Chugoku Electric Power's Approach in Poland

いいことプラス
Energia

November 28, 2013

The Chugoku Electric Power Co., Inc.

Contents of Today's Presentation

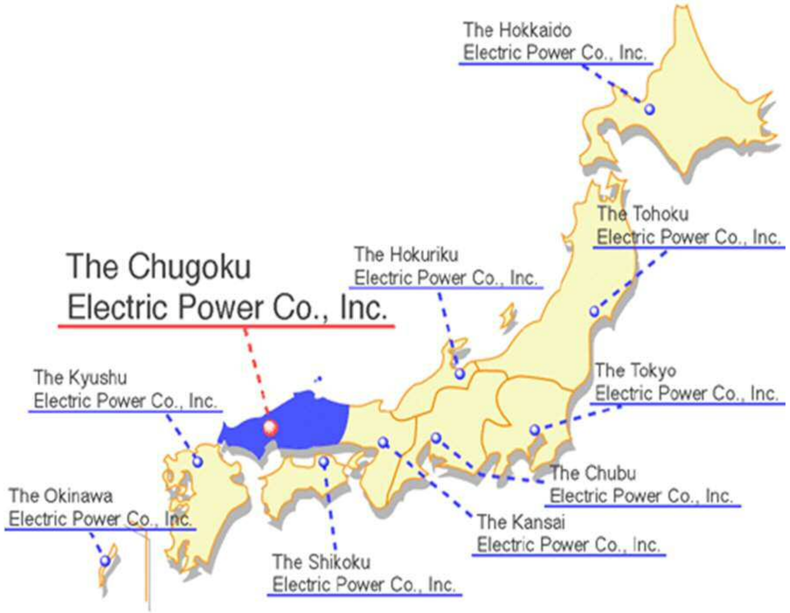
1. Outline of Chugoku EPCO (CEPCO)
2. Our Approach in Poland
3. JI Project between Polish Company and CEPCO
4. NEDO research program for "Developing Projects Using High-efficiency Coal Utilization Systems"
5. NEDO research program for "Program of Research on Global Warming Prevention Projects in Poland Applying Smart Grid Technology"

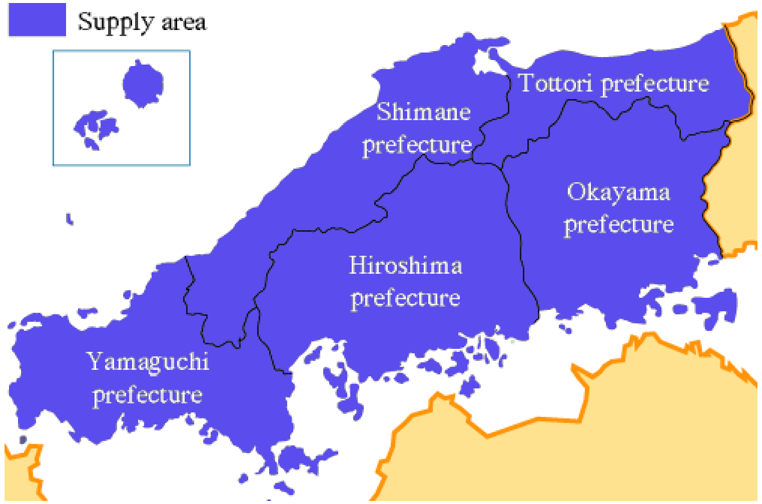
1 . Company Profile (1/2)

Name	The Chugoku Electric Power Co., Inc.
Our Main Business	Generation, Transmission, and Distribution of electric power
Address (Headquarters)	4-33 Komachi, Naka-ku, Hiroshima 730-8701, Japan
Date of Establishment	1 May, 1951
Number of Employees	9.814
Electricity Sales	Approx. 58.7GWh
Operating Revenues	1,199 billion Yen (approx. 12 billion USD)
Ratings	Moody's : A3※ (Long Term) ※As of 1 May, 2013

As of March 31, 2012

1. Chugoku Electric Power Company Profile (2/2)





Number of Electric Power Stations	Thermal 12 Hydroelectric 97 Nuclear 1 Renewable 1 Total 111
Generating Capacity Own Facilities	Thermal 7,801 MW Hydroelectric 2,906 MW Nuclear 1,280 MW Renewable 3 MW Total 11,989 MW
Transmission Lines	Route length 8,366 km
Substations	Number of substations 470 Authorized capacity 50,793 MVA
Distribution Lines	Route length 82,328 km

2. Our Approach in Poland

We began to visit Poland in 2007 to negotiate emission sales agreement. We concluded emission sales agreement in 2008 and 2009. We executed cooperation agreement with PGE and Tauron in 2010. We began to conduct feasibility studies for coal-fired thermal power station and investigations of smart grid in 2010 with support provided by METI and NEDO.

Year	Activity
Mar. 2008	Signed a contract regarding acquisition of emission credit from JI project of coal mine methane capture and utilization at JSW Borynia.
Sep. 2009	Signed a contract regarding acquisition of emission credit from JI project of coal mine methane capture and utilization at KW Szcyglowice, Sosnica.
May. 2010	Signed "Letter of Intent" regarding cooperation with PGE and Tauron.
Oct. 2010 ～ Mar. 2011	Implemented a study about possible utilization of Japanese clean coal technology in a Polish power sector as a METI's* program. *Ministry of Economics, Trade and Industry of Japan
Jun. 2011 ～ Mar. 2013	Conducted a feasibility study as a part of NEDO's research program for "Developing Projects Using High-efficiency Coal Utilization Systems".
Jun. 2011 ～ Mar. 2012	NEDO "Feasibility Studies with the Aim of Developing a Bilateral Offset Credit Mechanism FY2011" "Program of Research on Global Warming Prevention Projects in Poland Applying Smart Grid Technology"

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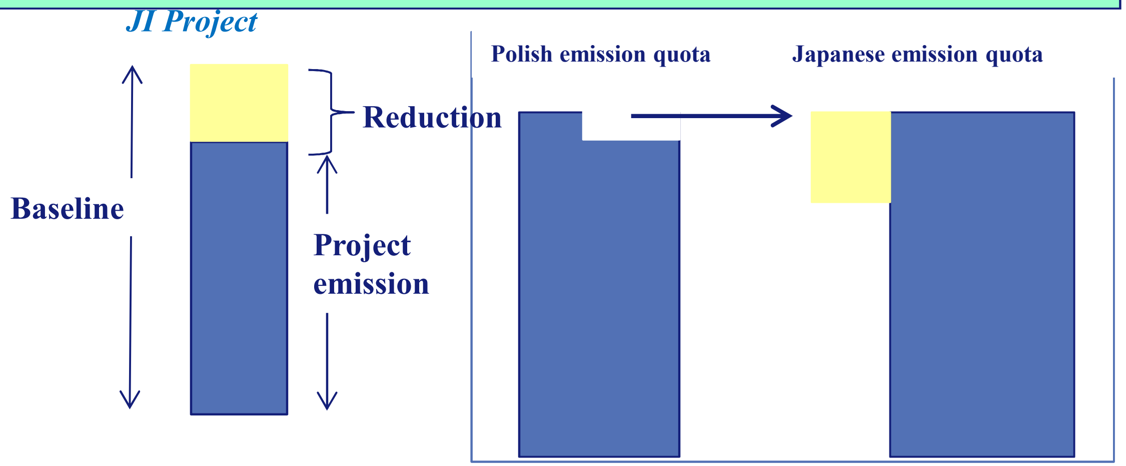
JI Project and Emission Transfer to CEPCO

・We started to implement JI projects in Poland in 2007. A total of 975,000 tons of CO_2 emission credits for the period by the end of 2012 were transferred from Poland.

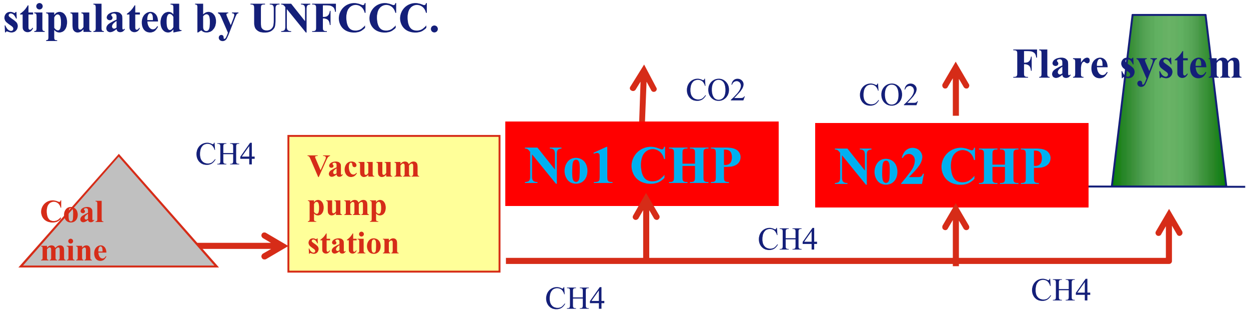
- JI is a mechanism in which Poland and Japan cooperate in conducting an emission reduction project in Poland and emission credits are issued according to the emission reduced as a result of the project.



Project	Counterpart	Emission reduction period	Emission transfer in tCO_2
Szczgolowice Coal Mine	KW	May 2009 to Dec. 2012	201,861
Sosnica Coal Mine	KW	May 2009 to Dec. 2012	244,036
Borynia Coal Mine	JSW	Mar. 2008 to Feb. 2012	106,609
Other	Other	Jan. 2009 to Oct. 2010	422,835
Total			975,480

JI Project at KW Szeczgolowice Coal Mine

CH4 is a 21 times more powerful greenhouse gas than CO2 in terms of global warming effect. The combustion of CH4 in CHP (Combined Heat and Power) or flare system is effective to prevent global warming. In addition, electric power and heat generated in CHP can be used at the coal mine. We reduced 200k tons of CO2 through the JI project at KW Szeczgolowice coal mine as well as contributed to the safe operation of the coal mine through the modernization of the ventilation system. We were involved in the preparation, review and registration of the project design documents and provided advice on the design of instruments in accordance with the method stipulated by UNFCCC.



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CEPCO's USC Plant

- We employed a 600°C class USC plant for the first time in Japan in an effort to increase the efficiency of our power generation plant.
- We have been operating the USC plant for about 15 years while overcoming initial troubles.

Site area	Approx. 690,000m^2
Output	1,000MW(Gross)
Steam conditions	600/600°C, 24.5MPa
Maximum continuous evaporation	2,900t/h
Efficiency	43%(HHV, Gross)
Environmental regulation value	SOx:102ppm NOx:60ppm Dust:28mg/m3N
Environmental equipment	・Dry type ammonia catalytic reduction method ・Low temperature electric dust collector ・Wet-limestone-gypsum
Commencement of operation	In 1998

Outline of Research Program

- **We conducted a research program based on the assumption that Japan's CCT is utilized for a new unit construction project at a coal-fired thermal power station of Tauron Group, our partner, which was at the initial planning stage.**
- **We conducted this research program in three steps in cooperation with Ministry of Economy, Trade and Industry and NEDO.**

May 2010	Execution of Cooperation Agreement with PGE and Tauron
Oct. 2010 to Mar. 2011	【Step 1】 Through a project supported by Coal Division of Agency of Natural Resources and Energy (CCT Facilities Diagnosis Cooperative Project) , we conducted a research program for the possible employment of Japan's CCT for coal-fired thermal power stations of Tauron and Energa.
Jun. 2011 to Mar. 2012	【Step 2】 Through NEDO research program for "Developing Projects Using High-efficiency Coal Utilization Systems", we conducted a research program for developing projects (FS) for new construction plan of USC coal-fired thermal power station of Tauron.
Jun. 2012 to Mar. 2013	【Step 3】 Through NEDO research program for developing projects for Tauron USC coal-fired thermal Power Station plan, we discussed the optimal layout and EPC cost reduction based on the result obtained in Step 2.

Major Specifications of New Plant(1 of 2)

- We recommend a mature USC plant which is superior in terms of stable operation and economic efficiency
- As for CCS (storing carbon dioxide in the ground), we evaluated the capture and compression of CO_2 from a technical viewpoint as CCS Ready applies due to EU directive and detailed discussions are required.

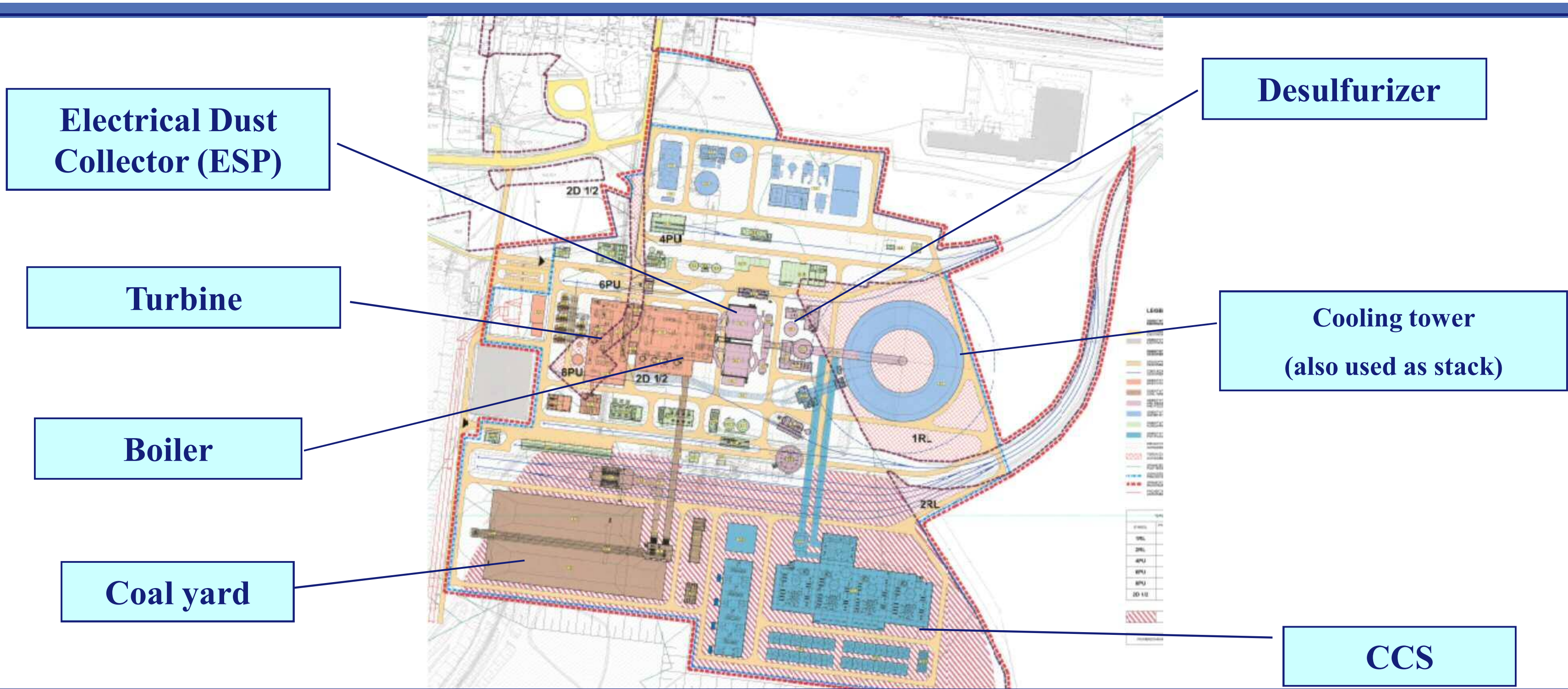
	Mature USC (Priority placed on safety operation)	Advanced USC Highest efficiency pursued
Designed plant efficiency (LHV, Gross/Net)	47.4 / 45.1%	47.7 / 45.4%
Steam pressure	25MPa	28MPa
Steam temperature	600 / 620°C	Same as the left
Plant output (Gross/Net)	1,050 / 1,000MW	
Annual electric energy Generated (Net, average for 30 years)	6,600GWh	6,469GWh
Main fuel	Hard Coal (Bituminous coal)	Same as the left
Environmental equipment	Denitrizer, desulfurizer, and dust collector	
Environmental planning value (regulation value)	NOx : 100mg/m3N (150mg/m3N) SOx : 100mg/m3N (150mg/m3N) Dust: 10mg/m3N (10mg/m3N)	

Major Specifications of New Plant (2 of 2)

- Replacing old existing units with a new unit enables to reduce environmental burden of the power station. The table below shows comparison between the new unit and existing units.

	New unit	Existing unit (Correspond to 1000MW)	Notes
Technology	Ultra Super Critical	Sub Critical	
Capacity	1,000MW (Net)	Correspond to 1000MW	Net
Heat rate	47.4%	37.1%	LHV, Gross
Auxiliary ratio	4.76%	8.89%	
Biomass co-firing	—	5.6%	Ratio by weight, Caloric value : 16.0MJ/kg
Coal consumption rate	386t/h	493t/h	Caloric value : 20.9MJ/kg
Annual coal consumption	2,530,000 t	3,240,000 t	Annual utilization ratio : 75%
CO_2 emission rate	0.726kg-CO_2/kWh	0.889kg-CO_2/kWh	Gross
Annual CO_2 emission	5.01million ton	6.41million ton	Annual utilization ratio : 75%

Recommended Layout for New Construction Project

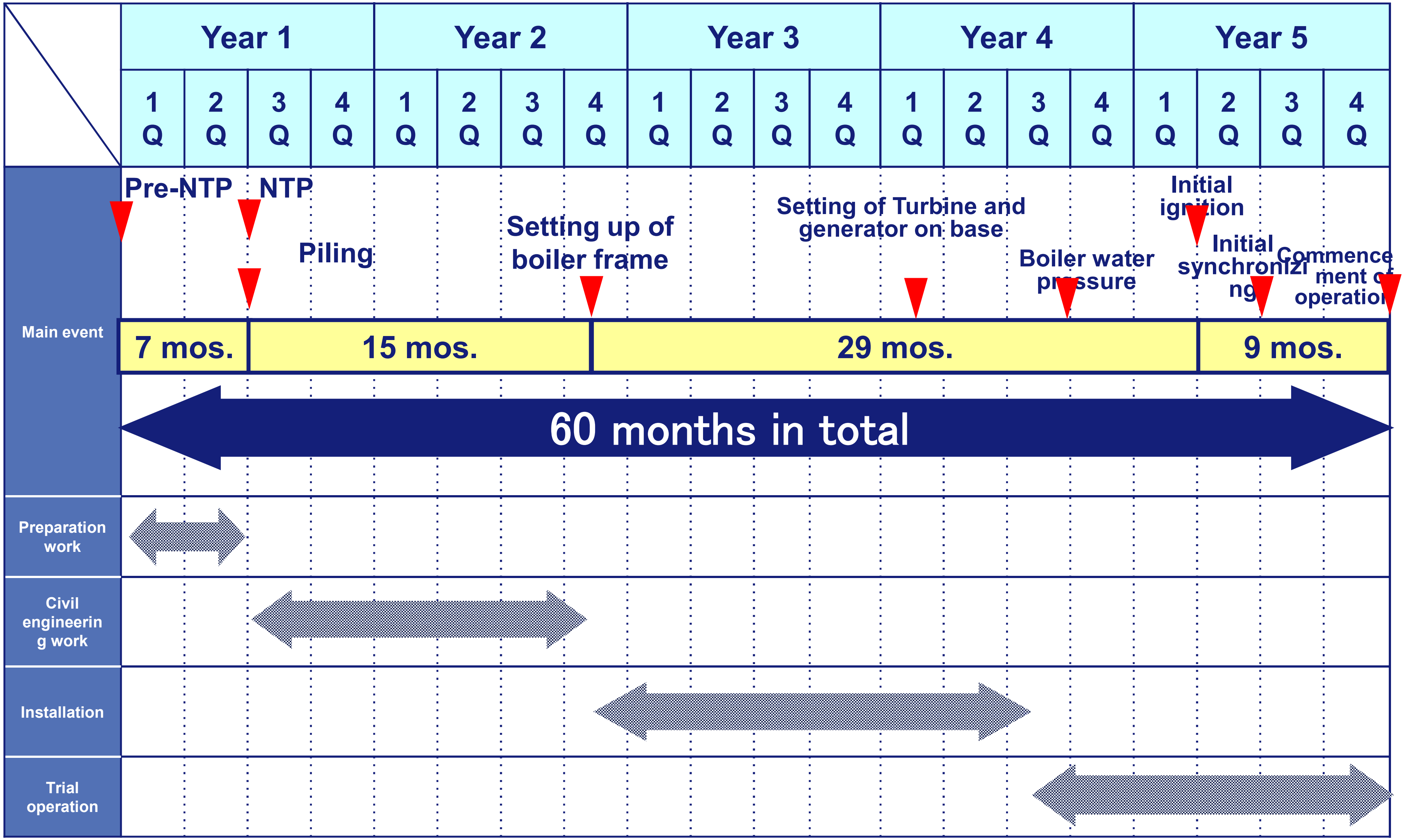


Layout made through a research program in 2011 【Step 2】		Optimal layout made through a research program in 2012 【Step 3】	
Condition of land use	Use of land owned by Tauron	**Condition of land use**	Acquisition of surrounding land (forests and private residents)
Merit	Through the research program conducted in 2011, we confirmed that it is possible to install all facilities in Tauron's land.	**Merit**	Shortening of conveyor Shortening of exhaust duct, etc.
Demerit		**Demerit**	Relocation of existing transmission lines Extension of cooling water system , etc.
Reduced cost		**Reduced cost**	Approx. 17 mil. Euro

New Plant Construction Schedule

- The construction period is 60 months.

NTP: Notice to Proceed



Conclusion

Technical evaluation

- It is highly possible to meet requirements for the construction of a 1,000MW USC plant in Tauron's land . There is no technical problem.
- Considering high reliability, operation cost and other factors, it is desirable to employ a mature USC plant with steam conditions of 600/620°C and 25MPa which has abundant achievement instead of an advanced USC plant with steam conditions of 600/620°C and 28MPa.
- We discussed various issues based on the assumption that 85 % of CO2 is collected through the installation of a CO2 chemical absorption system.

Economic evaluation

- A mature USC plant is more economically advantageous than an advanced USC plant due to its advantage in EPC cost and plant factor.
- In the case of the installation of CCS equipment, economic advantage is not generated when the price of CO2 allowance is less than 60EUR/t.

CO2 reduction potential

- The introduction of a USC plant will reduce emission by 1.4 million ton annually.

Challenges for Realizing Project

- **Recently the market price of wholesale electricty remains at a low level, which is far from the level in which the investment in power source development is recouped.**
- **It is indispensable to replace an aging coal-fired thermal power plant. If the situation continues in which power source development is difficult, there are concerns about tight supply-demand balance, supply shortage, rise in electric power rate and other problems.**
- **It is desirable to introduce a new electric power rate system such as Fit-CfD in Britain which complements a market price mechanism from a stable supply of energy viewpoint.**

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Outline of Research Program

Identification of problems and examination of measures against them to be caused by the expansion of the introduction volume of renewable energy

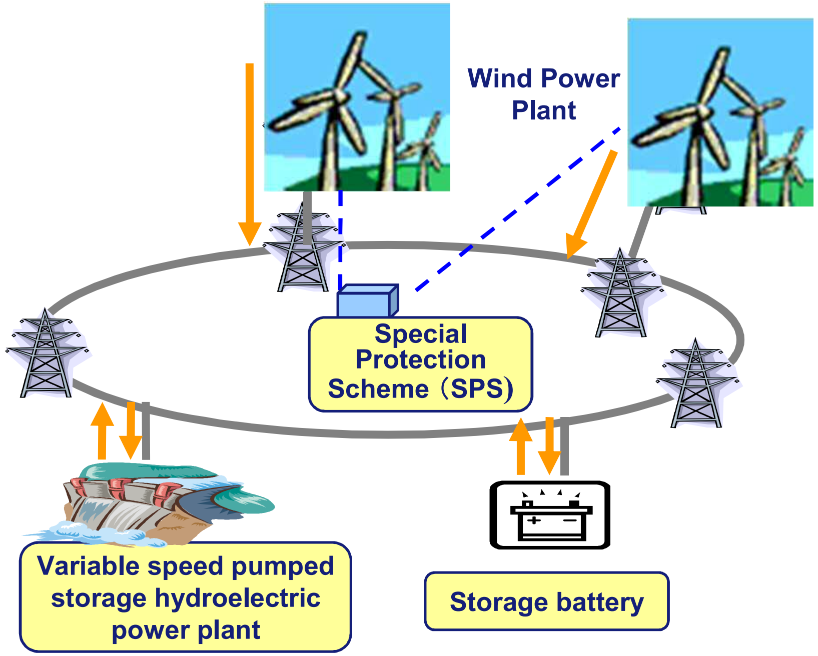
As the reinforcement of power system such as transmission line and distribution line is expected to cause problems including cost to respond to the expansion of introduction volume of wind power generation, examine measures for the introduction of renewable energy in order to minimize the cost of secure operation.

Measures for Stable Operation of Power Systems

■**Special Protection Scheme (SPS)**: Appropriately control the connection between the power source and the transmission and distribution system in the event of fault in order to maintain the secure operation of the power system.

■**Variable Speed Pumped Storage Hydroelectric Power Plant:** Change the rotating speed of pump mill wheels to finely adjust input power during pumping in accordance with the supply-demand situation in the power system.

■**Storage Battery**: Absorb output fluctuations of natural energy and generate smooth resultant output, supplying stable power in response to power demand.



Challenges for Transmission Line

Expected increase of wind power generation will cause various challenges – e.g., overload of power lines, difficulties in supply-and-demand balance, voltage regulation, -- in a power system

	Penetration of Wind Power Small / Near Future ⟷ Large / Farther Future
Overload of power lines	**EHV** HV, EHV Dynamic Rating Decision Support System System Reinforcement Special Protection Scheme
Supply-&-demand balance	Balancing Spinning Reserve Forecasting Energy storage
Voltage problems	MV HV, EHV No LVRT for old/MV wind turbine SC, ShR + WT control SVC, STATCOM
Related Smart Grid Technologies	Smart Meter DSM Battery Distribution Automation Other Smart grid technology

SC (Shunt Capacitor), ShR (Shunt Reactor), WT (Wind Turbine) , DSM (Demand Side Management)

(Note) Technologies in red letters are the proposed ones.

Proposal of Measures

Propose several measures which utilize Japan's original or advantageous technologies for each problem.

Problem	Proposed Measure
1. Overload mitigation in power lines	**1.1 Automatic control through Special Protection Scheme (SPS) in the event of fault** Automatically control wind power output in the event of power line tripping (e.g. in the case of fault). **1.2 Decision support system for optimal power system control (guidance)** Support operators to select the optimal power system control method (e.g. such as power system switching and/or generation shedding) in the event of power line tripping. **1.3 Overload control through storage batteries** Suppress overload in the power line by charging/discharging storage batteries installed in substations.
2. Insufficient adjusting reserve	**2.1 Utilization of storage batteries for power system** Introduce storage batteries for the power system to shift a peak and suppress fluctuations. **2.2 Introduction of variable speed pumped storage hydroelectric power plant** Introduce a variable speed pumped storage hydroelectric power plant as an adjusting reserve measure
3. Measure for voltage	**3.1 Voltage control system for distribution power system** Introduction of smarter voltage control system as a measure against voltage problem in the power system.
4. Smart grid construction	**4.1 Automatic distribution system** Introduce an automatic distribution system which satisfies needs for automating the distribution system. **4.2 EMS AMI system and regional EMS**

Thank you for your attention.