Investments in refinery capacities in Serbia

September 2016
Belgrade, Energy community
Vladimir Gagic, NIS, Refinery
Presentation content

1. Refinery history
2. Refinery today
3. Strategy and development
4. Key investments
5. Conclusion
History of refinery

1959. Refinery established as a business entity

1965. Start of construction of the first plant

1968. The first plants put into operation:
- Atmospheric Distillation Unit, S-100
- Thermal Cracking, S-200
- Naphtha Platforming, S-300
- Diesel and Jet Fuel HDS, S-400

1979. Start of the process units:
- Atmospheric Distillation Unit, S-2100
- Reconstructed Platforming S-300

1979. Refining capacity 4.8 mln t/y

1985. Start of the process units:
- Vacuum Distillation, S-2200
- Bitumen, S-0250
- FCC Complex and Alkylation

1987. S-200 reconstructed into Visbreaking Unit

1987. Refining capacity 1.3 mln t/y

1999. Bombardment

1999. Market liberalization

2001. Rebuilt refinery

2002. Reconstructed Vacuum Distillation

2002. Reconstructed FCC

2003. Reconstructed FCC

2009. Ownership transformation

2012. Put into operation of MHC-DHT Complex

2013. Reconstructed FCC

2015. Market liberalization

31.07. 2013. Deadline according to the Rules * for achieving the quality of petrol and diesel

31.12. 2015. Deadline according to the Rules * for achieving the quality of fuel oil

*Rules on technical and other requirements for liquid fuels of petroleum origin. Fig. Gazette of RS, no. 123/2012 of 28/12/2012
<table>
<thead>
<tr>
<th>Country</th>
<th>Owner</th>
<th>Refinery</th>
<th>Capacity MM tonnes</th>
<th>Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hungary</td>
<td></td>
<td>Duna</td>
<td>8,1</td>
<td>10,8</td>
</tr>
<tr>
<td>Slovakia</td>
<td>MOL</td>
<td>Bratislava</td>
<td>6,1</td>
<td>14,4</td>
</tr>
<tr>
<td>Croatia</td>
<td></td>
<td>Rijeka</td>
<td>4,5</td>
<td>9,1</td>
</tr>
<tr>
<td>Croatia</td>
<td></td>
<td>Sisak</td>
<td>2,2</td>
<td>6,6</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Lukoil</td>
<td>Burgas</td>
<td>9,5</td>
<td>9,1</td>
</tr>
<tr>
<td>Romania</td>
<td></td>
<td>Ploesti</td>
<td>2,4</td>
<td>12,2</td>
</tr>
<tr>
<td>Romania</td>
<td>OMV</td>
<td>Petrobrazi</td>
<td>4,5</td>
<td>11,1</td>
</tr>
<tr>
<td>Romania</td>
<td>Rompetrol</td>
<td>Petromedia</td>
<td>5,0</td>
<td>10,3</td>
</tr>
<tr>
<td>Bosnia</td>
<td>Zarubezhneft</td>
<td>Bosanski Brod</td>
<td>3,0</td>
<td>7,1</td>
</tr>
<tr>
<td>Serbia</td>
<td>NIS</td>
<td>Pancevo</td>
<td>4,8</td>
<td>8,5</td>
</tr>
</tbody>
</table>

Source: NIS, workgroup analysis  * Nelson index after refinery upgrade
Margins under pressure
- competition
- regulated prices → market related prices

Mogas / diesel imbalance
- need for max upgrading/conversion capacity
- need for export options

Product quality pressure
- Eurograde quality
- GHG balance – biofuels

Variability and uncertainty in demand growth escalate
globalization of the downstream sector
Strategy objectives

NIS Refining business:

– Health & Safety

– Modern & efficient processes and operations

– Long term profitability based on sustainable development model

– One of the most efficient refineries in South East Europe

– Zero per cent of heavy residues
Development directions

**Efficiency**
- Increase Operation Availability
- Improve Technology Efficiency
- Increase Energy Efficiency
- Develop Personal Efficiency

**New technologies**
- Use of conversion-type hydrogenation processes
- Technologies that will allow termination of fuel oil production

**Key directions:**
Maximize efficiency of existing refinery assets & Introduce new technologies
**Health and Safety**

Injuries (LTIF):

- **2006** – 69 injuries in Refinery
- **2016** – 0 injuries in Refinery

874 days without Refinery workers injuries!

Our workers increased number of observations and **improvement** actions to more that **9000/year!!!**

**Industrial safety**

- Number of maintenance activities on process equipment decreased **68%** after **reliability program implementation!**
HSE Indicators
Block Refining

Environmental improvement indicators

Constant environmental improvement is what we plan and do!

HSE Training in Refinery

- All Refinery and contractor workers must be HSE trained in our Refinery
- There are theoretical and practical training for all High risk works
- Our goal is to improve HSE culture
Efficiency: key performance indicators

**KPIs**

- **Energy efficiency index**
- **Operational availability**
- **Personnel index**

**Achieved Results**

- Energy efficiency improved by 35%
- Operational unavailability reduced by 47%
- Personnel efficiency improved by 67%

Key refinery performance indicators significantly improved
Key investments

Refinery modernization 1\textsuperscript{st} phase (till 2012)
   Mild Hydrocracking Complex (MHC) [completed]

Refinery modernization 2\textsuperscript{nd} phase (till 2019)
   Delayed Coker Unit (DCU) [in progress]

Introduction of the new technologies (phase realization)
Fully in line with NIS refining development strategy by 2030
MHC Complex [completed]

**Scope**
- Mild Hydrocracking complex
- Hydrogen Generating Unit
- Sulphur recovery unit
- Amine regeneration unit
- Sour water stripper unit

**Cost/Time**
Total cost: App. 500 MM EUR
Realization (EPC phase): 2009-2012

MHC Technology: Chevron
EPCM contractor: CB&I Lummus

**Effects**
- Increased yield of the diesel and petrol
- Improved quality of the products
- Reduced the content of the sulphur (according to the Euro 5 specification)

<table>
<thead>
<tr>
<th></th>
<th>Gasoline</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphur, max, mg/kg</td>
<td>650</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Benzene, max, % (v/v)</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total aromatics, % (v/v)</td>
<td>65</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Pb, mg/l</td>
<td>13</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Diesel</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphur, mg/kg</td>
<td>5.000 (avg)</td>
<td>max. 10</td>
<td></td>
</tr>
<tr>
<td>Polycyclic aromatics max, % (m/m)</td>
<td>not limited</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
MHC Complex [completed]

MHC/DHT FEED
- Petroleum, Light & Heavy Gas Oil from Crude Distillation Unit
- Vacuum Heavy & Light Gas Oil from Vacuum Distillation Unit

KEY FLOWS
- Unconvertible Oil: Feed to FCC unit
- Low sulphur kerosene: Diesel blending (high quality jet fuel)
- Low sulphur Euro Diesel: High quality product (Euro 5 standard)

MCH: Realized fully in line with NIS refining development strategy
**MHC Complex [completed]**

**Implementation Schedule**

<table>
<thead>
<tr>
<th>№</th>
<th>MHC Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MHC</td>
</tr>
<tr>
<td>2</td>
<td>Design &amp; survey work</td>
</tr>
<tr>
<td>3</td>
<td>Equipment and Materials</td>
</tr>
<tr>
<td>4</td>
<td>Construction and assembly works</td>
</tr>
<tr>
<td>5</td>
<td>Other</td>
</tr>
</tbody>
</table>

Project realized within planned budget and projected time frame.
Proved projected process performance.
### Delayed Coking Unit (DCU) [in progress]

**Scope**
- New Units
  - Delayed Coking Unit
  - Amine regeneration unit
  - Acid waste water treatment unit
- Revamping of existing Units
  - MHC/DHT hydro cracking
  - Sulphur & Merox Unit

**Cost/Time**
- Total cost: App. 330 MM US$
- Realization (EPCm phase): 2016-2019

**DCU Technology:** Lummus Technology
**EPCM contractor:** TBA

**Effects**
- Increasing of refinery profitability
- Maximizing high-margin finished products production
- Maximizing process utilization
- Increasing of flexibility (vs. market requirements and constraints)

**Product yield:**
- Termination of Fuel Oil production
DCU Feed
- Vacuum Residue from Vacuum Distillation Unit
- Slurry oil from Fluid Catalytic Cracking Unit.

**KEY FLOWS:**
- LPG: To LPG storage (after amine washing & caustic treatment)
- Coker Naphtha and Light Coker Gasoil: To DHT;
- Heavy Coker Gasoil: To Mild Hydrocracking (MHC);
- The produced coke: Market (as coke fuel grade)

DCU: Technology optimally selected for closing identified gaps
Delayed Coking Unit (DCU) [in progress]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>1</td>
<td>DCU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Design &amp; survey work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Equipment and Materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Construction and assembly works</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Current project status:

- Confirmed Project Economical effectiveness and approved project budget
- Signed Purchase Orders for LLI equipment
Delaye\text{d Coking Unit (DCU). Key phases

- Feasibility Study (completed 07/2013)
- FEED CONTRACTOR Selection (completed 02/2015)
- BASIC/FEED Design (completed 02/2016)
- EPCM CONTRACTOR Selection (in progress)
- EPCM (expected duration is 28 months)
Key business challenges recognized and addressed

Efficiency improvement program defined and realization started

First phase of refinery modernization completed

Competitive position on the market significantly improved

NIS refinery continues realization of significant investment program despite negative macroeconomic environment