KOZLODUY NPP REVIEW

CLEAN ENERGY

Special edition
November 2008

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IAEA FOLLOW-UP MISSION UNITS 5 & 6 MODERNIZATION PROGRAMME

10-21 November 2008

IAEA EXPERT TEAM

Marco Gasparini, IAEA Team Leader

I am Italian. My own town is Senigallia that is a beautiful summer beach resort by the Adriatic sea. I am currently living in Vienna, Austria. I work at the Division of Nuclear Installation Safety of the International Atomic Energy Agency. I have 16 years as a regulator in the Italian Safety Authority, 4 years research activity in the area of severe accidents in USA laboratories, 13 years at the IAEA with responsibility in the preparation of Safety Standards for the Design of NPPs and design safety reviews. I have participated in several IAEA safety review missions mainly as organizer and team leader.

"Strong motivation and commitment of the KNPP staff involved in the task. Excellent the arrangement of the logistics and the hospitality"

KNPP management and staff have put a great effort in the organization of the follow up. This allowed to start working very efficiently from the very first moment.

Antonio Madonna

I am from Italy, Rome. I work as a Director of Independent Expert Organization in Italy, ITER Consult. I have experience in conduct of regulatory reviews, safety evaluation, international cooperation. I have taken part into several safety review missions of the International Agency of Atomic Energy, mainly as an organizer and a team leader. I am impressed by the kind and generous hospitality, excellent organization of the Kozloduy NPP for the IAEA mission.

Peter Krs

I am from the Czech Republic, I live near Prague.

I have a University degree in nuclear engineering.

I work for a state agency, which is a regulatory authority in the area of nuclear safety.

I have extensive professional background – 23 years, with the regulatory authority and a power utility.

Since 1990 I have participated in many different IAEA missions.

Josef Misak

From the Slovak republic, I live in Piestany at present. I graduated from the Technical university in Prague, the Nuclear energy faculty, I have a PhD degree in technical sciences – nuclear engineering in the above mentioned university. Since 2004 I am the Director for strategy in the Nuclear Research Institute in the Czech republic. I deal with the co-ordination of technical projects of special importance and with development of the long-term strategy of the Institute. I have more than 37 years of experience in the nuclear energy sphere (nuclear safety); several years of experience in nuclear safety regulation; broad experience in development of international nuclear safety related documents and publications. I had various positions, up to director of a research institute and Chairman of the Slovak Regulatory Authority. During the period 1998-2004 I was Head of the IAEA Safety Development Unit, responsible for development of safety related publications in the area of deterministic and probabilistic safety assessments. I have numerous participations as a team leader in IAEA safety missions (DSRS, OSART, ASSET, IRRT, IRRS).

Perfect preparation for the mission, excellent hospitality

IAEA EXPERT TEAM

Jiri Zdarek

Good working environment, excellent experts, a clear vision to solve problems

I am from Prague, Czech Republic.

I graduated from the Technical University in Prague, Nuclear energy faculty. I specialized at Pennsylvania State University and at Sheffield University. I have a PhD degree from Prague Technical University. I work at Division of Integrity and Technical Engineering of the Nuclear Research Institute. I have accumulated my professional experience at the Sigma Research Institute (Piping and Valve Design) and at the Nuclear Research Institute as a Division Director. I took part in various design safety missions of the International Atomic Energy Agency in Rovno, Chmelnitski, Kozloduy, Balakovo, Novovoronezh

Pierre Labbe

I am from France, I live in Paris. I have graduated as civil engineer. I have a PhD in mathematical sciences. I work at the Headquarters of EdF Nuclear Engineering Division. In addition to my basic activity, I am a professor at the University of Lyon (Structural dynamics and earthquake engineering).

I work on conceptual designs of PWR NPPs including EPR. I worked for IAEA from 1999 to 2004 when I took part in a number of safety review missions, in particular of WWER 1000 including Units 5 and 6 of Kozloduy NPP in 2000. On the KNPP side, it appears that this follow-up review was prepared very seriously, in a very professional manner.

Peter Kelm

"I am impressed by the good preparatory work for the Mission. The Kozloduy NPP staff is very friendly."

I am Germany, Berlin. I have a University Degree – Nuclear Engineer. International Atomic Energy Agency, Vienna. My experience is in the area of NPP design and commissioning. I also have experience in the regulation and safety evaluation. I took part in the IAEA mission of Kozloduy Units 1-4.

KOZLODUY NPP REVIEW

SAFETY ISSUES:

ANALYSES

4 - Prevention of inadvertent boron dilution

13a –Mitigation of a stream generator primary collector break

17 –ECCS water storage tank and suction line integrity

24 - Cold emergency feedwater supply to SG

30 –Human engineering of control rooms

44 –Containment bypass

49 - Systematic flooding analysis

50 -Flood protection for emergency electric power distribution

56 - Scope and methodology of accident analysis

57 –QA of plant data used in accident analysis

57a - Computer codes and plant model validation

58 –Availability of accident analysis results for supporting plant operation

59 –Main steam line break analysis

60 –Overcooling transients related to pressurized thermal shock

61 –Steam generator collector rupture analysis

62 –Accidents under low power and shutdown (SPS) conditions

63 –Severe accidents

65 - Boron dilution accidents

66 -Anticipated transients without scram (ATWS)

68 –Total loss of electrical power

69 –Total loss of heat sink

SYSTEMS

7-RPV embrittlement and its monitoring

12 –Steam and feedwater piping integrity

13 –Primary circuit cold overpressure protection

14 –Reactor coolant pump seal cooling system

15 –Pressurizer safety and relief valves qualification for water flow

16 –ECCS sump screen blocking

18 -ECCS heat exchanger integrity

19 –power operated valves on the ECCS injection lines

20 –Steam generator safety and relief valves qualification for water flow

21 –Steam generator safety valves performance at low pressure

25– Ventilation26 –Hydrogen removal system

51 –Dynamic effects of main steam and feedwater line breaks

52 –Polar crane interlocking

FIRES, EXTERNAL AND INTERNAL EVENTS , PSA, SEISMIC DESIGN

46 –Fire prevention

47– Fire detection and extinguishing

48 -Mitigation of fire effects

54 -Analyses of plant specific natural external conditions

55 –Man-induced external events

64 –Probabilistic safety assessment (PSA)

53 - Seismic design

SAFETY ISSUES:

QUALIFICATION AND CLASSIFICATION OF EQUIPMENT AND ELECTRICAL -EQUIPMENT

1 - Classification of equipment

2 - Qualification of equipment

3 - Reliability analysis of safety class 1 and 2 systems

38 - Off-site power supply via start-up transformers

39 - Diesel generator reliability

42 - Emergency battery discharge time

43 - Ground faults in DC circuits

I&C AND DIAGNOSTIC SYSTEMS: REACTIVITY AND IN-CORE MONITORING

9 - Primary pipe whip restraints

27 - I&C Reliability

32 - Condition monitoring for the mechanical equipment

33-Primary circuit diagnostic systems

34 - Reactor vessel head leak monitoring system

35 - Accident monitoring instrumentation

36 - Technical support centre

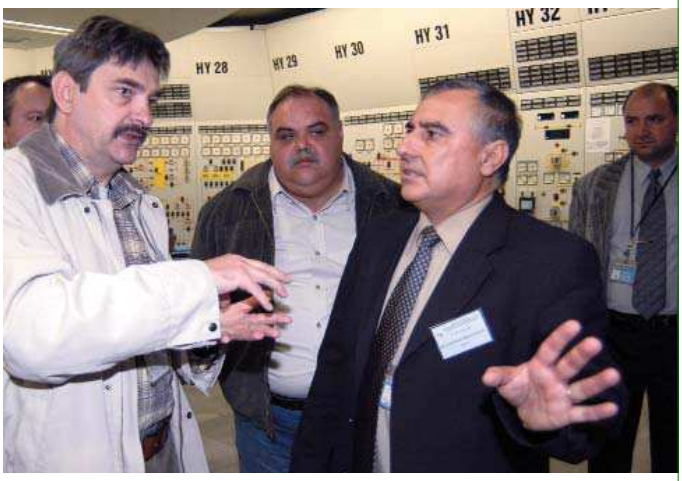
37 - Water chemistry control and monitoring equipment (primary and secondary)

5 –Control rod insertion reliability/fuel assembly deformation

6 - Sub-criticality monitoring during reactor shutdown conditions

29 –Automatic reactor protection for power distribution and DNB

31 - Control and monitoring of power distributions in load follow mode



KNPP UNITS 5 & 6 MODERNIZATION PROGRAMME

THE BEGINNING

Reference basis – IAEA document:

IAEA-EBP-WWER-05 - "Safety issues and their ranking for WWER-1000, model Â-320 NPPs";

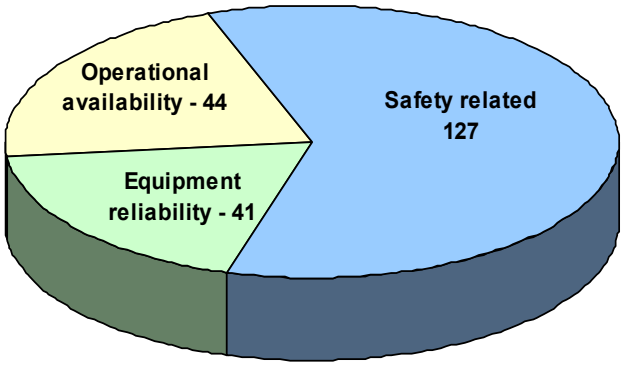
Approach selected:

- **Implementation of the full scope of improvements;**
- **Implementation on units in operation within the planned outage windows without affecting electricity production.**

SAFETY ISSUES IDENTIFIED

- 22 safety issues of category I
- 38 safety issues of category II
- 11 safety issues of category III

Structure of the MP – a set of 212 measures



KNPP UNITS 5 & 6 MODERNIZATION PROGRAMME

♦Initial definition of MP – January - 1995

♦IAEA mission - 1995 - review to assess the measures suggested in terms of their completeness and adequacy

♦Independent assessment of safety by Riskaudit/IPSN/GRS- 1997

♦Ieview of the Programme Status – IAEA mission 2000

♦IAEA Follow up mission 2008

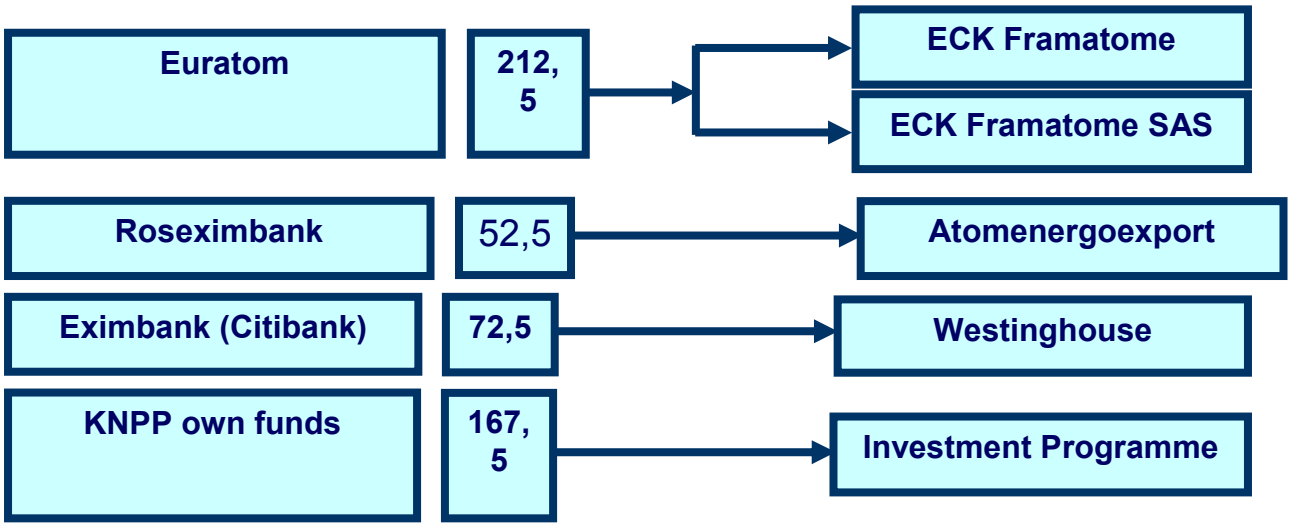
Classification of measures by areas of improvement

1. Safety enhancement related to the design changes - 60
2. Studies and additional analysis - 62
3. Equipment reliability enhancement - 41
4. Operational conditions enhancement - 4
5. Preparation for equipment decommissioning - 5

Modernization Programme—Financing

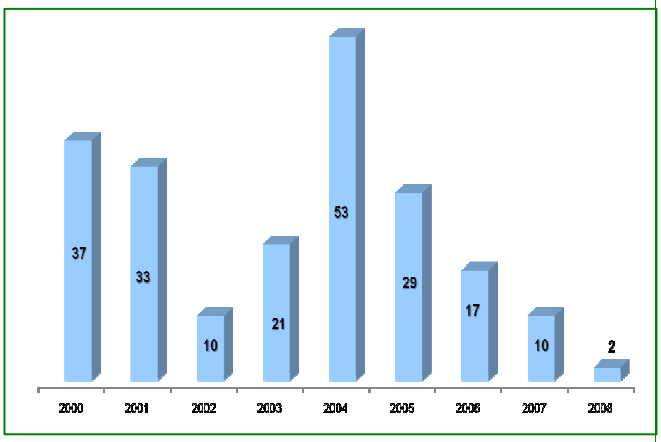
Total investment of 505 M. EUR

- 167.5 M. EUR Kozloduy own funds;
- 337.5 M. EUR through credit agreements;



KNPP UNITS 5 & 6 MODERNIZATION PROGRAMME

IMPLEMENTATION PER YEARS



Phase 1

Scope of activities:

Preparation /submitting of input data;

Development of Terms of Reference;

Development of Technical Project engineering reports from the analysis.

Completion of the first stage under the contracts with ECK and Westinghouse in 2000.

Phase 2

Contracts startup - June 2001

Scope of activities:

Development of detail designs;

Development of delivery documentation;

Equipment manufacture and procurement;

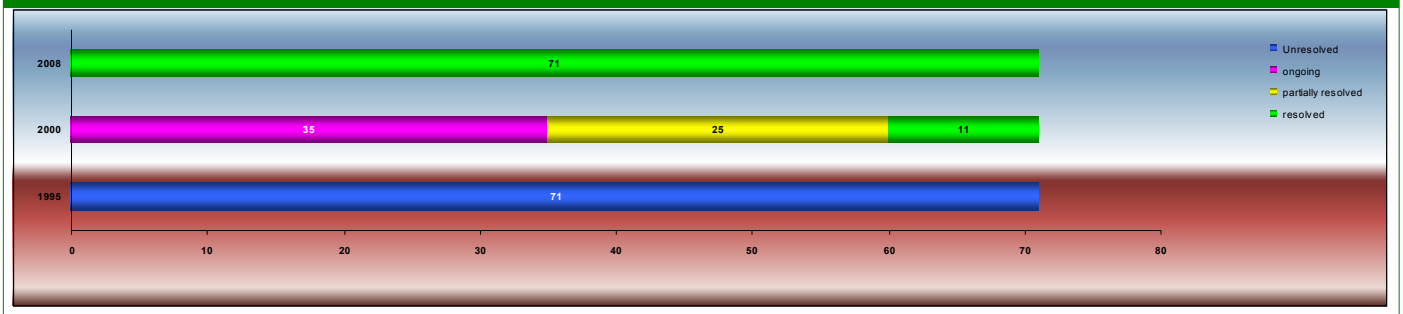
Installation of equipment;

Testing new systems;

Licensing;

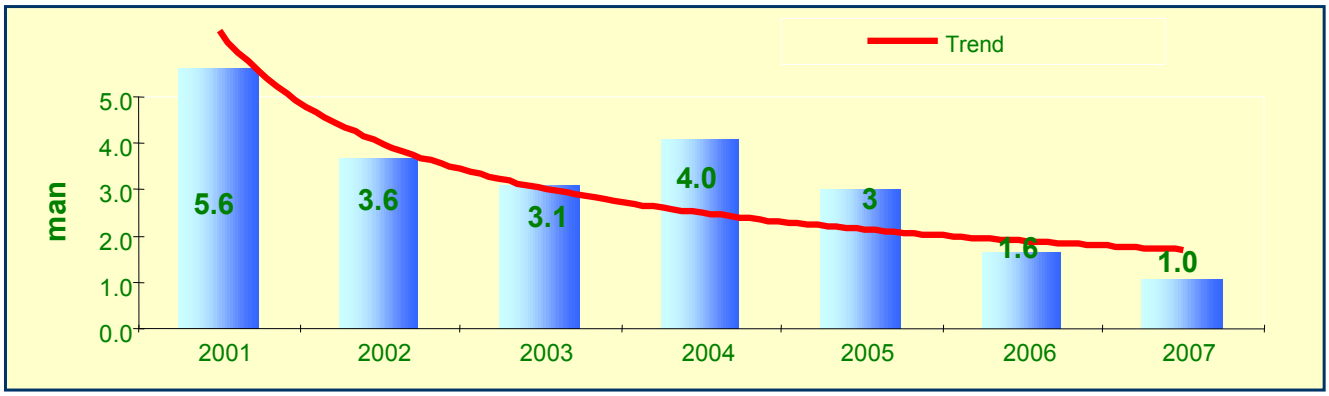
Commissioning.

SAFETY ISSUES AS RESOLVED THROUGHOUT THE YEARS



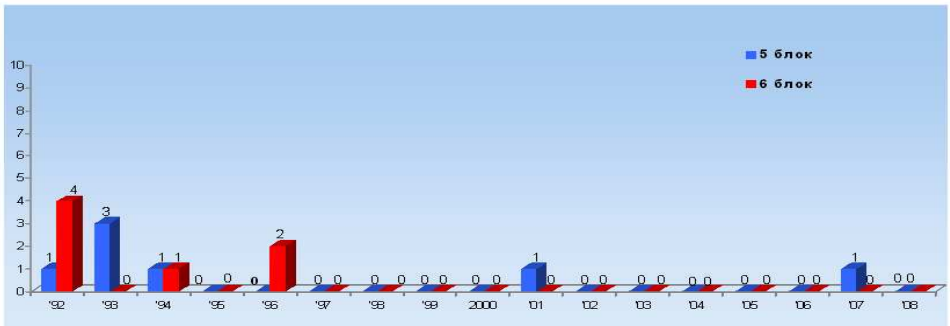
Benefits from the implementation

Personnel collective effective dose rate



Benefits from the implementation

Number of unplanned SCRAMs



KNPP UNITS 5 & 6 MODERNIZATION PROGRAMME

KOZLODUY NPP REVIEW

Closing meeting of the Follow-up mission held on 20th November 2008

" The results of our review are excellent. We are impressed by the complexity and the amount of the activities implemented under the Modernization Programme. I think you should be proud of it because you are one of the best plants in the world."

ЗЕЛЕНА ПАРТИЯ В БЪЛГАРИЯ

Ръководството на Зелената партия в България поздравява най-сърдечно работещите, служителите и ръководството на АЕЦ „Козлодуй" по повод 25-годишнината на централата.

За вложените огромни средства в последните години за повишаване и гарантиране на безопасността и на екологосъобразно производство във бреда с Юбилейната годишнина комисия АЕЦ „Козлодуй" за годишното отличие на Зелената партия в България за принос в опазването на околната среда.

София 04.08.1999 г.

Александър Карайчанов

Председател на Зелена партия в България

РЕПУБЛИКА БЪЛГАРИЯ

МИНИСТЕРСТВО НА ОКОЛНАТА СРЕДА И ВОДИТЕ

5 ЮНИ СВЕТОВЕН ДЕН НА ОКОЛНАТА СРЕДА

ГРАМОТА

на "АЕЦ - Козлодуй" ЕАД, гр. Козлодуй

ЗА ЗНАЧИМ ПРИНОС В ОПАЗВАНЕТО И ВЪЗПРОИЗВОДСТВОТО НА ОКОЛНАТА СРЕДА И ПРИРОДНИТЕ РЕСУРСИ

5 Юни 2001 г. – 5 Юни 2002 г.

ДОЛОРЕС АРСЕНОВА

МИНИСТЪР НА ОКОЛНАТА СРЕДА И ВОДИТЕ

KOZLODUY NPP REVIEW

CONTACT US

We look forward to hearing your views. Please feel free to contact us.

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WE ARE ON THE WEB!

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SOCIAL PROGRAMME

During the weekend the IAEA experts visited the old Bulgarian capital Veliko Tarnovo and Etara ethnographic complex, where they were impressed by the historical sights and by the authentic Bulgarian architecture.