



Jaderná elektrárna
Dukovany

Equipment restoration program
Dukovany NPP
MORAVA

Procedural report
SUMMARY

ČEZ-EDU
JULY 2001

The elaboration of the „*Back-fitting of Nuclear Power Plant Dukovany*“ program, the main goal of which was to increase the level of nuclear safety, was started already during the commissioning of the individual units in the Dukovany NPP. The initial design of the Back-fitting was elaborated in 1990 and in 1991 preparation and implementation of the individual activities was started. In the present time all major measures from this program are already implemented. A series of further activities, the aim of which was equipment renovation, was implemented also outside the „Back-fitting“ program.

Since the beginning of the ninetieth some trends appeared to infringe generally and uniformly the safety level of nuclear power plants constructed based on Russian design, and the efforts to put them out of operation increased in intensity. Regarding these trends, it became obvious that it would be necessary to perform a complex evaluation of the real situation in the Dukovany NPP. A series of analyses and supporting programs was carried out in the frame of international activities and with the Czech republic. Assessment of the Dukovany NPP was performed both by own experts from the Dukovany NPP and by independent (mainly foreign ones) experts. For instance experts from the International Atomic Energy Agency (IAEA), experts from nuclear power plants in operation from different countries, experts from the regulatory bodies (Czech and foreign), experts from the manufacturers of nuclear power plants equipment, etc.

Concept of the **Equipment renovation program**, which was later named **MORAVA (MO**dernization - **Re**construction - **Analyses** - **VA**lidation), was based on an extensive technical assessment of the Dukovany NPP (technical audit), the goal of which was to evaluate the actual situation of the Dukovany NPP and to propose a list of necessary modifications, which would form a basis for the equipment reconstruction in the next period of time.

The EDU audit was split in two parts:

A) **Internal audit**, carried out by teams of about 100 EDU employees with the support of external organisms (ÚJV ŘEŽ, 3E Praha and others), evaluated the equipment from five viewpoints:

1. Equipment reliability and its influence on nuclear safety
2. Failure rate of the equipment and its influence on the NPP availability (influence on the production outages)
3. Equipment requirements for maintenance
4. Residual lifetime and replacement parts status
5. Further influences, not included in the above (radiation protection, fire protection etc.)

B) **External audit** – in the frame of a PHARE project the ENAC consortium has performed an independent assessment of the technical security of the Dukovany NPP from the viewpoint of international standards and nuclear safety principles.

This step has represented the first verification of the proposed scope of modifications in the Dukovany NPP.

IAEA mission aimed to assess the approach of the Dukovany NPP to the solution of the so-called Safety issues (described by IAEA for VVER 440/213 in the frame of an off-budget program (publication IAEA-EBP-WWER-03).

To assess the level of operation many international missions were organized since 1989 (see below).

Below, the main milestones for the determination and specification of Equipment Renovation Program and its control, performed both by own efforts or using international support are listed:

1990 – Elaboration of the „Initial design of the so-called Back-fitting“, i.e. modernization based on the decision of the government of the ČSSR no. 309 (20th November 1986) with the main goal to increase the nuclear safety.

1991 – Creation of an Engineering services center in ČEZ-EDU

1991 – Start of activities included in the Back-fitting program

- 1991 – Assessment of the conclusions in the so-called „Green book“ (safety evaluation of the NORD NPP in the former GDR – EDU team),
- 1992 – Common activities of the VVER 440/V213 units operators (list of safety improvements, EDU representatives, members of the VVER 440/213 club)
- 1994 – 95 Internal technical audit (EDU working teams, support from ÚJV ŘEŽ)
- 1995 – External technical safety audit (consortium ENAC – PHARE program).
- 1995 – Safety report, updated after 10 years of operation (Škoda Praha)
- 1995 – Probabilistic safety assessment (team EDU and ÚJV ŘEŽ, further living PSA)
- 1996 – Finalization of the Back-fitting program (most of the activities carried out, the remaining ones were included into POZ)
- 1996 – Three parties agreement about cooperation and technical information exchange between EDU, EBO, and EMO (information exchange about modernization measures)
- 1996 - 99 Elaboration and validation of the regulation for extraordinary occurrences solution (EOPs – elaborated by the Westinghouse company) – analyses conclusions led to recommendation for modifications.
- 1997 – Evaluation of the conclusions of technical evaluations and missions.
- 1998 – Elaboration of the Equipment Renovation Program documentation (team EDU and ÚJV ŘEŽ, EGP Praha)
- 1999 - 2000 – Elaboration of the preliminary feasibility study (team EDU and EGP Praha)
- 2001 – Organizational change in ČEZ-EDU in the area of modifications control (creation of the technical engineering center and transfer of the investments preparation and implementation to the Maintenance and Repairs Department)

SÚJB requirements from the Decision for Units 1 to 4 and other supporting evaluations were further inputs to the Equipment Renovation Program.

Since 1990 also supporting programs PHARE (EU) are used.

For the verification of the Dukovany NPP approach independent evaluations were used (the main ones being):

- 1989 - OSART (IAEA) mission
- 1991 - RE-OSART (IAEA) mission
- 1993 – ASSET (IAEA) mission
- 1995 – IAEA mission for the Safety issues resolution area
- 1996 - ASSET (IAEA) mission
- 1996 - „Insurance“ (March & McLeuman, Gradmann & Holler)
- 1997 - „Insurance“ (Czech nuclear pool)
- 1997 - Peer Review (WANO, INPO)
- 1998 - IPERS (IAEA - PSA-1)

The Equipment Renovation Program linked up to the modernization activities designed and implemented in the frame of the Back-fitting.

Equipment Renovation Program was approved during the ČEZ-EDU technical council meeting in March 1998. It was later named MORAVA.

Significance and purpose of the works on POZ have two main aspects – the safety and economical ones (summary – reach the safety level accepted in the EU, to extend the license till 2025 while conserving the competitiveness).

Many safety relevant activities were already carried out. More than the half of the proposed measures based on IAEA safety findings, which are assessed also in the frame of the EU (Atomic Question

Group), is already resolved. All this induced a significant decrease of the reactor core melting probability (to a level of 1.77E-5).

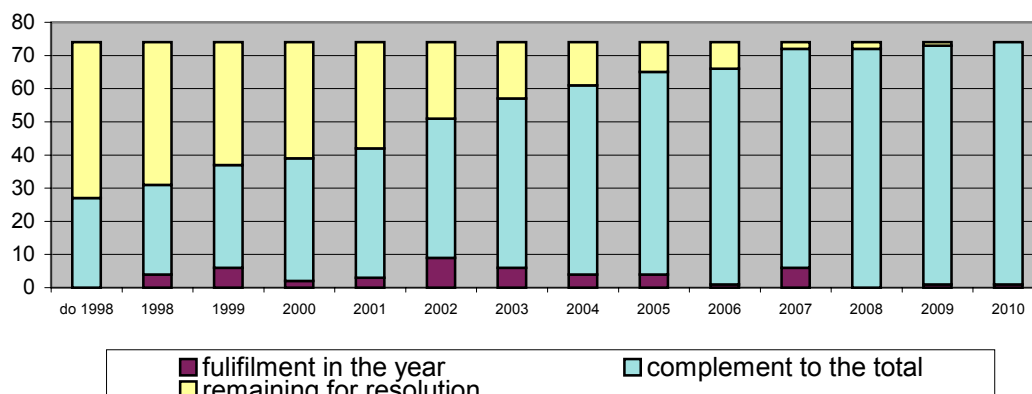
In the present time the main effort is directed to the solution of the Category III safety findings (the highest priority given for VVER440/213) and the intermediate category II.

Among the category III activities 3 problems are resolved and 5 activities are in progress in the present time:

- Finalization of the qualification and safety certificate for the vacuum-relief condenser
- Internal risk due to High-pressure pipe brake (level +14,7 m)
- Equipment qualification
- Fire prevention
- Seismic design

41 problems are classified in the category II. In the present time 20 problems are resolved and the remaining ones are in different stage of progress (refer to Attachment).

"Safety Issues" measures fulfilment Overview not Operation



Renovation of the Instrumentation and Control (I&C) system, designed in the seventieth, is being one of the most significant activities within the MORAVA program. Thanks to preventive replacement of components and their design multiple backup, the I&C system reliability is sufficient. The renovation of the I&C system in the Dukovany NPP will be performed stepwise without extension of outages duration. From the whole scope of activities, included in the I&C renovation, renovation in a part of the in-core measurement system is already carried out, and I&C renovation in diesel generators (reserve power supplies for NPP own consumption) are in progress.

Dukovany NPP Equipment renovation program control

Dukovany NPP Equipment renovation is composed of a set of partial constructions or modules. The A – thesis specifying among others also the EDU approach in the area of POZ preparation and implementation was also part of the POZ (dated March 1998). Stepwise implementation of the individual POZ parts or modules using standard procedure in accordance with the EDU legislation in a way not to influence the refueling outages duration and not to modify the basic safety philosophy of the project was one of the basic principles. The selected way of project implementation has proven to be the most suitable also regarding the optimal use of financial resources of ČEZ, a.s. without the necessity to plan great yearly peaks.

Termination of the modernization activities of the Dukovany NPP Equipment renovation program (MOP) is scheduled till 2010.

The whole set of activities was assessed as to feasibility, including the complex economic analysis. The evaluation results confirm the correctness of the selected approach.

CONCLUSION

The Dukovany NPP represents a cheap, reliable, and highly safe and environment friendly source of electric power in the ČR. It is a Czech nuclear power plant as its design was completed in the Czech republic, and it was constructed and manufactured there based on design background from the former Soviet Union. The parameters of the Dukovany NPP are fully comparable with the nuclear power plants operated in the Western countries (including the European Union countries) and will be further improved during the further plant development. It is also fully comparable with nuclear power plants operated in the countries in Western Europe as to safety; it is also fully competitive as to economic effectiveness.

The conclusions of the WENRA evaluation report „Nuclear safety in the EU candidate countries“ (10/2000) states: „It is expected that upon the complete implementation of the modernization program the Dukovany NPP will reach the safety level fully comparable with the nuclear power plants of the same operational age operated in Western Europe“.

Last evaluations of the European Union, elaborated at the beginning of 2001 by the AQG (Atomic Question Group) group and the WPNS (Working Party on Nuclear Safety) showed that the major safety deviations, which they had indicated, were correctly identified and solved in MOP with the highest priority.

The equipment renovation program MORAVA and its modernization part were thus determined in accordance with the European safety practice and the preparation and implementation is advancing in a correct, controlled direction.

MORAVA program – scheduled part

<p>1. Modification of equipment in PoE + 14,7m Elimination of the High-pressure piping break consequences</p>	<p>Feedwater and steam piping swing limiters 2002</p>
<p>2. Instrumentation and control system renovation</p>	<p>M 1. Safety systems - 2010 M 2. Process computer systems - 2010</p>
<p>3. Spent fuel intermediary storing facility extension (MSVP)</p>	<p>Civil part 2006</p>
<p>4. Activities for increase of pH in the secondary circuit</p>	<p>Units 2, 3, and 4 – 2004</p>
<p>5. Reconstruction of the diesel generator stations electrical part phases I, II</p>	<ul style="list-style-type: none"> • As on 07/2001 implemented already in 8 DGSs • Termination – 2002
<p>6. Insertion of electric valves in the special drainage line from the MCR board Insertion of electric valves in the special drainage line from the A,B301 board</p>	<p>2004</p>
<p>7. Change in the 110 kV reserve power supply connection</p>	<p>By 2004</p>
<p>8. Technical and support center</p>	<ul style="list-style-type: none"> • 1st part - 2004 • 2nd part - 2006
<p>9. Activities resulting form the leakage before break project Increase of KO resistance against vibrations</p>	<p>2003</p>
<p>Circulation piping swing limiters</p>	<p>2005</p>
<p>10. Containment internal structures resistance increase</p>	<p>2003</p>
<p>11. Main and emergency control rooms habitability securing – ventilation systems</p>	<p>By 2004</p>
<p>12. Diagnostic systems – modernization</p>	<p>2005</p>