DIESEL & GAS ENGINE POWER PLANT
Your Reliable Partner

Doosan Engine, a name that is synonymous with excellence in Diesel & Gas Engine Power Plants.

In every industry, there are forces that stand out as the leader who is benchmarked for joining the ranks of the very best.

In the field of Diesel & Gas Engine Power Plants, it needs abundant experience, state of the art technology, capability and high level of quality management to become a leader.

Doosan Engine has them all, and provides the optimum and customized solutions to meet your various requirements and expectation.

We are now creating a new legend for you and your next generation...
Today, the availability of electrical energy is decisive factor for economic and social development. A reliable power supply is the key element to meet the steadily growing demand of growth, prosperity and industrial development.

Among the various measures of electricity generation, 2-stroke low speed / 4-stroke medium speed diesel or gas engines are simply defined as the most efficient and economical solution for unit capacity of power plant up to 300MW.

Doosan Engine has plentiful experience in this business area and surely provides you with perfect satisfaction.
2-stroke Low Speed Diesel Engines are mainly used in projects where the ability to burn the cheapest fuel oil, i.e. the worst fuel possible, and the efficiency is the prime considerations as maintaining extremely high demands on reliability and availability. Such engines are therefore chosen for installation on islands and remote areas, in captive plants and IPP plants as well as in public utilities.

Doosan Engine built the world's first environment-friendly diesel power plant equipped with a wide range of green technology, that is, Selective Catalytic Reduction (SCR), Electro Static Precipitator (ESP) and Flue Gas Desulphurization system (FGD) in 2005 and 2009 at Jeju Island of Korea.

The various experiences in the engine based power plant have made Doosan Engine able to meet every individual plants’ conditions and requirements to the customers’ satisfaction.

Advantages
- Higher efficiency (Lower fuel oil consumption)
- Lower operation and maintenance cost
- Higher load flexibility
- No power derating at any site conditions
- Higher availability and reliability
- Longer lifetime
- Soundness of technology

Application
- Base load operation
- Peak load operation

Typical Application of 2-stroke Low Speed Diesel Engines vs. Plant Capacity Required:
4-Stroke Medium Speed Diesel Engines are equipped for small power generation which is used in places from remote islands to densely populated cities and industries such as independent power producers, mining, and utilities.

In addition, Emergency Diesel Generator (EDG) which uses 4-stroke Medium Speed Diesel Engine, is a type of power system to provide backup power resources in a crisis or failure of regular system. It has diverse use in a wide range and variety of settings at nuclear power plant, oil and gas refinery, large combined cycle power plant, large building and multiplex, etc..

Especially EDG for nuclear power plant is to feed safety loads to reactor vessel during shut down. It is one of the most important equipment to secure the safety and reliability of nuclear power plant.

Doosan Engine has supplied all EDGs for nuclear power plants in Korea during last 20 years in accordance with the comprehensive and strict rules & regulations.

The main characteristics are as below.

**Advantages**
- Lower initial investment
- Shorter construction period
- Easier extension of power capacity
- Easier transportation

**Application**
- Base load operation
- Peak load operation
- Stand by operation

### Typical Application of 4-stroke Medium Speed Diesel Engines vs. Plant Capacity Required:

<table>
<thead>
<tr>
<th>Engine Type</th>
<th>L21/31</th>
<th>L27/38</th>
<th>V28/32S</th>
<th>L32/40</th>
<th>V32/40</th>
<th>L32/44CR</th>
<th>V32/44CR</th>
<th>L48/60</th>
<th>V48/60</th>
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<td>514</td>
<td>Hz</td>
<td>50</td>
<td>60</td>
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<td>kW</td>
<td>kWm</td>
<td>kW</td>
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<table>
<thead>
<tr>
<th>Engine Type</th>
<th>V32/44CR</th>
<th>L32/44CR</th>
<th>L48/60</th>
<th>V48/60</th>
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</thead>
<tbody>
<tr>
<td>RPM</td>
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<td>514</td>
<td>Hz</td>
<td>50</td>
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<tr>
<td>Cyl.</td>
<td>kWm</td>
<td>kW</td>
<td>kWm</td>
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<td>8,173</td>
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<tr>
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<td>9,450</td>
<td>9,195</td>
<td>9,450</td>
<td>9,195</td>
</tr>
</tbody>
</table>

**V32/44CR**
| RPM | 750 | 720 | Hz | 50 | 60 | | | | |
| Cyl. | kWm | kW | kWm | kW | kW | | | | |
| 12 | 6,720 | 6,552 | 6,720 | 6,552 | | | | | |
| 16 | 8,960 | 8,736 | 8,960 | 8,736 | | | | | |
| 20 | 11,200 | 10,920 | 11,200 | 10,920 | | | | | |

**V32/60**
| RPM | 750 | 720 | Hz | 50 | 60 | | | | |
| Cyl. | kWm | kW | kWm | kW | kW | kW | kW | kW | kW |
| 12 | 6,600 | 6,582 | 6,600 | 6,582 | | | | | |
| 14 | 7,000 | 6,790 | 7,000 | 6,790 | | | | | |
| 16 | 8,000 | 7,760 | 8,000 | 7,760 | | | | | |
| 18 | 9,000 | 8,730 | 9,000 | 8,730 | | | | | |

**V32/725**
| RPM | 750 | 720 | Hz | 50 | 60 | | | | |
| Cyl. | kWm | kW | kWm | kW | kW | kW | kW | kW | kW |
| 16 | 3,760 | 3,610 | 3,600 | 3,546 | | | | | |
| 18 | 4,230 | 4,061 | 4,050 | 3,888 | | | | | |

**L27/38**
| RPM | 750 | 720 | Hz | 50 | 60 | | | | |
| Cyl. | kWm | kW | kWm | kW | kW | kW | kW | kW | kW |
| 5 | 1,600 | 1,536 | 1,500 | 1,440 | | | | | |
| 6 | 1,980 | 1,900 | 1,980 | 1,900 | | | | | |
| 7 | 2,310 | 2,218 | 2,310 | 2,218 | | | | | |
| 8 | 2,640 | 2,534 | 2,640 | 2,534 | | | | | |
| 9 | 2,970 | 2,851 | 2,970 | 2,851 | | | | | |

**L48/60**
| RPM | 750 | 720 | Hz | 50 | 60 | | | | |
| Cyl. | kWm | kW | kWm | kW | kW | kW | kW | kW | kW |
| 6 | 6,300 | 6,130 | 6,300 | 6,130 | | | | | |
| 7 | 7,350 | 7,151 | 7,350 | 7,151 | | | | | |
| 8 | 8,400 | 8,173 | 8,400 | 8,173 | | | | | |
| 9 | 9,450 | 9,195 | 9,450 | 9,195 | | | | | |

**L32/40**
| RPM | 750 | 720 | Hz | 50 | 60 | | | | |
| Cyl. | kWm | kW | kWm | kW | kW | kW | kW | kW | kW |
| 12 | 6,000 | 5,820 | 6,000 | 5,820 | | | | | |
| 14 | 7,000 | 6,790 | 7,000 | 6,790 | | | | | |
| 16 | 8,000 | 7,760 | 8,000 | 7,760 | | | | | |
| 18 | 9,000 | 8,730 | 9,000 | 8,730 | | | | | |

**L32/44CR**
| RPM | 750 | 720 | Hz | 50 | 60 | | | | |
| Cyl. | kWm | kW | kWm | kW | kW | kW | kW | kW | kW |
| 8 | 4,480 | 4,346 | 4,480 | 4,346 | | | | | |
| 10 | 5,600 | 5,432 | 5,600 | 5,432 | | | | | |

| For other engine types which are not specified in the above table, please contact us separately for further information. |
Due to the growing availability of gas via grids and LPG together with its value for money, gas is an increasingly popular option for power generation. Based on the recent technical development, it has been possible to implement options for dual fuel operation with 2-stroke Low Speed Gas Engine. This engine shall be equipped with high pressure reciprocating compressor supplying the engine with the main gas injection, while ignition is ensured by fuel oil injection.

2-stroke Low Speed Gas Engines are applicable anywhere, when fuel efficient, reliable and flexible power production is required. Besides traditional fuels such as heavy fuel and natural gas, bio fuels and synthetic bio fuels, etc. can be applied. Consequently, gaseous / liquid fuel flexibility makes 2-stroke Low Speed Gas Engines an obvious choice for projects where the engines are connected to interruptible gas supply systems or where a switch among various fuels are required for any reason.

Advantages
- Higher efficiency
- Lower operation and maintenance cost
- Higher load flexibility
- Fuel flexibility (Gas + Liquid fuel or Liquid fuel)
- Reduction of SOx, NOx, particle matters and CO2
- Unchanged power density and load response
- Longer lifetime

Operation mode

Fuel oil mode

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Like 2-stroke Low Speed, 4-stroke Medium Speed Gas Engines can be another option with dual fuel or gas operation for power generation.

### Dual Fuel (DF) Engine

Dual fuel engines operate on gas, diesel or heavy fuel oil (HFO), providing greater fuel flexibility. It is usually operated on gas fuel (99%), pilot liquid fuel (1%) and liquid fuel for backup use. Gas and pilot liquid fuel are applied individually and liquid fuel is supplied by injection pump. If one kind of fuel becomes difficult to obtain or prices move beyond reach, dual fuel engines can be simply switched to another source of fuel.

### Gas (G) Engine

Gas engines operate on gas fuel (99%) and pilot liquid fuel (1%) and operate only on gas fuel mode. Gas fuel and pilot liquid fuel use a common nozzle. Gas fuel is delivered under electronically controlled admission valves and pilot liquid fuel injection equipment is also electrically controlled.

The main characteristics are as follows.

**Advantages**
- Lower initial investment
- Shorter construction period
- Lower gas pressure (5-6 bar·g)
- Fuel flexibility (Gas + Liquid fuel or Liquid fuel)
- Reduction of SOx, NOx, particle matters and CO2
- Easier extension of power capacity
- Easier transportation

**Application**
- Base load operation
- Peak load operation
- Stand-by operation

### Typical Application of 4-stroke Medium Speed Gas Engines vs. Plant Capacity Required:

![Graph showing typical application of engines vs. plant capacity](image-url)

**Engine Types**
- L32/40DF
- V32/60DF
- L51/60DF
- V51/60DF
- V32/40G
- V35/44G
- L31/60G
- V51/60G

### Engine Specifications

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<thead>
<tr>
<th>Engine Type</th>
<th>RPM</th>
<th>Hz</th>
<th>Cyl.</th>
<th>kW</th>
<th>kWm</th>
<th>kWe</th>
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<tbody>
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<td>60</td>
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<td>60</td>
<td>9,450</td>
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<td>V32/40G</td>
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### Fuel Usage

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<th>Engine Type</th>
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<th>Backup</th>
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<td>Gas</td>
<td>Liquid Fuel</td>
<td>Liquid Fuel</td>
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<tr>
<td>G</td>
<td>Gas</td>
<td>Liquid Fuel</td>
<td>Liquid Fuel</td>
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</tbody>
</table>

### Operation Mode

- Base load operation
- Peak load operation
- Stand-by operation

**Ignition Method**
- Gas mode (Gas + Pilot diesel oil)
- Spark ignition

### Engine Characteristics

- Lower gas pressure (5-6 bar·g)
- Fuel flexibility (Gas + Liquid fuel or Liquid fuel)
- Reduction of SOx, NOx, particle matters and CO2
- Easier extension of power capacity
- Easier transportation

**Typical Application**

- **Plant Capacity (MWe)**
  - 0
  - 10
  - 50
  - 100
  - 150
  - 200
  - 250
  - 300
  - 350
  - 400

For other engine types which are not specified in the above table, please contact us separately for further information.
Depending on the range of services required, Doosan Engine provides not only the turnkey supply of power plant but also the individual service:

**Civil and Building Works**
- Site investigation and studies
- Powerhouse and auxiliary buildings
- Tank farm
- Exhaust stacks
- Storm drainage system
- Potable and sanitary water system
- Air conditioning and ventilation system
- Fire detection, alarm and fighting system
- Communication system
- Lighting
- Fencing, road works, landscaping, etc.

**Erection**
- Supervisory service for erection
- Complete erection
- Erection tools and material

**Commissioning**
- Supervisory service for commissioning
- Acceptance testing
- Reliability tests

**Training**
- Workshop training
- On site training during erection, commissioning and operation

**Operation and Maintenance**
- Planning of maintenance
- Overhaul supervision
- Technical consulting and trouble-shooting
- Performing planned maintenance
- Complete Operation and Maintenance

**Diesel & Gas Engine**
- Engineering
  - System planning
  - Basic and process engineering
  - Detailed engineering
- Mechanical Auxiliaries
  - Fuel oil system
  - Lube oil system
  - Primary and secondary cooling water system
  - Compressed air system
  - Combustion air / Exhaust gas system
  - Waste heat recovery and steam generation system
  - Environmental protection system
- Electrical and I&C Part
  - Alternator
  - Transformers
  - H/V, L/V switchgears
  - L/V distribution and MCC
  - Outdoor switchyard
  - Black-start DG system
  - UPS and DC system
  - Grounding and lightning system
  - Plant control system
  - Monitoring and alarm system
### Performance Record

#### 2-stroke Low Speed & 4-stroke Medium Speed Engine Power Plant

<table>
<thead>
<tr>
<th>Project</th>
<th>Customer</th>
<th>Location</th>
<th>Capacity</th>
<th>Engine</th>
<th>Operation Date</th>
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<td>Nam-Jeju #1~#4</td>
<td>KOSPO</td>
<td>Republic of Korea</td>
<td>10.0MW x 4Sets</td>
<td>7K60MC-S</td>
<td>1990</td>
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<td>Cabras #3~#4</td>
<td>GPA</td>
<td>USA</td>
<td>40.0MW x 2Sets</td>
<td>12K80MC-S</td>
<td>1995</td>
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<td>DML #1~#3</td>
<td>DMLL</td>
<td>India</td>
<td>12.8MW x 5Sets</td>
<td>7K60MC-S</td>
<td>1996</td>
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<tr>
<td>Kos #1~#4</td>
<td>PPC</td>
<td>Greece</td>
<td>11.6MW x 2Sets</td>
<td>7K60MC-S</td>
<td>1998</td>
</tr>
<tr>
<td>Kanudi #1~#2</td>
<td>PNG Power</td>
<td>Papua New Guinea</td>
<td>12.3MW x 2Sets</td>
<td>7K60MC-S</td>
<td>1999</td>
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<tr>
<td>Hirgigo #1~#4</td>
<td>EEC</td>
<td>Eritrea</td>
<td>22.0MW x 4Sets</td>
<td>12K60MC-S</td>
<td>2001</td>
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<tr>
<td>Kos #5~#6</td>
<td>PPC</td>
<td>Greece</td>
<td>16.5MW x 2Sets</td>
<td>9K60MC-S</td>
<td>2005</td>
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<tr>
<td>Paros #1</td>
<td>PPC</td>
<td>Greece</td>
<td>11.5MW x 1Set</td>
<td>9K60MC-S</td>
<td>2006</td>
</tr>
<tr>
<td>Chios #1~#2</td>
<td>PPC</td>
<td>Greece</td>
<td>14.4MW x 2Sets</td>
<td>9K60MC-S</td>
<td>2009</td>
</tr>
<tr>
<td>Jeju #1</td>
<td>KOMPO</td>
<td>Republic of Korea</td>
<td>41.3MW x 1Set</td>
<td>12K80MC-S</td>
<td>2009</td>
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<td>Punggau LNG #1</td>
<td>KOSAI</td>
<td>Republic of Korea</td>
<td>6.0MW x 1Set</td>
<td>14PC2.5</td>
<td>1995</td>
</tr>
<tr>
<td>Bukje #5~#8</td>
<td>KEPCO</td>
<td>Korea</td>
<td>5.0MW x 1Set</td>
<td>12PC2.5</td>
<td>1996</td>
</tr>
<tr>
<td>KARI #1~#2</td>
<td>Korea Aerospace</td>
<td>Republic of Korea</td>
<td>3.6MW x 2Sets</td>
<td>18V28/32</td>
<td>1998</td>
</tr>
<tr>
<td>SEM Philippines #1~#2</td>
<td>Samsung Electro</td>
<td>Philippines</td>
<td>4.2MW x 2Sets</td>
<td>9L32/40</td>
<td>2002</td>
</tr>
<tr>
<td>Fujairah #1</td>
<td>Offset Group</td>
<td>UAE</td>
<td>5.5MW x 1Set</td>
<td>12V32/40</td>
<td>2003</td>
</tr>
<tr>
<td>Makassar #1~#2</td>
<td>ARENA</td>
<td>Indonesia</td>
<td>1.9MW x 2Sets</td>
<td>9L21/31</td>
<td>2012</td>
</tr>
</tbody>
</table>

Total: 149PJTs | 531.5MW

#### 4-stroke Medium Speed

<table>
<thead>
<tr>
<th>Project</th>
<th>Customer</th>
<th>Location</th>
<th>Capacity</th>
<th>Engine</th>
<th>Operation Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punggau LNG #1</td>
<td>KOSAI</td>
<td>Republic of Korea</td>
<td>6.0MW x 1Set</td>
<td>12K80MC-S</td>
<td>1995</td>
</tr>
<tr>
<td>Shin-Kori #1~#2</td>
<td>EDG</td>
<td>Gijang, Korea</td>
<td>7.2MW x 1Set</td>
<td>12PC2.6B</td>
<td>2014</td>
</tr>
<tr>
<td>Shin-Ulchin #1~#2</td>
<td>EDG</td>
<td>Ulchin, Korea</td>
<td>7.2MW x 1Set</td>
<td>16PC2.5</td>
<td>2017</td>
</tr>
</tbody>
</table>

Total: 15PJTs | 315.0MW

#### EDG & AAC DG for Nuclear Power Plant

<table>
<thead>
<tr>
<th>Project</th>
<th>Customer</th>
<th>Location</th>
<th>Capacity</th>
<th>Engine</th>
<th>Operation Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yonggwang #3~#4</td>
<td>KEPCO</td>
<td>Republic of Korea</td>
<td>6.5MW x 1Set</td>
<td>S4CM UD45</td>
<td>1996</td>
</tr>
<tr>
<td>Wolson #2 EDG</td>
<td>KEPCO</td>
<td>Republic of Korea</td>
<td>6.5MW x 1Set</td>
<td>16PC2.5</td>
<td>1997</td>
</tr>
<tr>
<td>Wolson #3~#4 SDG</td>
<td>KEPCO</td>
<td>Republic of Korea</td>
<td>6.5MW x 1Set</td>
<td>16PC2.5</td>
<td>1999</td>
</tr>
<tr>
<td>Ulchin #1~#2 AAC DG</td>
<td>KEPCO</td>
<td>Republic of Korea</td>
<td>7.8MW x 1Set</td>
<td>16PC2.5</td>
<td>2005</td>
</tr>
<tr>
<td>Yonggwang #5~#6 EDG</td>
<td>KEPCO</td>
<td>Republic of Korea</td>
<td>7.2MW x 1Set</td>
<td>16PC2.5</td>
<td>2005</td>
</tr>
<tr>
<td>Ulchin #1~#2 EDG</td>
<td>KEPCO</td>
<td>Republic of Korea</td>
<td>6.5MW x 1Set</td>
<td>16PC2.5</td>
<td>2005</td>
</tr>
<tr>
<td>Kori #1~#4 AAC DG</td>
<td>KHNP</td>
<td>Republic of Korea</td>
<td>5.5MW x 1Set</td>
<td>14V32/40</td>
<td>2006</td>
</tr>
<tr>
<td>Yonggwang #1~#2 AAC DG</td>
<td>KHNP</td>
<td>Republic of Korea</td>
<td>5.5MW x 1Set</td>
<td>14V32/40</td>
<td>2010</td>
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<tr>
<td>Ulchin #1~#2 AAC DG</td>
<td>KHNP</td>
<td>Republic of Korea</td>
<td>5.5MW x 1Set</td>
<td>14V32/40</td>
<td>2010</td>
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<tr>
<td>Shin-Kori #1~#2 AAC DG</td>
<td>KHNP</td>
<td>Republic of Korea</td>
<td>7.2MW x 1Set</td>
<td>16PC2.5</td>
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<tr>
<td>Shin-Ulchin #1~#2 AAC DG</td>
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<td>Republic of Korea</td>
<td>7.2MW x 1Set</td>
<td>16PC2.5</td>
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<tr>
<td>Shin-Wolsong #1~#3 EDG, AAC DG</td>
<td>KHNP</td>
<td>Republic of Korea</td>
<td>8.0MW x 1Set</td>
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</tr>
<tr>
<td>Shin-Kori #1~#2 EDG</td>
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<td>Republic of Korea</td>
<td>7.2MW x 1Set</td>
<td>16PC2.5</td>
<td>2011</td>
</tr>
<tr>
<td>Shin-Ulchin #1~#2 EDG</td>
<td>KHNP</td>
<td>Republic of Korea</td>
<td>7.2MW x 1Set</td>
<td>16PC2.5</td>
<td>2017</td>
</tr>
</tbody>
</table>

Total: 15PJTs | 315.0MW

*1) EDG : Emergency Diesel Generator  *2) AAC DG : Alternative AC Diesel Generator  *3) SDG : Stand-by Diesel Generator
Diesel Power Plant Overview

**Perspective View**

1. Office & Control Room
2. Diesel Engine & Generator Set
3. Pipe Rack
4. Exhaust Gas Silencer
5. Cylinder Lo Service Tank
6. Exhaust Gas Stack
7. O.H. Crane
8. Exhaust Gas Duct
9. Exhaust Gas Boiler
10. Jacket Water Expansion Tank
11. Steam Drum

**Bird's-eye View**

DMIL, India
(38.4MW, 7660MC-S X 3Sets)