Ceramic Components for Industrial Gas Turbines (CERCO)

Fact Sheet

Project Information

Grant agreement ID: BRPR980791

Funded under
FP4-BRITE/EURAM 3

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1 November 1998

End date
30 April 2003

Overall budget
€ 0

EU contribution
€ 0

Coordinated by
Nuovo Pignone SpA
Italy

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Objective

The continuous increase in performance requirements for gas turbines calls for new materials in the most critical parts. Current superalloy materials are now very close to their physical limits. At present, ceramics materials with their superior temperature capability, offer the best alternative as next generation structural materials for hot section components in innovative design. Possible future benefits of ceramics for gas turbines include the ability to increase the turbine inlet temperature to more than 1400°C with uncooled parts. Fully optimised stationary gas turbines would have a ~20% gain in thermal efficiency and ~40% gain in output power in simple cycle compared to all metal engines with air cooled components. Emissions reductions to under 10 ppmv NOx are also forecast. The major critical factors slowing the exploitation of structural ceramics in gas turbine engines include the development of ceramic design technologies, the demonstration of ceramic component reliability in real engines and the further development of materials tailored to meet the specific loading conditions. The overall objective of this project is to improve the performance of stationary small size gas turbines through the selective replacement of metallic hot section components with uncooled ceramic parts.

Specific industrial objectives are:
1. To develop design technologies and know-how suitable to introduce ceramics in real engines. In particular: design of first stage nozzle in monolithic massive ceramic
In particular: design of first stage nozzle in monolithic massive ceramic (MC) and of combustor liner and first stage shroud in composite ceramic (CMC);

2. To open the market of industrial gas turbines for CMC-parts through material improvements and successful long time engine tests;

3. On a wider time scale: to prepare the field for introduction of CMC-parts into aircraft engines by material improvements and by increasing the general confidence into long time endurance of CMC in turbine applications.

The approach consists of a component development path (addressing both material and assembly interface issues with compliant layers) and of a CMC-material development path (addressing matrix and matrix-fiber interface):

- nozzle and shroud development with full scale testing in a real 5.5 MW engine for 4000 h;
- combustor development at reduced scale with 400 h testing in a rig reproducing full loading;
- development of oxide-oxide CMC involving fundamental manufacturing technologies such as fibre coating by sol/gel or CVD (Chemical Vapor Deposition) through a continuous improvement approach based on extensive high temperature testing in the laboratory followed by engine/rig testing on optimised prototypes of shrouds and combustors.

The consortium comprises a manufacturer of industrial gas turbine (NUOVO PIGNONE - IT), an aerospace company active in CMC development (DORNIER - DE), an international research center active in interfacial engineering and material testing (JRC/IAM-NL) and an applied mechanics laboratory (UNIVERSITY OF PATRAS-GR). BE97-4636

Programme(s)

Topic(s)

Funding Scheme

CSC - Cost-sharing contracts

Coordinator

Nuovo Pignone SpA

Address

Via F. Matteucci
50127 Firenze

Italy
Participants (3)

Commission of the European Communities
Netherlands
Address
3,Westerduinweg
1755 ZG Petten

Dornier Luftfahrt GmbH
Germany
Address
An Der Bundesstrasse
88039 Friedrichshafen

University of Patras
Greece
Address
26500 Patras

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