REPLACEMENT OF THE CONDENSER TUBE BUNDLES AT KOZLODUY NPP UNITS 5 & 6 WITH STAINLESS STEEL TUBES OR TUBES OF ANOTHER COPPER (CU) FREE MATERIAL
Prerequisites for the Replacement of the Tube Bundles

- Operation of the steam generators under adverse water chemistry
- Chlorides in secondary circuit
- Reduction of the design vacuum
- A lot of blocked bundle tubes resulting in the reduction of the heat exchange surface
- Pollution of the feedwater train due to the erosion wear of the tube bundles
- Reduction of the turbine efficiency
Decision Taken

- Decision taken – replacement of the condenser tube bundles by stainless steel tubes
- Approach chosen – replacement based on module principle;
- Detailed calculations, taking into consideration, as follows:
  - all potential loads on the new equipment from already existing systems and components;
  - the operation conditions of the system and transient processes;
  - the seismic qualification of the equipment in accordance with the requirements to Turbine Hall - (0.1g).
  - the existing building structure, foundations, permissible forces and loads on the roads and the site;
  - strengthening the building and steel structures;
  - strengthening the roads along the module transportation route to the mounting point.
Control by the Employer of the fire safety, operation safety, the procedures on quality assurance and in-service control
Preparation Works for Project Implementation

- Development of Activity Management Plan (AMP)
- Development of Detailed Design
- Development of designs for the dismantling of separate parts:
  - Mechanical and Process
  - Civil Engineering
  - Electrical and I&C
Development of a design for the assembly site in front of Turbine Hall, Units 5 and 6
Development of a design for strengthening the site at elevation 0.00, in Turbine Hall
Development of designs for the dismantling works for separate parts:
  • Mechanical and Process
  • Civil Engineering
  • Electrical and I&C
Preparation Works for Project Implementation

- Manufacturing and delivery of tube modules to the Kozloduy Port
Preparation Works for Project Implementation (4)

- Unloading the tube modules at the Kozloduy Port
Preparation Works for Project Implementation

- Unpacking the tube modules and incoming control at the Kozloduy Port
Preparation Works for Project Implementation

- Pneumatic tests of the tube bundles
Preparation Works for Project Implementation

- Fitting-up tube modules and updating design deviations
Preparation Works for Project Implementation (8)

- Inspection of the access for tube modules welding
Stages of Project Implementation at the Site

- Preparation of the site in front of the Turbine Hall, providing access for cranes and machinery
Stages of Project Implementation at the Site

(2)

- Dismantling the wall panels, process equipment and piping
Stages of Project Implementation at the Site

- Dismantling the water and flow turn chambers of the condensers and providing access up to void space
Stages of Project Implementation at the Site

(4)

- Cutting the tube bundles between the 9th and the 10th tube plates and withdrawing the bundles
Stages of Project Implementation at the Site

- Dismantling the tube bundles
Stages of Project Implementation at the Site

- Strengthening the condenser shell
Mounting supports at elevation 0.00 of Turbine Hall and strengthening the rail tracks over the circulation piping and strengthening the forth rib.

Mounting rail tracks for medium modules in front of and in the Turbine Hall.
Stages of Project Implementation at the Site (8)

- Transportation of medium modules to the assembly site, unloading and preparation for mounting
Stages of Project Implementation at the Site (9)

- Installation of medium modules and setting them in a design position
Stages of Project Implementation at the Site (10)

- Mounting rail tracks for end modules in front of and in the Turbine Hall
Stages of Project Implementation at the Site (11)

- Transportation of end modules to the assembly site, unloading and preparation for mounting
Stages of Project Implementation at the Site (12)

- Moving inside end modules and setting them in a design position
Stages of Project Implementation at the Site

- Welding connecting parts between the modules and the closing plates up to void space
Stages of Project Implementation at the Site (14)

- Inspection for cleanness up to the void space of the condensers, hydraulic tests and remediation of defects in welded joints
Transportation of the water chambers and parts for circulation piping
Stages of Project Implementation at the Site (16)

- Installation of water chambers and circulation piping
Closing the Turbine Hall walls and installation of the dismantled process equipment and piping
Results of the Tube Bundles Replacement

- Bringing to the minimum the corrosion rate of the whole secondary side equipment by increasing the pH value from 9.2 to 9.8;
- Minimum transport of corrosion products into SG;
- Reducing the rate of the SG electrokinetic corrosion;
- Achieving the design density of the condensate feed circuit by:
  - Reducing the content of O2, CO2 /H2CO3/, respectively the corrosion activity of the coolant
  - Improvement of the TG vacuum;
  - Increasing heat exchange surface
  - Increasing the power unit efficiency
Results of the Tube Bundles Replacement (2)

- Reduction of the operation of the Unit Demineralization Facility and the use of chemicals and reagents
  - Reduction of the amount of chemically purified water for secondary side make-up
  - Reduction of the costs of insufficient production resulting from the elimination of cooling water ingress into the void space of the condenser
  - Entire extension of the lifespan of the units in the result of:
    - Improved operating conditions
    - Extended lifespan of condensers and steam generators.
Conclusion

For the implementation of this large scale activity during the outage of the units (about 1300 tones of equipment were dismantled and another 1300 tones of new equipment were installed within 80 days) it was necessary to have:

1. A reasonably accurate design
2. Correct planning
3. Execution of the project activities with good quality

We appreciate the assistance of the NPP management in the implementation of the project.