - PRIOR TO POINT | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Face Area Correct | | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| T.L. of Duct Wall | 3/8-PL | 33 | 36 | 39 | 43 | 49 | 50 | 50 | 53 | 62 | |
| STI Panel No.: | NONE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Silenced SPL's | | 97 | 86 | 85 | 86 | 82 | 73 | 70 | 67 | 46 | **83** |

**TOTAL NEAR FIELD A-WT SPL, CASING RADIADTED PLUS STACK EXIT NOISE = 83**

Moore Fans LLC
800 S. Missouri Ave.
Marceline, MO 64658
Telephone: (660) 376-3575
Facsimile: (660) 376-2909

| GE AEP | | STD_UNIT | | | Item: | | |
|---|---|---|---|---|---|---|---|
| Class: | 10000 | VT SD | | | | | |
| Series: | 42 | Diameter: | 13.00 | feet | Blades: | 5 | |
| Temperature: | 80 | Fahrenheit | Elevation: | 800 | feet | Density: | 0.9530 | |
| Volume: | 182500 | Ft3/Min | Air Vel.: | 1449 | fpm | RPM: | 290 | |
| Static: | 0.598 | In H2O | Pv: | 0.124 | In H2O | Pt: | 0.760 | In H2O |
| Power Reqd.: | 30.72 | bhp | Motor: | 40.0 | bhp | Total Efficiency: | 71.1 | |
| Power Req'd @ -4 Fahrenheit 36.37 bhp | | | | | | Static Efficiency: | 56.0 | |
| No. Blds Req.: | 4.64 | | API Blds Req.: | 5.00 | | Blade Load: | 0.927 | |
| Tip Speed: | 11844 | fpm | Deflection Angle: | 50.7 | | Pitch Number: | 1.4 | |
| Entry Corr.: | 1.3 | | Tip Clearance: | 0.750 | inches | Design Angle: | 21.7 | |
| Starting Torque: | 2.0 | | Max Torque: | 1449 | Ft-Lbs | Torq/Bld: | 290 | Ft-Lbs |

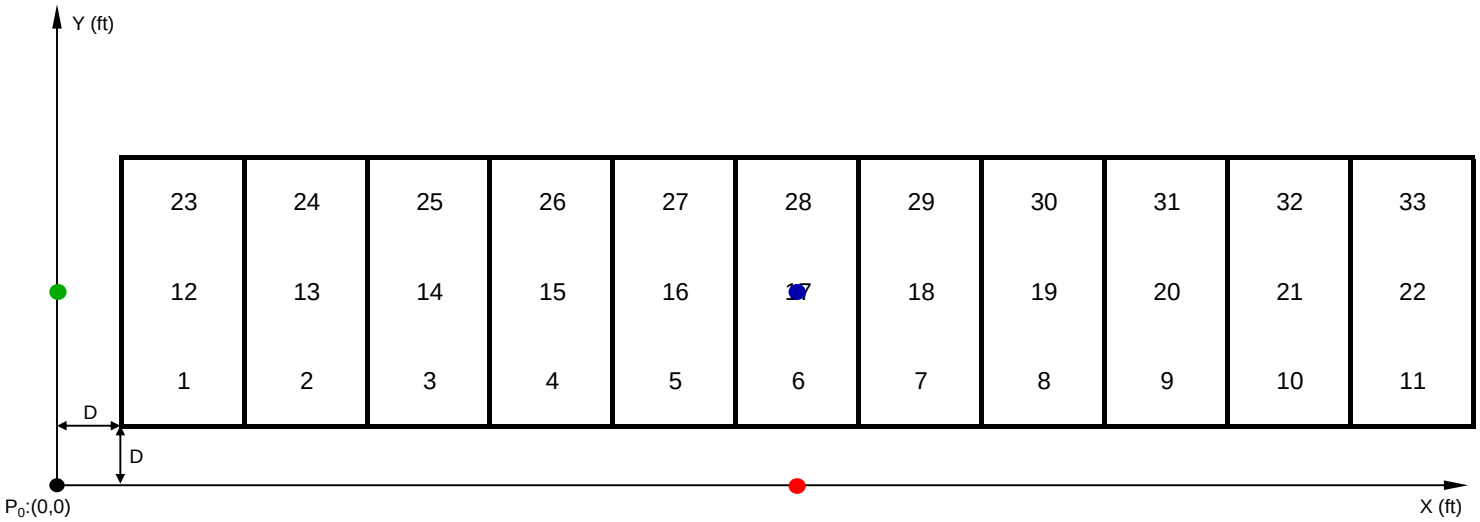
| | | |
|---|---|---|
| Appr fan weight: | 94 | Lbs |
| WR2 | 900 | Lbs Ft 2 |
| Fan Thrust Load: | 524 | Lbs |

Noise Level (per fan) Forced Draft based on VT Tips

| HZ | dBA | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
|---|---|---|---|---|---|---|---|---|---|
| PWL | 100.3 | 106.3 | 105.3 | 102.3 | 97.3 | 95.3 | 89.3 | 83.3 | 77.3 |
| SPL 1m Below Fan | 85.7 | 91.7 | 90.7 | 87.7 | 82.7 | 80.7 | 74.7 | 68.7 | 62.7 |
| SPL 1m @ Side | 80.9 | 86.9 | 85.9 | 82.9 | 77.9 | 75.9 | 69.9 | 63.9 | 57.9 |

Rating generated by Moore Fans Version 1.45 at 02/14/07 17:15:59

# ITERATIVE NOISE ANALYSIS FOR MULTI-BAY INSTALLATIONS




| | |
|---|---|
| Distance from Periphery, D (ft) | 400.00 |
| No Fans/Bay, N (4 max) | 3 |
| No Bays, B | 11 |
| Bay Width, W (ft) | 16.00 |
| Gap <-> Bays, G (ft) | 0.50 |
| Tube Length, TL (ft) | 60.00 |
| Plenum Length, L (ft) | 58.50 |
| Fan Ht above grade, H (ft) | 11.00 |
| Ear Level, Z (ft) | 5.00 |
| $L_w$fan, LF (dBA) | 100.3 |
| $L_w$belt, LB (dBA) | 65.0 |
| $L_w$motor, LM (dBA) | 81.0 |
| Ground Reflectivity, RF | 0.98 |
| $L_w$total per F/B/M, LT (dBA) | 103.3 |
| $L_w$total for ALL, LA (dBA) | 118.5 |

$L_w$ = Sound Power Level

| | |
|---|---|
| $P_1$ X (ft) | 490.50 |
| $P_1$ Y (ft) | 0.00 |
| $P_2$ X (ft) | 0.00 |
| $P_2$ Y (ft) | 429.25 |
| $P_3$ X (ft) | 490.50 |
| $P_3$ Y (ft) | 429.25 |

| | |
|---|---|
| Measured Noise Location X (ft) | 490.50 |
| Measured Noise Location Y (ft) | 0.00 |

| Fan No. | delX | delY | delZ | Tot Dist | SPL | logsum |
|---|---|---|---|---|---|---|
| 1 | 82.50 | 409.75 | 6.00 | 418.02 | 48.48 | 7.0E+04 |
| 2 | 66.00 | 409.75 | 6.00 | 415.07 | 48.54 | 7.1E+04 |
| 3 | 49.50 | 409.75 | 6.00 | 412.77 | 48.59 | 7.2E+04 |
| 4 | 33.00 | 409.75 | 6.00 | 411.12 | 48.62 | 7.3E+04 |
| 5 | 16.50 | 409.75 | 6.00 | 410.13 | 48.64 | 7.3E+04 |
| 6 | 0.00 | 409.75 | 6.00 | 409.79 | 48.65 | 7.3E+04 |
| 7 | 16.50 | 409.75 | 6.00 | 410.13 | 48.64 | 7.3E+04 |
| 8 | 33.00 | 409.75 | 6.00 | 411.12 | 48.62 | 7.3E+04 |
| 9 | 49.50 | 409.75 | 6.00 | 412.77 | 48.59 | 7.2E+04 |
| 10 | 66.00 | 409.75 | 6.00 | 415.07 | 48.54 | 7.1E+04 |
| 11 | 82.50 | 409.75 | 6.00 | 418.02 | 48.48 | 7.0E+04 |
| 12 | 82.50 | 429.25 | 6.00 | 437.15 | 48.09 | 6.4E+04 |
| 13 | 66.00 | 429.25 | 6.00 | 434.34 | 48.14 | 6.5E+04 |
| 14 | 49.50 | 429.25 | 6.00 | 432.14 | 48.19 | 6.6E+04 |
| 15 | 33.00 | 429.25 | 6.00 | 430.56 | 48.22 | 6.6E+04 |
| 16 | 16.50 | 429.25 | 6.00 | 429.61 | 48.24 | 6.7E+04 |
| 17 | 0.00 | 429.25 | 6.00 | 429.29 | 48.24 | 6.7E+04 |
| 18 | 16.50 | 429.25 | 6.00 | 429.61 | 48.24 | 6.7E+04 |
| 19 | 33.00 | 429.25 | 6.00 | 430.56 | 48.22 | 6.6E+04 |
| 20 | 49.50 | 429.25 | 6.00 | 432.14 | 48.19 | 6.6E+04 |
| 21 | 66.00 | 429.25 | 6.00 | 434.34 | 48.14 | 6.5E+04 |
| 22 | 82.50 | 429.25 | 6.00 | 437.15 | 48.09 | 6.4E+04 |
| 23 | 82.50 | 448.75 | 6.00 | 456.31 | 47.71 | 5.9E+04 |
| 24 | 66.00 | 448.75 | 6.00 | 453.62 | 47.77 | 6.0E+04 |
| 25 | 49.50 | 448.75 | 6.00 | 451.51 | 47.81 | 6.0E+04 |
| 26 | 33.00 | 448.75 | 6.00 | 450.00 | 47.84 | 6.1E+04 |
| 27 | 16.50 | 448.75 | 6.00 | 449.09 | 47.85 | 6.1E+04 |
| 28 | 0.00 | 448.75 | 6.00 | 448.79 | 47.86 | 6.1E+04 |
| 29 | 16.50 | 448.75 | 6.00 | 449.09 | 47.85 | 6.1E+04 |
| 30 | 33.00 | 448.75 | 6.00 | 450.00 | 47.84 | 6.1E+04 |
| 31 | 49.50 | 448.75 | 6.00 | 451.51 | 47.81 | 6.0E+04 |
| 32 | 66.00 | 448.75 | 6.00 | 453.62 | 47.77 | 6.0E+04 |
| 33 | 82.50 | 448.75 | 6.00 | 456.31 | 47.71 | 5.9E+04 |

**SPL @ X,Y -----> 63.39**