Your speakers today

Prezentuja

MICHAEL KEROULLÉ
Chief Commercial Officer
GE’s Steam Power

SLAWOMIR ZYGOWSKI
CEO
GE Poland

MARC VILLEMIN
Project Director
Ostroleka C

MICHAL MILOSZ
Deputy Project Director
Ostroleka C

LUKASZ MALEC
Deputy Project Director
Ostroleka C

TOMASZ KASIERSKI
Overall Project Engineering Manager
Ostroleka C
GE Steam Power Overview

Prezentacja GE Steam Power
Global power outlook
Światowy rynek energetyczny

INDUSTRY DYNAMICS

Fossil Fuels
Remains 60%+ of industry and a must to stabilize the grids

Renewables
Fastest growing segment although still less than 50%

Emerging Markets
85% of electricity growth, each country with unique needs

ELECTRICITY GENERATION

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MARKET DRIVERS
Motory rynku

- FLEXIBILITY
  Elastyczność
- COST OF ELECTRICITY
  Koszt prądu
- RELIABILITY
  Niezawodność
- LOWER CARBON FOOTPRINT
  Niższa emisyjność

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Coal portfolio capabilities

Technologia dla sektora węglowego

**Boiler island**

*Kotłownia*

- Two-pass, tower and CFB technology
- Coal mills
- Primary and secondary NOx control

**Turbine island**

*Maszynownia*

- Steam turbine
- Generator
- Condensers/heaters

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**Integrated offerings**

*Zintegrowane oferty*

- Integrated packages (EP)
- Power block/turbine island (EPC)
- Full turnkey (EPC)
- Integrated upgrades

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**AQCS**

*Sistem kontroli jakości powietrza*

- Flue-gas desulfurization
- Particulate control
- Mercury control

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30% of the world's steam turbine capacity

30% of the world's boilers

90+ Other OEM brands
Nuclear portfolio capabilities
*Technologia dla sektora jądrowego*

**Turbine and generator**
*Turbina i generator*
- HP/IP turbine
- LP turbine
- Generator

**Heat exchanger**
*Wymiennik ciepła*
- MSR
- Condensers

**Integrated offerings**
*Zintegrowane oferty*
- TGP (turbine generator package)
- Full turnkey turbine island
- Integrated retrofit

**Pumps**
*Pompy*
- Feedwater pump
- Condensate extraction pump
- Main circulating pump

50% of steam turbines for nuclear power plants
Projects under execution

Projekty w realizacji
Steam Power Projects – Key projects in execution
Główne projekty w trakcie realizacji

**UNITED KINGDOM**
- **Hinkley Point C**
  - 2 x 1770 MW

**FRANCE**
- **Flamanville**
  - 1 x 1750 MW

**ITALY**
- **Terna**
  - Synch. Condenser 2 x 250MVar

**EGYPT**
- **El Dabaa**
  - 4 x 1200 MW

**SOUTH AFRICA**
- **Medupi**
  - 6 x 800 MW
- **Kusile**
  - 6 x 800 MW/6 x FGD
- **Koeberg - SOP 81-1**
  - Engineering studies

**SAUDI ARABIA**
- **Yanbu III - SEPCO 3**
  - 5 x 620 MW

**TURKEY**
- **Akkuyu**
  - 4 x 1255 MW
- **Yenikoy & Kemerko**
  - 5 x Rehab & Upgrade

**PAKISTAN**
- **Hubco II**
  - 2 x 660 MW
- **Thar 2 – Tel**
  - 1 x 330 MW

**THAILAND**
- **Mae Moh**
  - 1 x 600 MW

**CAMBODIA**
- **CEL II Sihanoukville**
  - 1 x 150 MW

**CHINA**
- **Taishan**
  - 2 x 1700 MW

**FRANCE**
- **Flamanville**
  - 1 x 1750 MW

**GERMANY**
- **Uchtelfangen Amprion**
  - Sunch. Condenser 1 x 320MVar
- **Paks II**
  - 2 x 1200 MW

**FINLAND**
- **Hanhikivi**
  - 1 x 1200 MW

**POLAND**
- **Opole**
  - 2 x 900 MW
- **Ostrołęka**
  - 1 x 1000 MW

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**UAE**
- **Hassyan**
  - 4 x 600 MW

**INDIA**
- **Nabinagar**
  - 3 x 660 MW
- **Solapur**
  - 2 x 660 MW
- **2 x FGD
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GE, presence in Poland for the past 25 years
GE obecne w Polsce od 25 lat

A POLISH COMPANY
5,500 employees across Poland
1,800 engineers in EDC, R&D center
400 million USD investment for the past 25 years

POWER
Every second MW generated in Poland is produced by a GE equipment

CLEANER INSTALLED BASE
GE has installed or is currently installing 50 emissions control equipment to remove local pollutant

RELIABLE POWER
Fully committed to support Poland need for reliable power, GE has been involved and continue to work on Belchatow, Opole and now Ostroleka coal power plants

LOCALIZATION
70% of Opole project has been sourced out of GE’s Polish footprint – including its wide database of 5,000 suppliers

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Belfort Site
Steam Power
Belfort Site

EPC PROJECT EXECUTION CENTER, NUCLEAR STEAM TURBINE AND GENERATOR MANUFACTURING
Centrum realizacji projektów EPC, produkcja turbiny parowej i generatora

EPC project execution for coal and nuclear
• Leading Steam Power EPC projects from tendering to execution, together with regional engineering and project offices
• 24 projects/54 GW under execution

Nuclear steam turbine and generator manufacturing
• Arabelle Nuclear Steam Turbines from 700 to 1900 MW
• Generators from 500 to 2200 MVA (all fuels)

Additional scope
• Automation and controls teams
• Services and maintenance workshop and teams

OPOLE Construction, 2 x 900 MW Coal

Arabelle production at Belfort

And on site installation (1700 MW)
A few examples

Przykłady
Hinkley Point C – world’s largest nuclear power station

Outcomes for customer and the region

Customer: NNB Generation Company (HPC) Ltd
Location: United Kingdom

- 3.5 GW of UK grid capacity
- 7% Households powered
- 99.96% Reliability rate
- 5 million Additional power output per unit
- 7 MW
- 9 million Tons of CO₂ avoided each year

Project scope
- EPC for main equipment for 2 x 1,770 MW Turbine Islands
- World’s Largest Nuclear Steam Turbines (Arabelle)

Project team

Design & Engineering
- Steam turbine: Paris
- Generator: Wroclaw/Belfort
- Heat exchangers: Paris/Wuhan
- Main pumps: Paris/Rugby

Manufacturing
- World wide
- Belfort/Bristol/Asia
- Belfort
- Nantes

Leveraging our global network

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Hassyan – First coal-fired power plant in Middle East
Hassyan – pierwsza elektrownia węglowa na Bliskim Wschodzie

Project scope
• Integrated Power Package (i.PP) incl. AQCS and main WSC components

Outcomes for customer and the region
Korzyści dla klienta i regionu
Owner: SPV with DEWA & ACWA Power
EPC: In consortium with Harbin Electric International | Location: Dubai

Leveraging our global network

<table>
<thead>
<tr>
<th>Engineering and Design</th>
<th>Sourcing and Manufacturing</th>
<th>Construction and Commissioning</th>
<th>Final acceptance test</th>
</tr>
</thead>
<tbody>
<tr>
<td>4x600 GW Of power</td>
<td>25% Boost to Dubai current grid capacity</td>
<td>1.3 million People powered</td>
<td>10% Points more efficient than global average</td>
</tr>
</tbody>
</table>

IN 2016                      2025
Take over

4 x 600 MW ultra-supercritical coal fired power plant with gas as back-up fuel
About Opole
• Opole will provide 1.8GW to the Polish grid once completed.
• GE is the EPC contractor for Opole
• Opole uses 2x 900 MW USC units designed and manufactured by GE
• The generators and steam turbines are manufactured in Wroclaw and Elblag respectively, the equipment is designed by Polish engineers

2021
Final acceptance

2x900 MW

Worldwide expertise engaged:
Global Factory Network
• Wuhan: Pressure parts of boiler
• Elblag: Steam turbines
• Wroclaw: Generators

Design, engineering and planning

Lodz
Belfort
Massy
Stuttgart
Milano
Kolkata
Mannheim
Wroclaw

5000
Workers at site

2 million
People powered
Ostroleka C Scope

Zakres prac projektu Ostrołęka C
Ostrołęka C – Reliable and flexible baseload

**Elektrownia Ostrołęka C scope**

**Zakres prac projektu Ostrołęka C**
- General management - as investor
- Rail connection subproject
- Power evacuation subproject

**GE scope / Zakres pracy po stronie GE**
- GE is the full EPC contractor for Ostroleka C, in charge of General design and design coordination.
- Manufacturer of boiler and STG
- Construction coordinator
- Commissioning

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**Outcomes for customer and the region**

**Korzyści dla klienta i regionu**

- **1000 MW** of power
- **46%** Efficiency rate
- **26%** Less CO₂ per MW

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**Engineering and Design**
- 2018

**Sourcing and Manufacturing**
- 2020

**Construction and Commissioning**
- 2023

**Service**
- Take over
Ostrołęka C 1000MW – Project scope

**Power block**
*Blok energetyczny*
- Boiler (tower)
- Turbine hall
- Electrical buildings
- Wet cooling tower

**Rest of plant systems**
*Pozostałe elementy elektrowni*
- Auxiliary boiler
- Raw water pumping station from river
- Condensate polishing plant
- Main and closed cooling water systems

**Air quality control systems**
*System kontroli jakości powietrza*
- Flue gas desulphurization
- Powder active carbon
- Electrostatic participator
- Selective Catalyst Reducer

**Civil works**
*Prace budowlane*
- All civil works for the complete plant
- Roads and access
- Railway inside power plant

**Electrical**
*System elektryczny*
- Electrical systems – full scope
- Power evacuation up to switchyard

**Handling and storage systems**
*Systemy gospodarki materiałami*
- Fuels: hard coal, light fuel oil
- Fly ash, slag
- Gypsum, limestone

**Digital**
- Controls systems
- Cybersecurity
Large Steam Project – Leveraging the global organization to deliver locally - Wykorzystanie globalnych kompetencji w realizacji lokalnych projektów

**Poland - Projects**
- Plant integration (PM onshore)
- Engineering
- Procurement
- Site management, C&C
(Warsaw, Lodz, Ostroleka)

**Germany - Boiler**
- PM Boiler
- Engineering
- Procurement
- TFAs
(Stuttgart)

**France - Projects**
- Plant integration (PD, PM off-shore)
- Engineering
- Procurement
- Construction support
(Belfort)

**Switzerland**
- Procurement
- Gen Rotor manufacturing
(Baden, Birr)

**India - ESP**
- ESP management
- Engineering
- Procurement
- TFAs
(Noida)

**China - Boiler**
- Engineering
- Procurement
- Boiler Manufacturing of Pressure Parts
(Wuhan)

**China - FGD**
- FGD management
- Engineering
- Procurement
- TFAs
(Beijing)

**Poland - STG**
- STG management
- Engineering
- Procurement
- ST&G Manufacturing
(Elblag, Wroclaw)

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Typical timeline of an EPC Project

Typowa oś czasu dla projektu EPC
Engineering Procurement Construction – Milestones
Projektowanie, zakupy, montaż – kluczowe wydarzenia

- **PREPARATORY WORKS**
- **NOTICE TO PROCEED**
- **CIVIL PERMIT DESIGN**
- **START OF CIVIL WORKS**
- **START OF BOILER ERECTION**
- **START OF STEAM TURBINE GENERATOR ERECTION**
- **START OF TURBINE HALL STEEL STRUCTURE**
- **BOILER PRESSURE TEST**
- **START OF COMMISSIONING**
- **BOILER FIRST FIRE**
- **SYNCHRONIZATION**
- **HAND OVER TO THE CUSTOMER**

- **CONTRACT SIGNATURE**
- **'18**
- **'19**
- **'20**
- **'21**
- **'22**
- **'23**

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What happens before major construction on-site?
Co sie dzieje przed głównymi pracami na budowie?

**ENGINEERING**
- BASIC DESIGN
- SPECIFICATIONS FOR KEY EQUIPMENT
- DETAIL DESIGN (FOUNDATION)
- STEEL STRUCTURE ENGINEERING
- DOCUMENTATION FOR CONSTRUCTION

**PROCUREMENT**
- TENDER PROCESS FOR KEY EQUIPMENT
- KEY EQUIPMENT INPUT DATA
- VENDOR ENGINEERING
- TENDER PROCESS FOR SUBCONTRACTORS
- PO PLACEMENT

**CONSTRUCTION**
- POWER BLOCK MAIN CIVIL WORKS
- PO PLACEMENT
- DOCUMENTATION FOR CONSTRUCTION
EPC process – Year 1
Proces EPC - 1 rok

ENGINEERING

Civil permit design
Basic engineering
Key equipment specifications
Detail engineering

PROCUREMENT

PO of major equipment
PO to design offices
PO for main civil works

CONSTRUCTION

Soil survey
Construction site preparation
Site facilities and infrastructure
Power block foundations
EPC process – Year 2
Proces EPC - 2 rok

ENGINEERING

PROCUREMENT

CONSTRUCTION

'23

'Detail design
Workshop drawings

'Main cooling water piping delivery
Water treatment plant delivery
Main overhead crane delivery

'19

'20

'21

'22

'23

'22

'21

'20

'19

Boiler Main Steel Structure
Cooling Tower Shell
Turbine Hall Steel Structure

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EPC process – Year 3
Proces EPC – 3 rok

ENGINEERING  PROCUREMENT  CONSTRUCTION

Detail design

Turbine & Generator delivery
Mechanical equipment
Electrical equipment delivery

Boiler pressure part
Main equipment
Material handling systems
Water handling systems
EPC process – Year 4
Proces EPC – 4 rok

ENGINEERING

'23
\- Detail design
\- Quality documentation
\- Certification

'22
\- Spare parts

'21
\- Boiler pressure test
\- Piping erection
\- Electrical erection
\- Cold commissioning

'20

'19

PROCUREMENT

CONSTRUCTION

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EPC process – Year 5
Proces EPC – 5 rok

ENGINEERING

PROCUREMENT

CONSTRUCTION

'19
'20
'21
'22
'23

Operations and maintenance manuals
As-build documentation

First fire
Synchronization
Hand Over

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Power plant walk-through

Spacer po elektrowni
Questions and Answers

Pytania i odpowiedzi