ENI REFINING & MARKETING
SANNAZZARO GASIFICATION PLANT
PROJECT UPDATE AND START UP EXPERIENCE

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Raffaella Lucarno - Eni Refining & Marketing, Italy
Joachim Wolff - Shell Global Solutions, The Netherlands
Eni R&M-Sannazzaro
Process Block Diagram

Process Block Diagram
**IMPIANTO DI GASSIFICAZIONE TAR DA VISBREAKING**

**PROJECT DESCRIPTION**

- **ENI R&M**
  - 2280 t/d Syngas
  - 38000 Nm3/h H2
  - VVR(TAR)
  - Snamprogetti/Shell GS

- **EniPower**
  - 250 MWe
  - Snamprogetti/Ansaldo

**Tar**

<table>
<thead>
<tr>
<th>Data on dry basis</th>
<th>Design Feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>%wt 85.73</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>%wt 9.05</td>
</tr>
<tr>
<td>Sulphur</td>
<td>%wt 3.54</td>
</tr>
<tr>
<td>HHV (* = calculated)</td>
<td>MJ/kg 41.28</td>
</tr>
<tr>
<td>LHV (* = calculated)</td>
<td>MJ/kg 39.30</td>
</tr>
</tbody>
</table>

- Feedstock: 1200 t/d VVR(Tar)
- Shell “radiant cooler”
- “High” pressure (62 barg)
- AGR (MDEA-Dow)
- Ni/Fe Carbonyls removal
- Hydrogen (Membr.+PSA)
- 2 gasif.+ 1 LTGC ?? etc.
- Start Up March’06

- 1 x V94-2K (Siemens/Ansaldo)
- 2 x V94-3A.2 (Siemens/Ansaldo)
ENI Sannazzaro IGCC
Project Description

Eni Gas & Power

EniRefining & Marketing

Natural gas (12.5 km new pipeline)

Gasification plant
50 t/h Tar

H2

Syngas

EniPower

Ansaldo-Siemens V94-3A.2 (400 MW)

Ansaldo-Siemens V94-3A.2 (400 MW)

Ansaldo-Siemens V94-2K (250 MW)
Integration

Refinery

(FIRE WATER, IW, WATER TREAT., IA, SIGNAL EXCH., etc.)

Eni Refining & Marketing Division

Shell Global Solutions

Snamprogetti
A company of Saipem
GASIFICATION PLANT
OVERALL PERFORMANCES

Feed = 2 x 25 t/h

<table>
<thead>
<tr>
<th>Tar</th>
<th>Data on dry basis</th>
<th>Design Feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>%wt</td>
<td>85.73</td>
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<td>41.28</td>
</tr>
<tr>
<td>LHV (* = calculated)</td>
<td>MJ/kg</td>
<td>39.30</td>
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</table>

Hydrogen Recovery – 2560 tons/d
LHV – 3700 kcal/kg
465 MWth

<table>
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<tr>
<th>Composition</th>
<th>Data on dry basis</th>
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<tbody>
<tr>
<td>CO</td>
<td>%mol</td>
</tr>
<tr>
<td>H2</td>
<td>%mol</td>
</tr>
<tr>
<td>CO2</td>
<td>%mol</td>
</tr>
<tr>
<td>Ar</td>
<td>%mol</td>
</tr>
<tr>
<td>N2</td>
<td>%mol</td>
</tr>
<tr>
<td>H2O</td>
<td>%mol</td>
</tr>
<tr>
<td>CH4</td>
<td>%mol</td>
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</table>
Sannazzaro Gasification Project
Main Characteristics

Eni Refining & Marketing-EniPower

- Feedstock: VVR(Tar)
- Shell “radiant cooler”
- WHE with internal Superheater (high efficiency-steam production)
- “High” pressure (62 barg)
- Acid gas removal (MDEA-Dow)
- Carbon Dioxide production
- Ni/Fe Carbonyls removal
- SARU to minimize solid waste production
- Hydrogen recovery (Membr.+PSA)
- 1 x V94.2K(Siemens/Ansaldo)
- 2 gasif.+ 1 LTGC etc.

- Start-up: March 2006
- Commercial Operation: April 2006
**Sannazzaro Gasification Project**

**Contract Summary**

<table>
<thead>
<tr>
<th><strong>Eni Refining &amp; Marketing-EniPower</strong></th>
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<tbody>
<tr>
<td>Contract type</td>
<td>LS</td>
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<tr>
<td>Scope of work</td>
<td>EPC</td>
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<tr>
<td>Contractor(s)</td>
<td>SP</td>
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<tr>
<td>Licensor(s)</td>
<td>SGS / Dow / UOP</td>
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<td>Detailed eng.</td>
<td>SP</td>
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<tr>
<td>Construction</td>
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**POWER BLOCK**

AnsaldoEnergia
## SannazzaroGasification Project
### Commercial Operations

<table>
<thead>
<tr>
<th>Summary</th>
<th>Duration</th>
<th>Start-up Dates</th>
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<tbody>
<tr>
<td>Commissioning</td>
<td>127 days</td>
<td>From 17\textsuperscript{th} November’05 to 23\textsuperscript{rd} March’06</td>
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<tr>
<td>Start-up Train 1</td>
<td>5 days</td>
<td>From 23\textsuperscript{rd} March’06 to 27\textsuperscript{th} March’06</td>
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<tr>
<td>Start-up Train 2</td>
<td>11 days</td>
<td>From 19\textsuperscript{th} April’06 to 29\textsuperscript{th} April’06</td>
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<tr>
<td>Overall Start up</td>
<td>38 days</td>
<td>From 23\textsuperscript{rd} March’06 to 29\textsuperscript{th} April’06</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Cause of shutdown</th>
<th>1st train</th>
<th>2nd train</th>
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<tbody>
<tr>
<td>Instrumentation</td>
<td>6</td>
<td>0</td>
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<tr>
<td>Mechanical</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Operational</td>
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<td>2</td>
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<tr>
<td>Common part</td>
<td>1</td>
<td>1</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td></td>
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</table>
Sannazzaro Gasification Project
Outages Report

PLANT OUTAGES

- Instrumentation: 44%
- Mechanical: 21%
- Operational: 21%
- Common Part: 14%

Eni Refining & Marketing Division
Snamprogetti
Sannazzaro Gasification Project
Outages Report

Train 1 (up to 07/31/2006)
- On stream: 83%
- Operational: 10%
- Instrumentation: 2%
- Mechanical: 1%
- Common Part: 4%

Train 2 (up to 07/31/2006)
- On stream: 74%
- Operational: 25%
- Instrumentation: 1%
Sannazzaro Gasification Project
Commercial Operations

SYNGAS SENT TO ENI POWER

<table>
<thead>
<tr>
<th>Date</th>
<th>ton/day</th>
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<tbody>
<tr>
<td>1° ON</td>
<td>2° OFF</td>
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<tr>
<td>1° ON</td>
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<td>1° ON</td>
<td>2° ON</td>
</tr>
</tbody>
</table>

START UP
UNITA' 33
Sannazzaro Gasification Project
Commercial Operations

MONTHLY AVERAGE PRODUCTION OF SYNGAS

- Mar-06: 488 ton/day
- Apr-06: 1038 ton/day
- May-06: 1361 ton/day
- Jun-06: 2000 ton/day
- Jul-06: 1907 ton/day
Sannazzaro Gasification Project
Commercial Operation

MONTHLY ELECTRICAL OUTPUT MWh (GAS TURBINE & STEAM TURBINE)

- **Mar-06**: 0 MWh
- **Apr-06**: 41362 MWh
- **May-06**: 22154 MWh
- **Jun-06**: 91672 MWh
- **Jul-06**: 96308 MWh

Legend:
- **Steam Turbine**
- **Gas Turbine**
Sannazzaro Gasification Project
Sannazzaro Gasification Project
First Run Experience

Issues

• Mechanical design (leakages) on HP BFW Air Cooler

• Design (leakage) on newly developed superheater modules of the WHE

• Soot deposition in the slurry tank

• Solid handling transportation
ENI Sannazzaro Gasification Plant

- "Smooth" start-up
- "High" availability

Owner
Licensor
Contractor
GASIFICATION TECHNOLOGY
THE MATURE WAY...

Sannazzaro Gasification plant has shown a very smooth and reliable start up coming into operations in a very short time with performances at high level of availability and with promised process performance from the very beginning.

“This proved that gasification technology is really today a mature technology; and we look forward to be part of new projects that can be valuable for both Owner and Contractor and also for the Environment”