

LOTHECO



**“Combined Cycle Power Plant with Integrated
Low Temperature Heat”**

Presentation: Ass. Prof. Kakaras E.

CAME-GT Combined Workshop

16/2/2001 - Brussels

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ENK5-CT-2000-00063



- EU project within 5th Framework Programme
- Total project value: 340,087 Euro
- European Commission contribution: 300,027 Euro
- Duration: 30 months,
- Official Commencement Date: 1st October 2000
- End of project: 30 April 2003
- 6 partners: 4 universities and 2 companies from 4 E.U. countries (Greece, Germany, Austria, United Kingdom)



- Combined cycle applications with:
 - Improved efficiency
 - Economic and ecological benefits
 - Utilisation of low-temperature waste heat

- Related concepts:
 - Cheng cycle
 - H.A.T. (Humid Air Turbine)

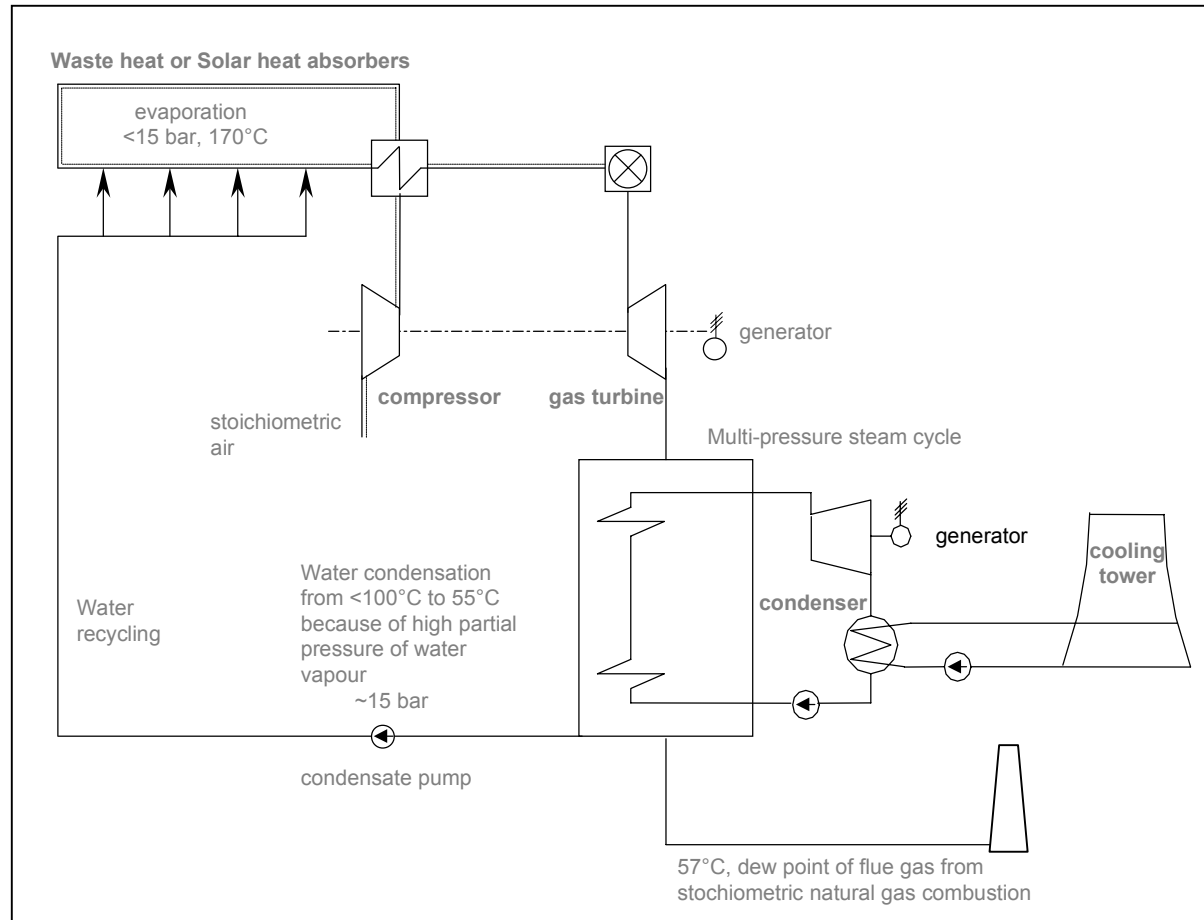
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- Investigation and development of a new Natural Gas Fired Combined Cycle concept, making use of low temperature waste heat to evaporate injected water droplets into the compressed combustion air of the gas turbine
- Focus on:
 - performance of feasibility studies for potential test cases application
 - Study and market survey on the components of the cycle
- Experimental work on the gas turbine's combustor

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- Efficiency higher than 70%
- Compression of only stoichiometric air
- Very low temperatures in the evaporator (100-170 °C)
- High heat transfer rate in the evaporator
- Low NO_x emissions
- Can operate as conventional Combined cycle

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Work package No	Work package title	Work Package Leader	Partners involved
1	Development and optimisation of the New Combined Cycle	TU-BS	
2	Optimisation of Gas Turbine Combustion Chamber, Market Survey and Proposals on Final Configuration of Compressor and Gas Turbine	ICSTM	TUW
3	Study of Evaporator's and Heat Recovery Boiler's Characteristics and Market survey	NTUA	
4	Identification of Potential sites for Adaptation of the New Concept	PPC	Fichtner TU-BS NTUA ICSTM
5	Study of Economic, Environmental and Social impacts of the new Combined Cycle	NTUA	PPC Fichtner
	Coordination	PPC	
	Total		

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Partner	Organisation name	Function
1	PPC	Identification of Potential Sites for Adaptation of the New Concept, Study of Economic, Environmental and Social impacts of the new CC, Coordinator
2	TU-BS	Development and Optimisation of the new Combined Cycle
3	NTUA	Study of Evaporator, Heat Recovery Boiler with Condensation and Condensate Polishing Plant, Identification of Main Characteristics of the Components, Market Survey and required modifications of components
4	TUW	Market Survey and Proposals on Final Configuration of Compressor and Gas Turbine
5	ICSTM	Optimisation of Gas turbine Combustion Chamber
6	FICHTNER	Identification of one ISCCS project, Calculation, Evaluation and Comparison of the Thermodynamic Cycle of the Foreseen ISCCS Concept with the Thermodynamic Cycle of the Integration of the LOTHECO Concept into the ISCCS - Study of Economic, Environmental and Social impacts of the new CC.

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INVOLVEMENT OF PARTNERS IN THE PROJECT

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WP No: 1	Start month: 1	End month: 29	
Work package title	Development and optimisation of the New Combined Cycle		
<p>Objectives</p> <p><u>Task 1.1: Improving efficiency of the new combined cycle</u></p> <p>Improving efficiency by optimising the cycle using a cycle calculation program and an optimisation algorithm. Data from the different components like compressor, gas turbine, evaporator, condensing heat recovery steam generator will be exchanged with WP2 and 3.</p>			
<p>Description of work</p> <p>The development and optimisation of the new Combined Cycle is a major item to be considered for the success of the project. Within (Task 1.1) TU-BS will adapt existing general programs (a cycle calculation program and an optimisation algorithm) to optimise the efficiency of such new cycles. The performance data of the different components of the cycle will be exchanged with partners of WP2, 3 and 4.</p> <p>Preliminary calculations have shown that a target efficiency higher than 70% can be attained. The resulting configuration can also ensure that a future plant of this type will have an availability of 90% and a reliability of 95%.</p>			

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WP No: 2	Start month: 1	End month: 29	
Work package title	Optimisation of Gas Turbine Combustion Chamber, Market Survey and Proposals on Final Configuration of Compressor and Gas Turbine		
Objectives			
<p>Task 2.1: Optimisation of combustion chamber, using advanced experimental techniques</p> <ul style="list-style-type: none"> - Laboratory tests of the combustion of natural gas with an air-water vapour mixture - Measurements of NO_x emissions in flue gas and flue gas condensate composition <p>Task 2.2: Market survey of compressor and gas turbine</p>			
Description of work			
<p>ICSTM will carry out laboratory tests on the combustion of natural gas with an air-water vapour mixture in a gas turbine. (Task 2.1). The results will demonstrate the extent to which the addition of water to the primary zone, in the form of wet steam, can improve gas turbine operation in terms of overall thermal efficiency and reduction in emissions (particularly NO_x). The measurements detail will be sufficient for use by computational methods and the latter part of the project will involve interaction between computational and experimental results in order to enhance the overall benefit.</p> <p>Within Task 2.2 TUW will conduct a market survey of compressors and gas turbines in the range given by the new Cycle and by general data provided by PPC and TU-BS in WP4 and 1 respectively. Then a study of the possibility of using combinations of components will follow. Proposals will be formulated on the final configuration of the compressor and gas turbine.</p>			

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WP No: 3	Start month: 1	End month: 24	
Work package title	Study of Evaporator's and Heat Recovery Boiler's Characteristics and Market survey		
Objectives			
<p>Task 3.1: Basic configuration of water evaporator in pressurised air</p> <p>Task 3.2: Study of the heat recovery boiler with water vapour condensation from the flue gas</p> <p>Task 3.3: Market survey for the evaporator</p>			
Description of work			
<p>Within Task 3.1 NTUA will formulate the basic configuration, which is necessary to verify the economic aspects of the evaporator. Special attention will be given to the evaporator's pressure drop, because of the influence on the plant's efficiency.</p> <p>Within Task 3.2 NTUA will focus on the heat recovery steam generator study. NTUA will provide data from this research work to TU-BS in WP1, in order to calculate the efficiency and the operational aspects of the cycle. Data from the laboratory tests in WP2 will also be used on the identification of the main characteristics of the condensate polishing plant.</p> <p>Within Task 3.3 NTUA will conduct a market survey for the evaporator and the heat recovery boiler in the range given by the new Cycle.</p>			

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WP No: 4	Start month: 1	End month: 29	
Work package title	Identification of Potential sites for Adaptation of the New Concept		
Objectives			
Task 4.1: Identification of one ISCCS project, calculation and evaluation			
Task 4.2: Identification of potential sites for implementation of the new concept			
Description of work			
<p>Within Task 4.1, FICHTNER will identify one ISCCS (Integrated Solar Combined Cycle System) project and calculate, evaluate and compare the thermodynamic cycle of the foreseen ISCCS concept with the thermodynamic cycle of the integration of the LOTHECO concept into the ISCCS.</p> <p>Within Task 4.2, a market survey of potential sites for adaptation of the new Combined Cycle concept will be carried out by PPC, the work scheduled with the contribution of FICHTNER, TU-BS, NTUA and ICSTM, taking into account the results of the work performed in previous WP's.</p>			

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WP No: 5	Start month: 25	End month: 29	
Work package title	Study of Economic, Environmental and Social impacts of the new Combined Cycle		
Objectives			
<p>Task 5.1: Data collection from existing power plants for comparison with the current state of art of Combined Cycles equipment</p> <p>Task 5.2: Adaptation of existing exergoeconomic programs for economic, environmental and social evaluation</p> <p>Task 5.3: Comparison of new combined cycle with existing power supply concerning:</p> <ul style="list-style-type: none"> - economic, - environmental and - social impact. 			
Description of work			
<p>In WP5 the new combined cycle will be compared with existing Combined Cycles concerning economic, environmental and social impact. Within Task 5.1 PPC will provide all the necessary data for this comparison. NTUA will evaluate the results obtained from the previous task, based on existing exergoeconomic programs. (Task 5.2)</p> <p>The economic, environmental and social impact of the proposed new Combined Cycle will be examined by NTUA and FICHTNER and conclusions on the new Combined Cycle performance will be formulated, based on the comparison with existing power units. (Task 5.3)</p>			

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Milestone No	Milestones	End of month
1	The specifications of the evaporator will be established	12
2	All combustion chamber measurement results will be ready	15
3	The characteristics of the heat recovery boiler and the condensate polishing plant will be established	24
4	The evaluation of the integration of the LOTHECO concept in an Integrated Solar Combined Cycle System will be completed	24
5	The formulation of proposals on the configuration of compressor and gas turbine based on the use of components available on the market will be ready	29
6	The identification of potential sites in Europe for adaptation of the New Concept will be completed	29
7	The specific emissions and costs (internal, external) of the new Combined Cycle compared with usual plant types etc. will be established	29
8	The optimisation of the new Combined Cycle will be completed	29

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MILESTONES

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Deliverable No	Deliverable title	Delivery date
1	Optimised Cycle data - (R),(S)	30
2	Test results of combustion chamber - (R), (S)	24
3	Proposal on the compressor's and the gas turbine's configuration - (R)	24
4	Results from the study on the evaporator and the heat recovery steam generator - (R),(S)	12
5	Results from study of the condensate polishing plant - (R)	24
6	Market survey of evaporator - (R)	18
7	Identification of a potential ISCCS site and a report comparing the thermodynamic cycle of the foreseen ISCCS concept with the thermodynamic cycle of the integration of the LOTHECO concept into the ISCCS - (R)	24
8	Identification of Potential sites for Adaptation of the New Concept - (R)	29
9	Adapted program for economic, environmental and social evaluation - (S),(R)	24
10	Comparison of new Combined Cycle with existing Combined Cycles - (R)	30
11	Summarising Report - (R)	30

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DELIVERABLES

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