GETICA CCS
CO_2 CAPTURE

CO_2 Transport and Storage

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Turceni Power Plant (1)

- ✓ Pulverized lignite-fired Power Plant
- ✓ Conventional steam cycle in condensation
- ✓ Operates in the base load of the National Grid
- ✓ Its seven power units were commissioned in 2 stages:
  - ✓ Stage I – 4 units (no. 1 – 4) of 330 MWe = 1320 MWe, commissioned between 1978 - 1982
  - ✓ Stage II – 3 units (no. 5 – 7) of 330 MWe = 990 MWe, commissioned between 1983 – 1987; the construction of the Power Unit no. 8 was stopped by Governmental Decision, HGR no. 897/2002.

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Turceni Power Plant (2)

- ✓ The present situation of the power units (the commissioning year between brackets):
  - ✓ Unit no. 1 (1978): in operation
  - ✓ Unit no. 2 (1979): out of service, decommissioning started
  - ✓ Unit no. 3 (1980): in operation
  - ✓ Unit no. 4 (1981): in operation, retrofitted in 2002
  - ✓ Unit no. 5 (1983): in operation, retrofitted in 2006
  - ✓ **Unit no. 6 (1985): conserved, will be retrofitted**
  - ✓ Unit no. 7 (1987): in operation
  - ✓ Unit no. 8 (unfinished): decommissioned

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Turceni – Unit no. 6 (330MW)

- undergoing **retrofitting process** – deadline 2014
- **FGD** system – deadline 2012
- **ash and slag "dense slurry"** system – deadline 2012

Main technical features after retrofitting	
Steam Turbine + Electric generator	
Rated gross power	330MW
Maximum long term available gross power	310MW
Annual average gross power	280MW
Steam Boiler	
Steam flow	1035t/h
Steam parameters (pressure / temperature)	192 / 540 bar / ^{0}C
Efficiency	88%

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Chilled Ammonia Process

Well-known and reliable flow-scheme:

- ✓ Cooled flue gas is treated with ammonium carbonate in solution, which reacts with CO_2 to form ammonium bicarbonate.
- ✓ Raising the temperatures reverses the above reactions – releasing pressurized CO_2.

Advantages over traditional technologies:

- ✓ Energy-efficient capture of CO_2 .
- ✓ High CO_2 purity, high CO2 pressure.
- ✓ Tolerant to oxygen and flue gas impurities.
- ✓ Stable reagent (no degradation possible).
- ✓ No emission of trace contaminants.
- ✓ Low-cost and globally available reagent.
- ✓ Value by-product (fertilizer).

Ad-hoc technology!

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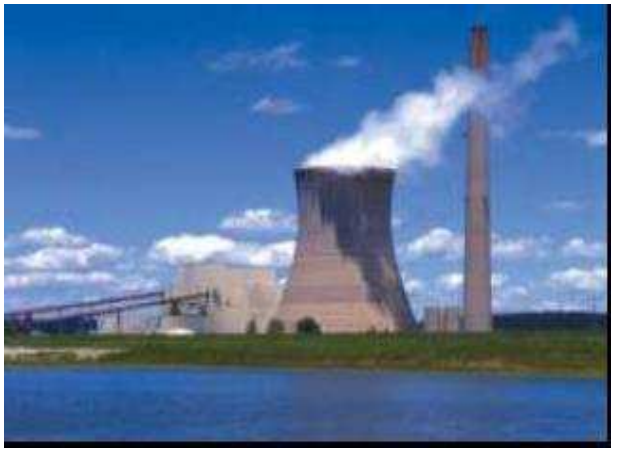
Chilled Ammonia Process
Mountaineer Validation Facility – New Haven

- ✓ AEP´s Mountaineer Plant (1,300 MWe) - coal fired (West Virginia).
- ✓ In 2009 CAP applied to to a slip-stream of flue gases (20 MWe).
- ✓ CO2 stored into deep formations (1.5 miles beneath plant surface).
- ✓ Validation Plant (Mountaineer) – final results:
  - ✓ CO2 Captured = 7,000 tons/month.
  - ✓ CO2 Capture Rate: 90% demonstrated (75% as design).
  - ✓ CO2 Stream Purity of 99% minimum.
  - ✓ Ammonia losses in line with predictions / simulations.
  - ✓ Energy Penalties in line with predictions / simulations.
  - ✓ Capture Plant availability greater than 90%.
  - ✓ Robust steady operation during all operation modes.
- ✓ Plant will run till June 30th 2011 to further investigate storage.
- ✓ ALSTOM gained important expertise **in the full CCS chain**.
- ✓ Important contribution to implementation of risk mitigation and managment.



Mountaineer Power Plant

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Feasibility Study Results

- ✓ Technology Selection (Chilled Ammonia Process).
- ✓ Process Optimization (lower parasitic load to power plant).
- ✓ Heat Integration Concept selected (CCS Ready Concept).
- ✓ OPEX and CAPEX estimated.
- ✓ Identification of interfaces with Power Plant.
- ✓ Identification of interfaces with Transport / Storage.
- ✓ Preliminary 3D Model for the new plant.
- ✓ Characterization of CO2 Stream delivered to Transport.
- ✓ NER300 Application, support for its preparation (workshop).

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Conclusions

- ✓ Chilled Ammonia Process was selected due to the higher performances and negligible enviromental impact (legislation compliance and no harmful effluent).
- ✓ Chilled Ammonia Process has been validated in accordance with Alstom´s R&D Roadmap (one further step to commercial size plants).
- ✓ Chilled Ammonia Process has demonstrated a robust steady-state operation (even at load changes) using real flue gas.
- ✓ Process simulations have been proved to be reliable and predicting well the actual plant parameters, such as:
  - ✓ CO2 Capture Rate
  - ✓ Ammonia Losses
  - ✓ Energy Demand
  - ✓ Solution Circulation Rate
  - ✓ CO2 Composition
- ✓ Confidence in the design for a large-scale demonstration project.
- ✓ Next step → FEED to be developed to reach +/- 10% cost estimation before EPC.

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Thank you for your attention!

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