REDUCTION OF NOX EMISSIONS IN COAL POWER PLANTS

SALMISAARI SCR, HANASAARI SNCR

Turkish visitors at Salmisaari power plant 23.2.2016
Reima Rynö
Background

- NOx, SOx and particulate emission limits tightened
- New NOx-limit could not be reached with existing deNOx equipment
- Catalyst (SCR) to Salmisaari
- Urea injection (SNCR) to Hanasaari
NOX EMISSIONS FROM HELEN

HELEN NOx EMISSIONS AND ENERGY PRODUCTION 1980-2013 (FROM HELSINKI REGION)
CASE SALMISAARI

SCR – Catalyst
Salmisaari B power plant

- Boiler 1
  - Natural circulation pulverized hard coal boiler
  - Fuel power 504 MW
  - Commissioned 1984
- NOx-reduction method originally:
  - Over Fire Air (OFA)
Salmisaari NOx emissions and limits (mg/Nm³)

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous limit</td>
<td>500</td>
</tr>
<tr>
<td>Typical emission</td>
<td>400</td>
</tr>
<tr>
<td>Limit by IED</td>
<td>200</td>
</tr>
<tr>
<td>Limit by TNP (calculated)</td>
<td>200</td>
</tr>
<tr>
<td>Possible limit in future</td>
<td>180</td>
</tr>
</tbody>
</table>

Salmisaari SCR project schedule

2008 – 2010
Feasibility studies

4/2013
Decision to proceed to SCR procurement

5/2013 – 2/2014
SCR procurement process by EU-wide bidding

3/2014
Purchase order

Technical design

11/2014 – 9/2015
Building work

5/2015 – 10/2015
Installations

11/2015 – 12/2015
Testing and commissioning

Guarantee tests
SCR WORKING PRINCIPLE IN SALMISAARI

Picture is based on preliminary sketch
SCR equipment presentation
SCR equipment presentation
SCR equipment presentation
SCR equipment presentation
SCR equipment presentation
SCR experiences

- First retrofit SCR to hard coal boiler in Finland
- Technical risks are low, working principle is simple
- Possibility to very high (90…95 %) NOx-reduction
- Needs modifications to flue gas duct, new steel structures, possibly also new buildings for equipment and reagent (urea or ammonia) reception
- The system was commissioned in 12/2015.
- Performance has been very good
CASE HANASAARI

SNCR – Urea injection into boilers
Hanasaari B power plant

- Boilers 3 ja 4
  - Natural circulation pulverized hard coal boilers
  - Fuel power 2 x 363 MW
  - Commissioned 1974 and 1977
- Original NOx-reduction method:
  - Low-NOx burners
Hanasaari NOx-emissions and limits (mg/Nm$^3$)
Hanasaaren projektin aikataulu

11/2012 – 12/2013
Feasibility studies

TNP decision and decision to purchase SNCR

Procurement process by EU-wide bidding

12/2014
Purchase order

10/2014 – 5/2015
Technical design

4/2015
Construction work

7/2015 – 9/2015
Boiler 4 installations

10/2015 – 04/2016
Boiler 4 testing

6/2016
Boiler 3 installations

7/2016 – 8/2016
Boiler 3 testing
SNCR working principle in Hanasaari
SNCR in Hanasaari, urea injection testing

Testing 2013 and 2014. In the tests was NOx-reduction of approx. 30% achieved.
SNCR in Hanasaari, equipment presentation
SNCR in Hanasaari, equipment presentation
SNCR in Hanasaari, equipment presentation
SNCR in Hanasaari, equipment presentation

Kuva: M.A.L. Umwelttechnik GmbH [http://www.mal.at/]
SNCR in Hanasaari, equipment presentation
SNCR experiences

- First SNCR in coal boiler in Finland
- Much cheaper than SCR but lower NOx-reduction and technically more risky
- In theory, possibility to reach 30 – 40 % NOx reduction (SCR: > 90 %)
- Working principle otherwise simple, but the urea must be injected into very narrow temperature range: approx. 900 – 1100 °C.
- Common method in energy production and industry, but installations to large (hundreds of megawatts) hard coal boilers are not so many
- Each boiler is unique (boiler type, power, fuel, etc.) and therefore it is very important to test urea injection in practice to see the performance before purchase.
- SNCR in boiler 4 is under test phase, the performance is not yet as good as designed but improvements are being made during the tests.
- SNCR for boiler 3 to be installed in summer 2016
Summary

- Coal energy can be produced with only small emissions into air
- The starting point for the project was unclear considering technology and legislation and political decisions (What are IED limits? Will the TNP period come or not? Will the Hanasaari be shut down or not and when? Which NOx-reduction method to choose?).
  - From this starting point in end of 2012 we are now close to finish
- Time is needed for comprehensive studies, practical testing (SNCR), procurements and design, therefore legislative decisions are needed years before restrictions coming into effect
- The NOx project has met its targets and Helen coal plants can now reach the new IED/TNP NOx-limits. Also new SOx and dust limits are reached.
TEŞEKKÜR EDERIM
THANK YOU
KIITOS

reima.ryno@helen.fi