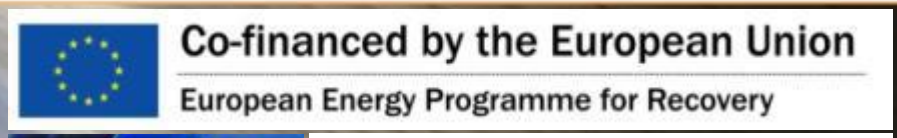
PGE CCS Project



Warsaw, November 18th, 2014

Introduction

In 2009 PGE Elektrownia Bełchatów S.A. initiated activities aiming at construction of a demonstration CCS plant.
The CCS plant was intended to be integrated with the 858 MW power unit, hereinafter also referred to as Base Plant, that since September 2011 has been running at Bełchatów Power Plant Division.

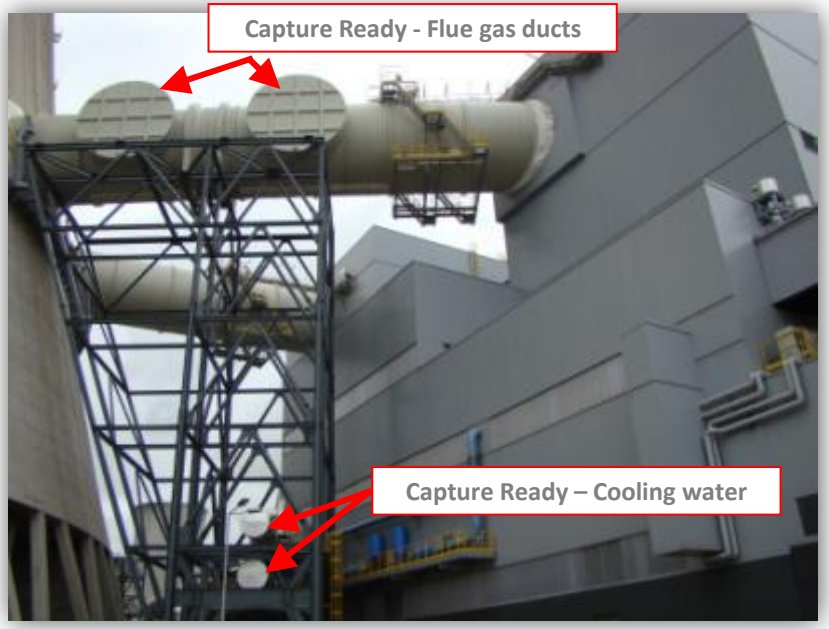
Integration with 858 MW power generation unit

The new 858 MWe power generation unit was originally not designed to be “Capture Ready”. This means that some modifications to the unit needed to be implemented in the course of its construction to ensure an integration of the CCP.

The key modifications included:

- Re-engineering and re-location of the equipment from the area identified for the CCP
- Tie-in for off-take and return of cooling water required for the CCP
- Tie-in for off-take and return of flue gas to the main flue gas ducts

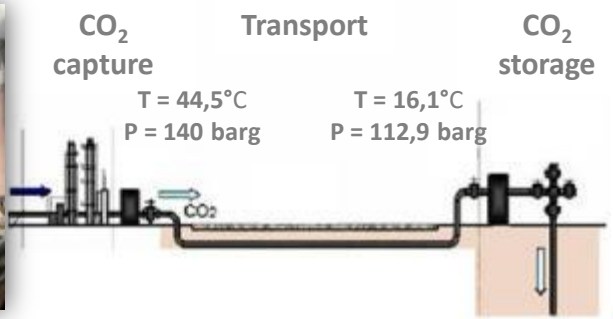
The scope of work was completed on 30th October 2010 as a part of the EPC turnkey contract dedicated to the new 858 MWe power generation unit



Technical specifications of the CCS Plant (Basis of Design)

The Bełchatów CCS Project included the following key components:

- The power generation unit with the gross capacity of 858 MWe, supercritical parameters, efficiency 42%, lignite fired
- **Carbon Capture Plant (CCP)** of size equivalent to 260 MW, capture efficiency 85%, utilizing the Advanced Amine Process (AAP) & its integration with the 858 MW unit, scaled to capture approximately 1,8 million tones of CO_2 per annum, a slipstream of the flue gas equivalent to 33.3% of total flue gas flow was extracted from a tie-in connection point located downstream one of the wet FGD absorbers
- **CO_2 Transportation**: this component comprised the construction of the (buried) pipeline and the associated infrastructure to transport the compressed CO_2 from the Carbon Capture Plant to the storage site
- **CO_2 Storage**: this component covered injection of pressurized CO_2 into the ground (deep saline aquifers) for permanent storage and the associated facilities



Carbon Capture Plant (CCP)

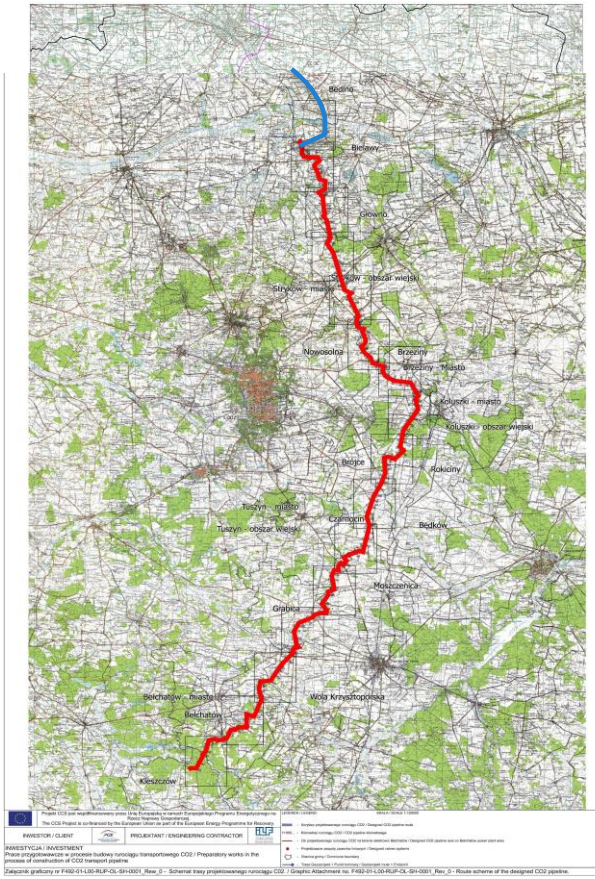
- Dec. 11th, 2009 the first CCP Environmental Decision was issued.
- Feb. 23rd, 2010 r. a building permit for the CCP was validated
- At the beginning of 2010 the AAP scheme was changed into 2nd generation flow scheme, which should result in CCP operating costs reduction, especially considerable steam consumption drop. The 2nd generation flow scheme resulted in several changes in the context of number and size of equipment
- In 2010 FEED documentation, additionally was extended of the part of works including detail engineering process for the critical equipment

Finally the entire FEED and Detailed Engineering documentation were delivered by the Contractor on June 6th, 2011.

The next step was planned: selection of the Main Contractor of CCP in turnkey contract formula

Transport component (1)

- In 2009 the Feasibility Study for CO_2 pipeline was prepared.
- Transport preparatory work programme started in n June, 2012, terminated January 2013,
- Work scope covered:
  - Comprehensive pipeline routing through 16 communes (15+1))
  - Preliminary technical analysis of the CO_2 pipeline transport
  - Preliminary technical analysis of pipeline depressurisation condition
- Main results:
  - The final pipeline length ~142 km
  - The seizing the optimal CO_2 pipeline diameter i.e. 300 mm and the maximum possible distance between the block valves and associated depressurization columns (to 16 km)
  - Based on experts opinion, the location of the injection area indicated was changed



Transport component (2)

As a result of the project termination some activities within the preparatory works could not be completed.

Those are:

- In the framework of the environmental impact assessment study preparation and obtainment of the Environmental Decision for the CO_2 pipeline, the catalogue of nature was partially prepared

- Providing documentation regarding inclusion of the pipeline route in the Local Plan for Spatial Development in relevant communes and relevant Commune Council decisions in this regard or Decisions on Conditions of Development for 16 communes along the pipeline route

- Preparation of the technical part of the Terms of Reference for selection EPC pipeline turnkey contractor.

- The entire documentation concerning plots' owner registry – total number of plots - 4097

Storage component (1)

- **2009 - 2011 Phase I of the storage component: „Site selection”.**

  Within Phase I of storage component geological examination two of the three storage structures under consideration, i.e. Lutomiersk-Tuszyn (up to Bełchatów) and Wojszyce, was ongoing and included 2D seismic, drilling tests, gravimetric and additional specific research in appraisal wells dedicated to CO_2 migration, i.a. for reservoir and seal rocks magnetic resonance, advanced sonic, well inclination, electrical formation imaging, element spectroscopy, formation pressure, isolation scanner, sidewall cores, minifrac, strength measurement, compression tests, etc. The third potential storage site, Budziszewice, had adequate geological data archived and available. Therefore, only data reprocessing and new interpretation was considered for this CO_2 storage site location.

Drilling rig at the Wojszyce and Lutomiersk – Tuszyn sites

Protected area of the appraisal well at the Wojszyce site (Kaszewy-1 hole).

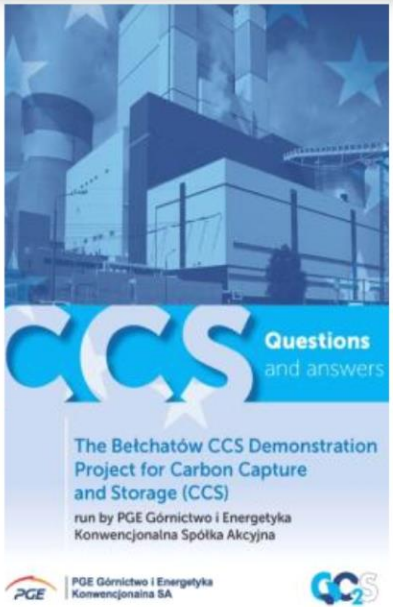
Storage component (2)

- Based on the above-mentioned processes, the advisor within the Phase I of the storage component, prepared “Site Selection Report” in June 2011.
- Thereafter, a joint report was prepared in December 2011 by AGH University of Science and Technology
- Ultimately, based on experts’ and advisors’ opinions, PGE GiEK SA selected in February 2012 Wojszyce structure for the Phase II of the storage component implementation, i.e. Site Characterization with the Budziszewice structure as an alternative
- The main reasoning behind the choice of Wojszyce was:
  - Relatively simple anticlinal structure without faulting and thick, homogeneous cap-rocks
  - High excess capacity
  - Only one existing and properly abandoned well (Kaszewy 1)

CAPEX and OPEX – financing opportunities

Given the demonstration character of CCS Project, PGE GiEK SA would prefer to arrange non-refundable financing support as much as possible. The following sources of financing were expected to provide the basis for funding the CCS Project:

- European Energy Plan for Recovery (EEPR) – grant agreement was signed on 5th May 2010.
- Emissions Trading Scheme „NER300" Programme – the application was submitted on 9th February 2011
- Norwegian Financial Mechanism (NFM) – Memorandum of Understanding was signed on 10th June 2011
- Domestic Financing Mechanism



Public engagement activities (1)

The strategic impact of public understanding and acceptance of the CCS concept is substantial in enabling its widespread commercialisation. Outreach activities particularly concerning CO_2 transport and geological storage:

- Since September 2009 PGE GiEK SA organized several meetings and the workshops with authorities from regional and local level.

- Since September 2009 to the end of August 2010 outreach team provided the external public engagement campaign according to I Phase of the storage component developoment for communities, where geological examination and tests were ongoing.

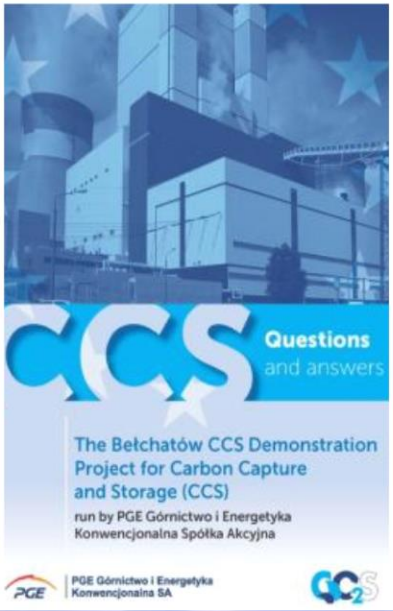
- 2010/2011 social groups characterization done by an external PR company.

- Twenty five briefing meetings in March 2012 have been held in the community offices of the local authority representatives in Lodzkie Voivodeship.

- Since July 2012 PGE GiEK SA had been conducting an informative campaign concerning the preparatory work for CO_2 transportation pipeline in 16 of the Communities in Lodz Voivodeship.

During the meetings the local authorities and inhibitants showed their interest in the topic of Bełchatów CCS Project.

Public engagement activities (2)



Resignation

February, 2013 PGE GiEK SA made the decision to close the Bełchatów CCS Project

The most important threats were:

- Lack of legal and financial framework at the national level for implementation of the CCS Project, reflected by:
  - lack of determination to support financing of the project within the Domestic Financial Mechanism,
  - delayed implementation of the directive on the geological storage of carbon dioxide into national legal framework, being of crucial importance for implementation of the CCS project as the present law did not foresee a possibility of injecting industrial amounts of CO_2 into underground geological formations,
  - lack of legal mechanisms, in the light of the present legal framework, allowing for qualification of the CO_2 transportation pipeline as a public purpose investment, it significantly complicated the process of consultations with communes as well as, in the same context, still delayed enactment of the act on transportation corridors which would enable comprehensive solutions eliminating barriers in the investment process for line investments including CO_2 transportation pipelines and defining them as the public purpose investments.
- Problems with selection of the Coordinator of Phase II of the storage component caused by a lack of interest of the oil&gas companies to invest in the risky and uncertain CCS area facing the perspective of quick benefits in the field of for instance shale gas
- Opposition of the public to geological and geophysical works carried out within the storage component implementation, and to the idea of underground CO_2 storage in general, and in some communes also lack of public acceptance for routing the CO_2 transportation pipeline.

As a result of the above-mentioned facts PGE GiEK SA sent a letter of termination to the European Commission in March 2013 and the effective date of the termination date was determined by EC in May 2013, finally project was closed and settled.

Lessons learned (1)

- Support and involvement of the local, regional and national governments throughout all project phases, as well as a positive public perception especially for both onshore transport and storage, are crucial for creating the advantageous circumstances for the successful implementation
- CO_2 transportation pipeline should be qualified as a public purpose investment to eliminate barriers in the investment process (also specific act of transportation corridors including Co2 option would be useful)
- Financial support for the project from all levels: EC assistance, national and potentially regional to the investment phase as well as operational phase as long as CCS will fully commercial and competitive
- Lesson from the integration of CCS with a power plant, productive cooperation between the power plant construction and CCS teams is essential.
- Selection of the proper technology provider, who has to recognize and address in a proper way process dynamics limitations early at the stage of the design process.
- Within transport component implementation the important issues are the permitting process and public acceptance for onshore CO_2 transportation.

Lessons learned (2)

- In the context of storage facilities, the crucial point is to select, examine and characterize a storage site to mitigate all threats and risks concerning CO_2 leakage and to locate the storage site as near as possible to carbon capture plant (risk concerning CO_2 transport) and also within a quiet sparsely populated area
- Critical issue is to organize a very comprehensive public campaign from the start up of the project implementation, even during the planning phase. Stakeholders have to be informed all the time and feel, that play crucial role in project decisions' process.
- Active participation in CCS networks and platforms to share experiences and learn from other CCS initiatives.
- Multidisciplinary CCS project character forced to create competent all-party project team: technical, public engagement, permitting, financial, knowledge dissemination specialists with enthusiastic, ambitious people deeply involved in the project

We truly believe such CCS Team was created and good, successful work was done till the project closure point

Evidences:

- **EC approval of all eligible costs determined by PGE GiEK SA in the EEPR Action budget vs project settlement**
- **Valuable technical documentation provided in the project lifetime**
- **Experience gained and international relation ships established through knowledge sharing platforms**

Thank you for your attention

Marzena Gurgul