KOZLODUY NPP REVIEW

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INSIDE

Units 3 and 4 shut down

On December 31, 2006, at 9:48 p.m. the second generator of Unit 4 was disconnected from the national power grid. A few minutes earlier, at 9:37 p.m. the second generator of Unit 3 was also stopped. The power of the two reactors was gradually decreased; they were both shut down following the standard procedures.

The operators stopped the reactors in line with a Ministerial Decision of December 21, 2006 following the pre-accession agreements of Bulgaria and the European Union.

The chairman of the Nuclear Regulatory Agency issued amendments to the licenses for the stopped Units as fuel was taken out of them and stored in by-reactor ponds. The operational licenses for Units 3 and 4 were issued in 2003 and allowed operation till 2011 and 2013 respectively. The newly issued amendments became effective as of January 1, 2007.

From February 5 to March 2, the fuel of Unit 4 was transferred from the core to the by-reactor ponds. Operations were executed in line with a special program approved by the Nuclear Regulatory Agency. Safety procedures were strictly followed while removing the fuel. Later in March, the fuel of Unit 3 was also transferred to the ponds.

The design lifetime of VVER-440 reactors is 30 fuel cycles. Both Units were prematurely shut down as Unit 3 reached 22 cycles only, and Unit 4 worked for 21 cycles.

Kozloduy NPP was left with just two operational Units after the closure of Units 3 and 4. The company still operates Units 5 and 6, each of them equipped with a VVER-1000 reactor.

Accents

Indicators show zero power of turbine generators 7 and 8

Facts & figures

Unit 3 achieved first criticality on December 4, 1980. On December 17 the Unit was connected to the national power grid, and on January 27, 1981 it reached 100% of its power capacity.

Unit 4 reached first criticality on April 25, 1982. It was connected to the grid on May 17, 1982 and a month later it was already operating at full power.

For its 26 years of operation Unit 3 has generated 68,701,925,094 KWh of electric power. Unit 4 has generated for the time of its operation 66,710,220,364 KWh. In 2006 only the two Units had a 35% share in the overall generation of Kozloduy NPP each of them producing more than 3 billion kilowatt-hours of electricity.

"For the past few years Bulgaria had been covering 45% to 100% of the electricity deficit of net importer countries in South-East Europe."

"As a result of the early termination of operation of Units 3 and 4 of Kozloduy NPP on 31.12.2006, there is a very real danger that security of electricity supply in the region could be disturbed. In fact, there exist no physical alternative, other than Bulgaria, to import electricity into neighboring countries, because of the lack of inter-grid connections to most of the exporting EU countries."

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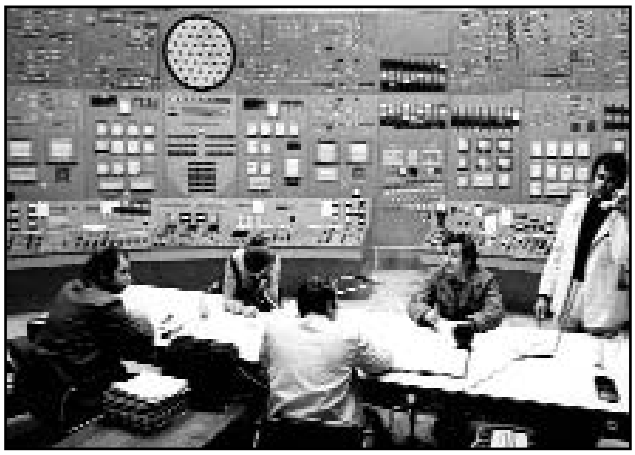
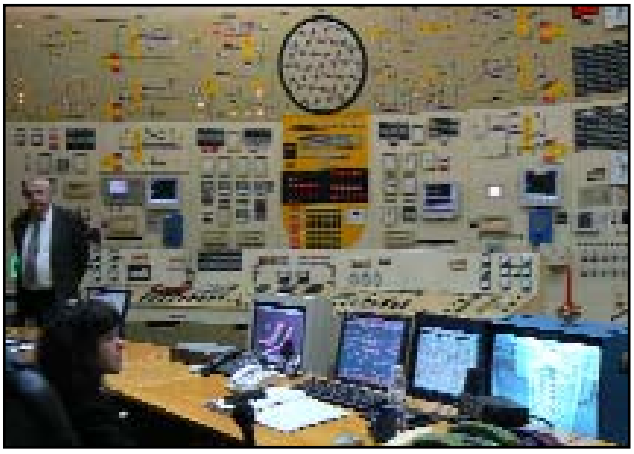
Rumen Ovcharov
Minister of Economy and Energy
of the Republic of Bulgaria

Focus



Control room of Unit 3, December 19, 1980, two days after connection to the grid
Photo Oleg Popov, BTA



Control room of Unit 3, December 31, 2007, during shut down operations

Units 3 and 4 – the facts

Units 3 and 4 of Kozloduy NPP are VVER-440, or water-cooled water-moderated nuclear reactors, an upgraded B-230 model. They have triple redundancy safety systems. These reactors, as all installed reactors on the KNPP site, totally differ from the Chernobyl type RBMK reactors. Kozloduy NPP's reactors may be compared, according to their features, with pressurized water reactors which are the most widely spread type of reactors used in about 70 percent of all nuclear plants worldwide. In fact, most newly constructed reactors in the world are VVER or PWR.

The original design for Units 3 and 4 was based on normative requirements from the 1970's. Systematic analyses and upgrading of these reactors began as early as 1990 to match current safety requirements and international standards. Kozloduy NPP's specialists worked with their counterparts from the International Atomic Energy Agency (IAEA).

Upgrades

Permanent upgrades and safety improvements were implemented on these units over the last 15 years aiming at improvement of initial design in line with rising technological standards in the nuclear industry.

In 1991, the first IAEA's mission was held at Kozloduy NPP: a Safety Review Mission for Units 1-4. Based on recommendations of this mission, the Bulgarian Council of Ministers decided on urgent safety improvement measures. In line with this decision, the plant accepted an approach of gradual safety improvement. In 1991-1997, a three-stage modernization program was implemented at the 440 MW units. It was prepared on the basis of expert assessments, IAEA's recommendations, and nuclear regulator's requirements (at that time – the Committee for Peaceful Use of Nuclear Power). Also, the operational experience

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Units 3 and 4 – the facts

of the plant was taken into account. To get an independent safety assessment, the plant sought open licensing of activities with experts from the World Association of Nuclear Operators, the regulatory body, and a consortium of research institutes and regulators of EU countries. During the entire period of this program (1991-1996), about 1,000 design modifications were implemented on the Units.

In 1995-1996, parallel to this three-stage program, a comprehensive analysis was done in cooperation with the chief designer and an elaborative complex program was developed for Units 1-4. The goal of the program was to apply corrective measures to achieve compliance with modern standards thus ensuring further operation of the VVER-440 Units until expiration of their design lifetime.

The program began in 1997. About 500 new design modifications were implemented until 1999. A large international team of experts was gathered to work on the program, including experts from major European companies, the International Atomic Energy Agency, the Western European Nuclear Regulators Association (WENRA), etc.

During the 1990s, Kozloduy NPP allocated USD 245 million in the modernization of the VVER-440 Units.

In 2000, an updated version of the modernization program was prepared, taking into account the recommendations for optimization of activities. The number of measures was increased for Units 3 and 4, as it became clear that Units 1 and 2 will be shut down in 2002. Thus, in 2000-2002 more than 300 additional design modifications were implemented on Units 3 and 4, and a new Safety Analysis Report was also prepared. Additional USD 66 million was spent on modernizations of Units 3 and 4.

In the framework of the complex modernization program the major design deficiency of Units 3 and 4 was corrected: the confinement of the rectors was improved through modernization of accident localization systems. A Jet Vortex Condenser was mounted on Units 3 and 4 in 2001-2002, and the number of envisaged design-basis accidents was increased following the recommendations of the IAEA and the Western European Nuclear Regulators Association.

> With 25 international reviews, Kozloduy NPP became the most rigorously inspected plant in the world

Following assessment of applied modernization measures in 1991-2002, the chief designer classified these Units as a new model B-209M, which meets contemporary safety requirements and is comparable with VVER-440/B-213.

Till the end of 2005, following the long-term operational licenses, additional projects were implemented amounting to EUR 14.3 million.

International Reviews

With 25 international reviews (1991-2003) of the design basis, operational practices, seismic resistance and regulatory control, Kozloduy NPP became the

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Units 3 and 4 – the facts

most rigorously inspected plant in the world.

In the last several years, Kozloduy NPP was subject of inspection by the most authoritative international nuclear organizations.

In 2002, the engineering company ENCONET conducted an independent review at Kozloduy NPP. The experts concluded that the amount of upgrades implemented on Units 3 and 4 met the safety criteria of the Atomic Questions Group, IAEA, WENRA, and the U.S. Nuclear Regulatory Commission.

These conclusions were stated once again by the IAEA mission to review the results of safety upgrading activities of Units 3 & 4. It took place in June 2002. The report read, **"It was concluded that the plant operational safety is a priority for KNPP management and that in the process of its improvement the plant has reached a level that corresponds to the level of plants of the same vintage worldwide."** Furthermore, the experts stated, **"As concerns Units 3 and 4, in the course of the Modernization Program, the main safety functions were improved to the level, or in some cases beyond the level, which meets the IAEA initial recommendations of TECDOC-640."**

In 2003, Kozloduy NPP hosted yet another peer review by the World Association of Nuclear Operators. The goal was to get another independent assessment as regards safety of Units 3 and 4. The WANO team gathered 18 experts from 11 countries, representatives from the regional centers of the association in Moscow, Atlanta, Paris and Tokyo. The team concluded that Kozloduy NPP has achieved significant improvements over the last years and had qualified personnel which would ensure good performance in the years to come.

In October 2003, 11 experts from the Atomic Questions Group conducted a peer review at Kozloduy NPP in line with the pre-accession agreements of the Bulgarian government and the EU. The team included specialists from Italy, Belgium, Denmark, Germany, Greece, Spain, France, Austria, Finland, Great Britain and the European Commission.

The conclusions of the review were among others:

⊙There was evidence that all the AQG recommendations have been addressed adequately.

⊙There was evidence that implementation plans exist for those recommendations that have not yet been completed.

⊙Information provided by Kozloduy NPP, regarding the availability of financial and human resources for implementing remaining outstanding recommendations, indicated the feasibility to complete all outstanding work in accordance with planned schedules.

⊙It was recognized that personnel from Kozloduy NPP have up-to-date knowledge of international practices and upgrading measures, and related application, in other similar nuclear units in eastern European countries. There was evidence of effective and comprehensive upgrading of the Units 3 & 4 when compared to the status of a few years ago.

⊙The AQG does not consider further monitoring activity on the recommendations of the AQG to be necessary.

Focus

WANO backs up Kozloduy NPP in declaration

The Moscow Center of the World Association of Nuclear Operators issued a special declaration to support further operation of Units 3 and 4. The Board of Directors passed the document at a meeting on January 30, 2007. Kozloduy NPP was presented by Kiril Nikolov, Deputy Executive Director of the plant.

The declaration reads:

"In the last several years, Kozloduy NPP undertook various WANO programs (peer reviews, technical support, exchange of operational experience) and demonstrated good results as regards safety and reliable operation of Units 3 and 4. Various events have been organized to implement operational experience. Operational criteria significantly improved: the plant availability factor exceeded 91 percent; the number of reactor trips felt below world averages; fuel reliability has improved significantly (in fact, two times); the collective radiation dose of personnel matches world average levels.

In June 2003, a WANO team of international experts conducted a peer review at Unit 3 and 4. The results demonstrated that Kozloduy NPP achieved a significant improvement in plant operation over the last ten years, and it has employed competent personnel which provides for good results in the future.

The Board of Directors of WANO – Moscow Center takes into consideration the fact that, in the last 15 years, Kozloduy NPP implemented a large-scale modernization on Units 3 and 4 in order to improve safety and reliability, and units were brought in compliance with modern safety standards.

We declare:

At present, Kozloduy NPP has reached a high level of safe and reliable operation and no technical reasons exist for the early closure of Units 3 and 4."

Training of operational personnel

Operators of Units 5 and 6 took part in a specialized training which started on February 5 and lasted five weeks. The training course was designed for specialists who need to get their licenses from the Nuclear Regulatory Commission.

According to Bulgarian legislation, operational personnel need to undergo 20-days courses each year. These courses include simulator exercises as well as lectures.

This year, the training took place at the Ledenika Recreational Complex in order to add a team-building element to the traditional training. During the course, the specialists were familiarized with the implementation of a new information system, nuclear safety issues, and new elements in the Kozloduy NPP's Emergency Plan. They also practices stress reducing techniques.

Rasho Parvanov named Person of Year 2006

Rasho Parvanov, head of operational division, became the Person of Year 2006 in the contest initiated by the regional newspaper *Dunav*. He received the well deserved title by his fellow-citizens as a recognition of his professionalism and active civil position in defense of Units 3 and 4. Mr Parvanov competed for the title with six other nominees in several categories: education, healthcare, power generation – Kozloduy NPP, culture, etc.

"I didn't expect to become a Person of the Year and I'm pleasantly surprised now. This title motivated me to go ahead even more persistently and fight for the small reactors. I am sure that Kozloduy NPP has become an issue of national importance and the destiny of the nuclear units is crucial for most Bulgarians," said Rasho Parvanov.

Two more Kozloduy NPP employees won honorary titles in the contest. Rumen Tirikov, head of Maintenance Division, was announced a winner in the power generation category, and Vasko Petrov got the award in the culture category for his participation in the amateur theater group of Kozloduy NPP.

Journalists meet Kozloduy NPP's top management

At the end of January 2007, Kozloduy NPP organized the traditional annual meeting with journalists from regional and national media. The event took place at the Ledenika Recreational Complex. Mr Ivan Genov, Executive Director, presented information on the status of the nuclear plant and the financial results for 2006. He pointed out that the company exceeded the production target by 7.35 percent, and the generated electricity was about one billion kilowatt hours more than in 2005. This quantity comes close to the generation in 2001 when Kozloduy NPP operated six Units. The plant fulfilled the open market quotas at 100 percent. For a second year in a row, none of the Kozloduy NPP Units had a reactor trip. Moreover, Unit 6 marked 10 years without a reactor trip.

Responding to the large interest to the closure of Units 3 and 4, Chief Engineer Vladimir Uruchev made a presentation about the technical parameters of these Units. He stressed out the implemented modernization measures as well as the high international appraisal for the Units following numerous peer reviews and safety assessment missions.

Deputy Executive Director Kiril Nikolov answered various questions with regard to negative effects of the early closure of the VVER-440 Units.

Discussion

Experts discuss the future of nuclear industry in Bulgaria

On January 18, a discussion took place in Pleven entitled 'Present status and future development of the Bulgarian nuclear industry.' The meeting was organized by BULATOM, the Bulgarian nuclear forum, together with the Pleven District Administration and the Ministry of Education.

The goal of the forum was to provide more information about the nuclear industry in Bulgaria as well as to discuss the future construction of the Belene NPP. A major point of debate was the preparation of engineering personnel for Belene. Mr Stanislav Georgiev, Secretary General of BULATOM, chaired the meeting.

Three specialists form Kozloduy NPP took part in the meeting. Vladimir Uruchev, chief engineer of Units 1-4, presented information about the safety and the reliability of Units 3 and 4. He also talked on the negative consequences of the early closure of these Units from ecological and economic point of view.

Valentin Ribarski, head of KNPP's Decommissioning Department, pointed out the major preparatory steps for decommissioning. He said this process was regulated by normative documents to the same extent as nuclear plant operation.

Another accent in the discussions was the university education of engineers for the Belene NPP. It became clear that Bulgaria will need more qualified personnel for operation of the new nuclear facility.

The participants were particularly interested in the presentation of Lyubomir Pironkov, head of the Kozloduy NPP Training Center. He talked about the significance of the human factor in nuclear industry, and the various aspects of specialized training. He stressed the fact, that the profession of nuclear operator presents a good opportunity for personal development but it also requires a strict adherence to safety requirements. This profession also calls for a permanent improvement of qualification in a highly competitive atmosphere. Information was presented about the international practices in this field.

Sabin Sabinov, project manager at Parsons E&C - Bulgaria, presented in brief the major stages of construction of the Belene NPP in the context of the nuclear renaissance in the world.

At this meeting, guests from several high schools of Pleven had the chance to get first-hand information about the nuclear industry in the Bulgaria.

KOZLODUY NPP REVIEW
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