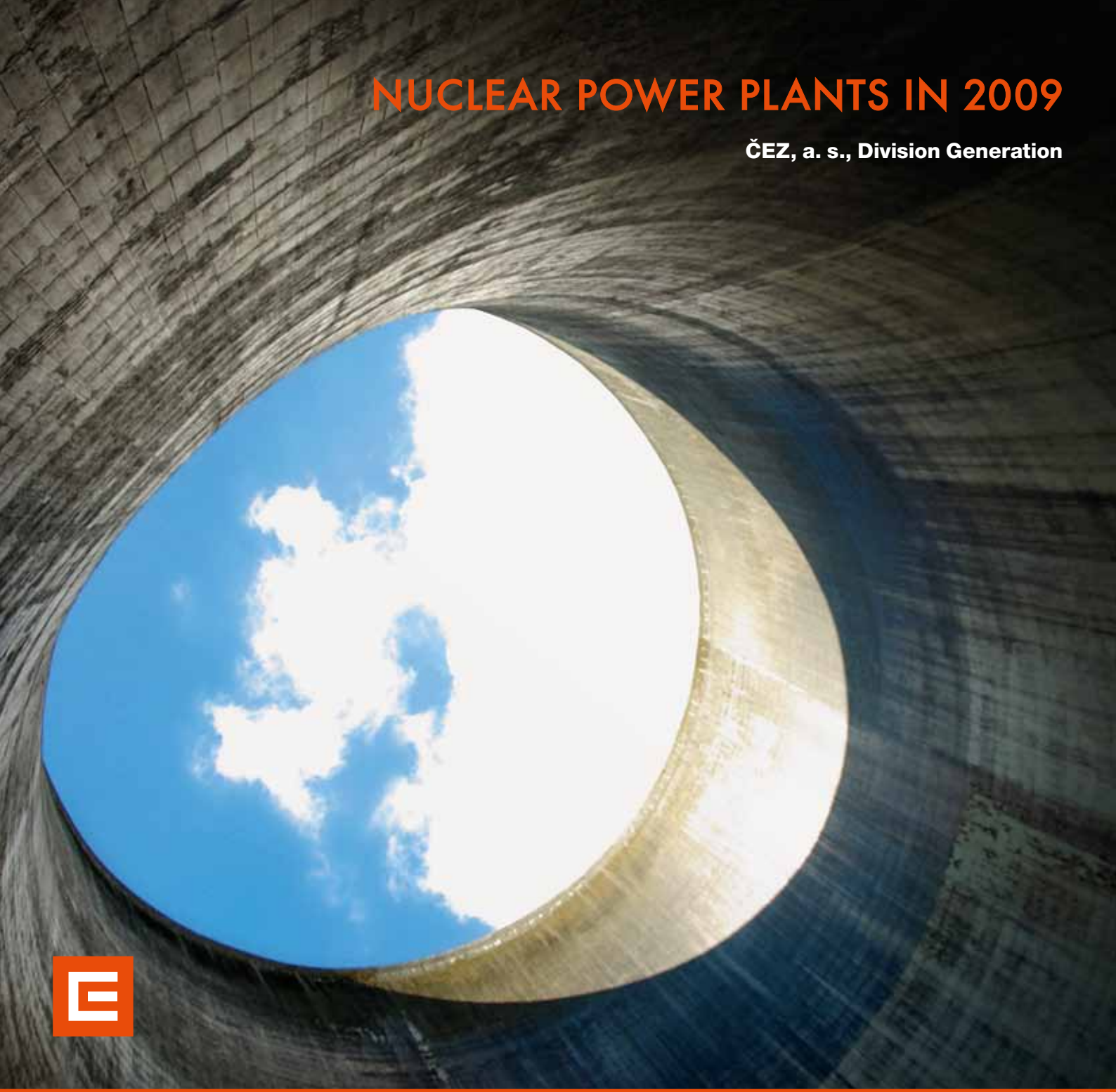
NUCLEAR POWER PLANTS IN 2009

ČEZ, a. s., Division Generation



International Energy Agency
World Energy Outlook 2009:

Nuclear power is one of the technologies that must be accelerated, promoted and relied upon if the world is to stabilise carbon dioxide emissions at an acceptable level.

content


We are aware of the role nuclear power plants play in the economic results of CEZ, as well as in the stability of the power supply market, in the power security of the Czech Republic and in the process of reducing Czech dependence on imports of traditional primary power resources while domestic supplies of coal are becoming limited.

introduction

DEAR FRIENDS,

Over the course of the past year, our company has taken very important steps towards further improving the efficiency in the use of nuclear power plant Units and towards general development of the nuclear power industry. We are aware of the role nuclear power plants play in the economic results of CEZ, as well as in the stability of the power supply market, in the power security of the Czech Republic and in the process of reducing Czech dependence on imports of traditional primary power resources while domestic supplies of coal are becoming limited. Nuclear power plants are also an important means for fulfilling the commitment of the Czech Republic to reduce its CO_2 emissions.
In 2009, we continued to prepare new nuclear power sources. In the Mid-year, we announced the commission to build two new generation units at Temelin NPP, fitted with pressurised water reactors – as well as the possibility of five more units in other locations in Europe. The supplier selection process was launched according to a public commission bill. The Third and Fourth Units at Temelín NPP are expected to be finished in 2020.
For the planned construction, we have a preference for a custom-supplied project including construction and operation launch, and of nuclear fuel. We require the supplier to own the full intellectual rights to the project. The selection process is fully transparent to ensure that the selected technology and supplier fulfil our expectations, meet all deadlines, keep to the budget and ensure safe, reliable and competitive operation of the new reactor Units in the future. CEZ also explored the possibility of building nuclear power plants abroad.
A contract was signed agreeing to form a new enterprise focusing on the building of one or two nuclear power Units in Jaslovské Bohunice. In March 2009 the Energonuclear S. A. enterprise was founded in Romania with CEZ as a stockholder. This company's main goal is to prepare and supervise the project of completion of the Cernavoda NPP.
The two currently operating Czech nuclear power plants remain our topmost priority though. Their outstanding performance significantly impacts on the economic results of the whole CEZ Group. In the past few years, both power plants launched important programmes and projects, aimed at further improving the efficiency of generator units and increasing the safety of operation.
The Dukovany NPP is undergoing a process of modernization. As a result, the output of Unit 3 increased to 500 MW in May 2009. In the next three years, we plan to finish the modernization process of the remaining generator Units. Apart from increasing the output of the power plant, we would like to extend its operation beyond 2015. This will have a significant economic impact. The power plant maintains its outstanding results in operation and safety measures among nuclear power plants worldwide. The program of improving the operation of Temelín NPP primarily focused on the stabilization of safe operation of all Units and the optimization of refuelling outages. After a trial period for testing new fuel (to be used from 2010), we plan to use the design reserves of the existing reactor Units to increase their output.
We also launched programmes aimed at improving the performance of personnel of both operating nuclear power plants. We are dealing with an acute need to replace those who will retire with qualified experts, and to maintain the passing of important knowledge on to younger colleagues. The preparation of new nuclear unit construction highlights an additional need for a large number of young, highly professional employees, to whom we offer the prospective of a stable job and great career opportunities.
In 2010, both our nuclear power plants are set to celebrate important anniversaries. Dukovany NPP will celebrate 25 years of operation of its first unit. In Temelín, 10 years will have passed since the minimum output on the first reactor Unit was achieved. This year will be full of new activities as well as a number of programs launched previously. I firmly believe that it will be a successful one.

Vladimír Hlavinka
Executive Director of Division Generation and member of CEZ Board of Directors

Both Czech nuclear power plants boast a suitable location for new nuclear power Units. The natural conditions are sufficient, experts already work here, the infrastructure is appropriate and good relations with the public are maintained.

Petr Závodský, Director of Nuclear Construction Department

preparation of a new nuclear build

CEZ enters a new era

CONSTRUCTION OF NEW POWER RESOURCES, THE TREND OF CUTTING CO_2 EMISSIONS

All over the world, the renaissance of nuclear power is enforced by the increasing costs of primary power resources and the effort to reduce greenhouse gas emissions, namely CO_2 emissions. For reasons of power safety, governments attempt not to be dependent on a single power resource (coal or gas, for example) and thus on a limited number of suppliers of these goods. Instead, they try to combine the variety of resources in a varied power resource portfolio. For the time being, renewable resources such as solar power, wind power, hydro power and biomass cannot cover our power needs for the foreseeable future. Nuclear power plants produce vast amounts of clean, emission-free electricity and they are thus a core element of power systems of most developed countries. For CEZ Group, too, the transformation to low-carbon power production is one of its top priorities. This is why we plan to extend and modernize our nuclear power plants as well as participate in nuclear power plant projects abroad.

In 2009, 435 nuclear power Units operated worldwide. A further 53 Units are being built, mostly in China, India, Russia and South Korea. In Europe, new Units are being built in France, Finland and Slovakia. A further 136 Units are in the process of planning and preparation, for example in Great Britain, USA, Japan, Romania and Bulgaria. A number of other European countries such as Sweden, Netherlands, Belgium and Germany have extended the period of operation of their nuclear power plants and Italy, for example, is seriously considering renewing its nuclear power plant programme.

PREPARATION OF NEW NUCLEAR POWER PROJECTS, MILESTONES

In 2009, CEZ continued to prepare the construction of two further reactor Units in Temelín NPP. On April 1 2009, a new department Nuclear Power Plant Construction was founded. Its main task is to coordinate the preparation of nuclear power projects in the Czech Republic (Temelín, Dukovany) and abroad (Jaslovské Bohunice – Slovakia).

Both Czech nuclear power plants boast a suitable location for new nuclear power units. The natural conditions are sufficient: experts already work here, the infrastructure is appropriate and good relations with the public are maintained. When compared to an entirely new construction in a new place, extending existing nuclear power plants emerges as more efficient and considerate towards nature and landscape.

TEMELÍN NPP

At Temelín, an EIA (Environmental Impact Assessment) is underway which seeks an independent expert study which is required to receive necessary permissions. As part of the EIA, the impact on citizen health as well as the impact on environment is assessed. In February 2009, the first stage of the declaratory process was finished, and the Ministry of the Environment received comments from the Czech Republic, Germany and Austria – as the EIA process is international. In the course of 2009, explorations continued on the location. On the basis of field research, base studies for the EIA documentation were composed and they will be submitted to the Czech Ministry of Environment.

In 2009, talks with the authorities of the South Bohemian Region advanced significantly, resulting in the signing of a general collaboration contract between CEZ and the South Bohemian Region authority. Based on this contract, infrastructure investment is planned in connection with the extension of Temelín NPP.

On August 3 2009, CEZ announced a public bid for two nuclear power Units fitted with pressurized water reactors. The real output of each of the reactor Units should be over 1000 MWe. In the bid, there is an option for up to three similar nuclear power Units in other potential locations in Europe.

Schematic model of two new Units
at Temelín NPP

On October 30 2009, three companies submitted their bids (AREVA, Westinghouse and a consortium of Škoda JS – Atomstroy-export – Gidropress). The final selection process will be carried out in 2010–2011, according to public commission bill.

DUKOVANY NPP

In co-ordination with the Temelín project, feasibility studies are being carried out at Dukovany NPP, aiming to map the possibility of extending the installed output on location. Results show that it would be possible to construct one additional reactor Unit in this area; field research should culminate in 2010.

INTERNET REFERENCE

Overview of world nuclear energy development:
www.world-nuclear.org/info/reactors.html

Declaratory process for EIA: tomcat.cenia.cz/eia/detail.jsp?view=eia_cr&id=MZP230)

Public bid for two nuclear power Units:
www.isvzus.cz/usisvz/usisvz01009Prepare.do?znackaForm=6003460305001.

Overview of world power industry development:
www.worldenergyoutlook.org


“We create values safely” – is the first principle of our company culture. We consider Safety as one of the most important factors determining quality. It is our responsibility as well as our commitment.
Miroslav Holan,
Director of Safety Department

safety

In all power plants operated by CEZ, with special emphasis on nuclear power plants, we carry out regular evaluations and internal enquiries aimed at ensuring the maximum possible safety of technologies, as well as at the protection of our personnel, the public, and the environment. To further improve the safety levels at our plants, we use a number of tools. Among our most important activities in this field in 2009 were:

Extensive research of safety culture – we received valuable feedback from our employees, their assessment and views of safety issues,

Safety Policy update – corporate commitment and the expectations of the top management in terms of safety were updated in a new top-level company document,

Periodic Safety Review (PSR) – we began practically using the new safety assessment process for evaluating the state of facilities, project and other documentation, management control systems, human factors, etc., in comparison with the best worldwide practice.

- **PSR at Dukovany NPP** (after 20 years of operation) – in the process of implementation of corrective measures.
- **PSR at Temelín NPP** (after 10 years of operation) – the evaluation process was completed.

Up-dating of probability risk assessment model – we improved the method of risk assessment evaluation for nuclear power plant operation.

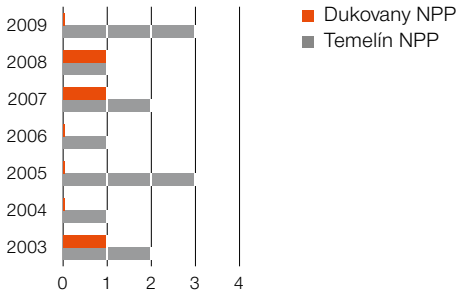
Safety of nuclear power plants is ensured in a number of standard areas such as:

NUCLEAR SAFETY

Within the nuclear power plants, a system of operating experience feedback is consistently applied. All domestic and foreign safety-related events are analyzed and used to further improve the safety and reliability of operation. Extended system of operational safety and performance indicators is applied to evaluate the safety in all possible areas. Similarly to worldwide practice, safety-related events are classified according to the seven-degree international INES scale (International Nuclear Event Scale). The INES 0 and INES 1 degrees cover small deviations and events of the lowest safety significance with no impact on human health or the safety of the environment. For two years now, our nuclear power plants have been running a program “Achieving excellence in human performance” (QLV program). Its aim is to operate nuclear power plants without safety-related events, to ensure professionalism in our staff performance, and to prevent negative impact of operation on the safety, environment, or human health.

To follow the efficiency of the programme, the QLV index was introduced, measuring the reliability of employees (both in-house staff and external suppliers) when carrying out crucial tasks.

1 **Number of Events Classified as INES 1**



TECHNICAL SAFETY

In keeping with the ever-increasing requirements on equipment safety, the Division Generation has expanded its Technical Safety department. Its main task is to define technical safety rules and to carry out independent control of technology and technical requirements on equipment. An internal inspection body was founded (supervised by the State Office for Nuclear Safety – SUJB), carrying out independent

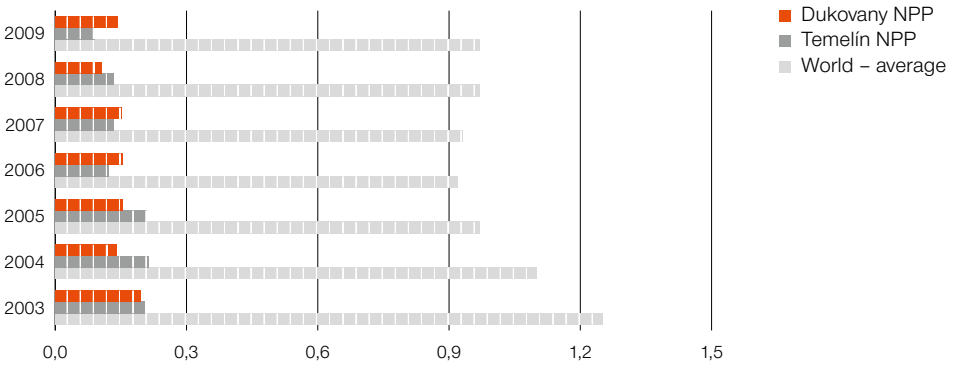
Main control room crew during the Black-out drill at the simulator

supervision of technical safety requirements. The output of this department is also submitted to the state regulatory body in order to document technical safety of equipment at CEZ's nuclear power plants.
In technical inspections of its nuclear power plants, CEZ utilizes the most contemporary methods of measurement, keeping in line with the latest findings of science and technology. A recent example is the utilization of highly advanced phased array technology in the control of blade locks of low-pressure parts of the 1000 MW turbine. This method can detect potential material defects in critical areas early enough to take the necessary measures.

RADIATION PROTECTION

Both nuclear power plants have consistently shown very good performance in protection against ionizing radiation.
One of main indicators of efficiency of technical and organizational measures designed to limit potential irradiation of individuals is an indicator called Collective Effective Dose (CED). CED represents the cumulative total internal and external irradiation of all workers who perform any activities in the radiation-controlled area. In terms of the low values of CED, both nuclear power plants operated by CEZ rank among the world elite. In 2009, the values of CED at Dukovany NPP were 0.143 Sv per Unit and 0.089 Sv per Unit at Temelín NPP. The slightly increased CED value at Dukovany NPP is related to the extensive reconstruction of the reactor Unit 3.
The low values of CED document the success of the CEZ strategy to produce electricity and heat from nuclear resources safely and efficiently.

2 **Collective Effective Dose (CED)**
(Sievert per Unit)



Considering effluents from nuclear power plants into the surrounding environment, both Temelín and Dukovany plants are resources with minimal impact on the environment. For example, the gaseous effluents reached only tenths of a percent of the levels authorized by the State Office for Nuclear Safety. This trend was maintained successfully again in 2009.

Rescue of an injured person from a cable channel during a drill

Low values of this indicator in both locations confirm the minimum impact of nuclear power plants' operation on the surrounding environment and on the population.
At our nuclear plants, we introduced individual electronic dosimetry. This technology is more advanced than the system used previously (TLD and film dosimetry), and it will further improve the radiation protection levels.

EMERGENCY PREPAREDNESS

In 2009, a high level of emergency preparedness was confirmed at both of our nuclear power plants, testified in the results of controls and inspections carried out by the State Office for Nuclear Safety. In the course of 2009, a total of 8 emergency drills aimed testing emergency response at reactor Units took place, including the emergency response units of fuel transport facilities.

PHYSICAL PROTECTION

In the framework of the 8th international regional training at Temelín NPP in March 2009, the representatives of the International Atomic Energy Agency (IAEA) confirmed the physical protection systems at both nuclear power plants as a good practice. In 2009, no unauthorized activity with radioactive materials or facilities (or any such attempt) occurred at our plants.

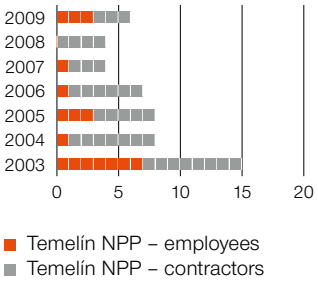
FIRE PROTECTION

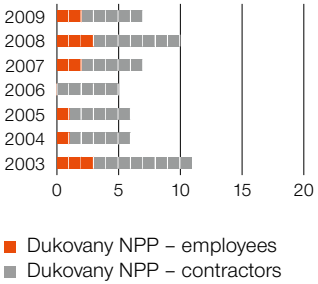
In 2009, no fires affecting technologies occurred at our nuclear power plants. One small event at the Dukovany NPP was caused by a short-circuited distribution frame of an small electric heater and it was quickly extinguished by the present personnel. Health or lives of the present employees were not in danger and the safe operation of the nuclear reactor was not in any way compromised. Our fire brigades participated in a number of emergency events outside of our plants in the framework of the integrated emergency system of the Czech Republic.

INDUSTRIAL SAFETY

For many years in a row, both plants have undergone an independent review by the State Office of Occupational Health and Safety, denoting them as a "Safe Enterprise". The reviews confirmed a functional and efficient system at both nuclear power plants, leading to consistent improvement of occupational health and safety. By international comparison, our Industrial Safety accident rate is in the upper quartile and we count among the best-performing power plants in the world.

3 **Industrial Safety Accidents of Employees and Contractors**
(number of accidents)





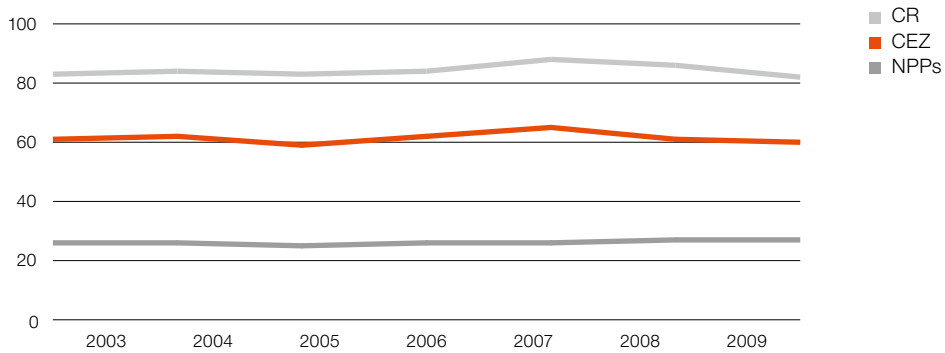
power generation in the Czech Republic

In 2009, a total 82.2 million MWh of electricity was generated in the Czech Republic. 33% was generated by nuclear power plants at Dukovany and Temelín. Their total installed capacity 3830 MWe constitutes 21% of the total installed capacity in the Czech Republic. This results from the fact that they are the most exploited plants, given their lower variable costs when compared to other power resources.

TREND OF POWER GENERATION

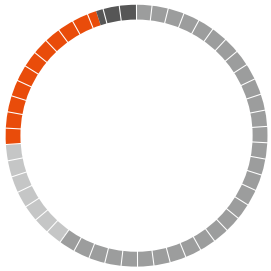
In the upcoming years, the share of nuclear power in the portfolio of CEZ is set to increase steadily. At both plants, the increase of output and total generation is planned thanks to the modernization of technology and the optimization of outages.

4 **Generation of Electricity in the Czech Republic**
(million MWh)



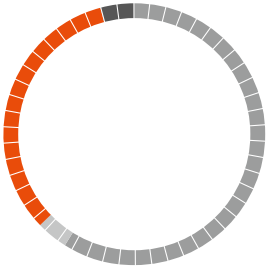
5 **Share of Installed Capacity and Power Generation in the Czech Republic in 2009**

Installed Capacity 17.994 MW
(percent)



- coal **60**
- nuclear **21**
- hydro and renewable **14**
- gas **5**

Power Generation 82.2 million MWh
(percent)



- coal **59**
- nuclear **33**
- hydro and renewable **4**
- gas **4**

The electricity supplied by Dukovany NPP is relatively cheap, safe and reliable; the plant counts among 25 % best-performing power plants worldwide.

Zdeněk Linhart, Director of Dukovany NPP up to 31. 12. 2009

Tomáš Žák, Director of Dukovany NPP since 01. 01. 2010

Dukovany nuclear power plant

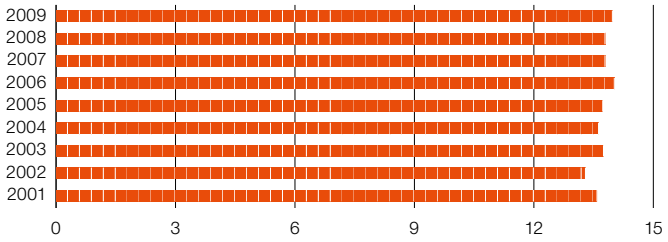
OPERATION

In 2009, the year's production of Dukovany NPP was third highest in history. Its four reactor Units generated 13,955,118 MWh of electricity, covering 17% of the total electricity consumption in the Czech Republic. The most important aspect in achieving this result was the reliable operation of the NPP and the increase of output by 4 × 16 MWe owing to the modernization carried out between 2005 and 2008. Continuing modernization permitted to increase the output of Unit 3 by further 40 MWe. When all the planned modernization works are finished, the plant is expected to reach 4 × 500 MWe capacity.
In 25 years of operation, Dukovany nuclear power plant generated the total of 308,106,966 MWh of electricity. The operation capability of Units is evaluated by Unit Capability Factor. In 2009, this indicator reached 85.29% surpassing the worldwide average by 4.4%. For achieving this result, the length of outages plays the most important role.

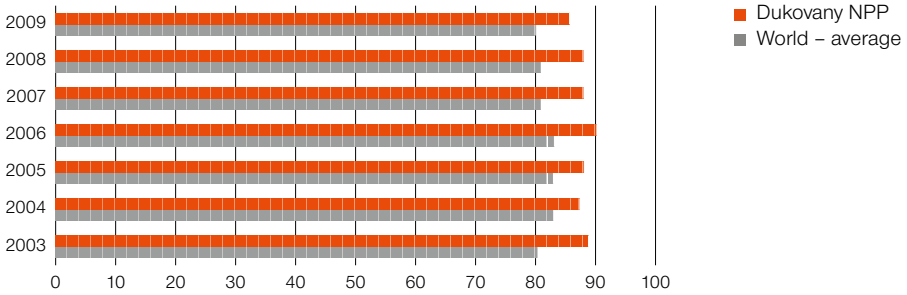
MAINTENANCE

In 2009, all four reactor Units of Dukovany NPP underwent refueling and operation outages. At all Units, all activities planned in the framework of maintenance, testing and inspection

6 **Power Generation**
(million MWh)



7 **Unit Capability Factor**
(percent)



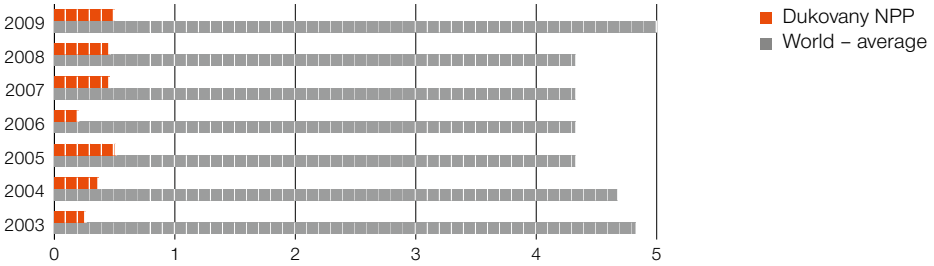
Main Control Room of Unit 3 during achievement of 500 MWe output

programs were completed; the total length of outages was 195.1 days.
The most complex outage, on Unit 3, took 85 days, during which the following projects were carried out:

- Reconstruction of the I&C system (Modules M3–M5),
- Use of design reserves of the reactor Unit,
- Reconstruction of the electrical protection system,
- Refueling with advanced fuel type Gd–2M.

These modifications allowed increase to the output of the reactor and to reach the total capacity of the Unit 3 of 500 MWe.
One of the basic indicators of maintenance efficiency is the Unplanned Capacity Loss Factor. The value of 0.59% at Dukovany NPP counts among the lowest in the world (see picture 8).

8 **Unplanned Capacity Loss Factor**
(percent)



INVESTMENT

Similar to preceding years, in 2009, Dukovany NPP continued the process of implementing several major investment projects designed to increase the efficiency of power generation.

- **Reconstruction of the I&C system divided into two projects:**
  1. **Modules M1–M2,**
  2. **Modules M3–M5.**

- **M1 and M2 modules** covers the modernization of safety and information systems as well as the implementation of a new post-accident monitoring system. The M1 and M2 modules were implemented gradually during planned outages between 2002 and 2009 and constituted the largest investment project at Dukovany NPP.
- **M3, M4 and M5 modules** covers the reconstruction of automatics and control circuits of the primary and secondary circuits, including the replacement of oil-based regulation of the turbine. It should be the final step in the modernization of the I&C system of the plant. Actual implementation began in 2009 during the planned outage of Unit 3 and should commence on the remaining Units during their planned outages by 2015.
- **Use of design reserves** – the process covers a number of replacements of technologies such as parts of the turbines, the generator unit, the Unit transformer, etc. with the goal of improving efficiency and increasing total capacity from the original 440 MWe to approx. 500 MWe.
- **Reconstruction of the essential cooling water system** – in all Units, old pipes of larger diameter are being replaced with new steel pipes in order to prolong the lifespan of the power plant.

Dukovany NPP in the colourful highland countryside

NEW PROGRAMS AND PROJECTS IN DUKOVANY NPP

The electricity supplied by Dukovany NPP is relatively cheap, safe and reliable; the plant counts among the 25 % best-performing power plants worldwide. CEZ is thus seeking ways to further improve its safety and efficiency. This is achieved by prolonging the lifespan of the power plant, by increasing its output and by improving personnel performance and maintenance.
This is why we launched a number of programs designed to fulfill this objective, namely:

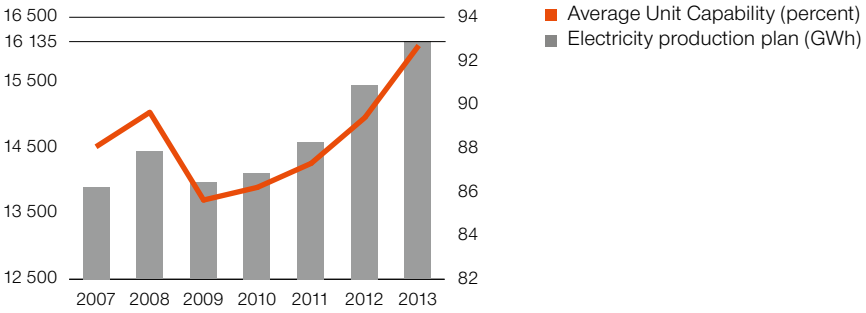
Safely 16 Tera (EDU)

The goal of this CEZ Group key project is to maintain high levels of safety while producing 16 TWh of electricity in a given year. This goal is to be fulfilled by 2013. The project takes advantage of necessary replacement of parts at the end of their lifespan to increase efficiency and the capacity of the Units, while making use of the detailed knowledge of the power plant when improving maintenance and reduction of outages time.

Main goals and expected benefits:

- To achieve annual output of 16 TWh post 2013.
- To increase capacity of all Units (up to 500 MWe) by gradual modernization.

9 **Planned Output and Unit Capability Factor of Dukovany NPP**



- To improve planning and organization of outages, and to cut the average outage by 35 days per year (compared to 2007).
- To provide high-quality maintenance and to keep the Unplanned Capacity Loss Factor at least on the level of 0.8%.
- To surpass the 89% level of the Unit Capability Factor.

One of the crucial conditions of the project is to maintain safe operation of the power plant and to remain among the 25% best-performing nuclear power plants worldwide according to WANO Performance Indicators.

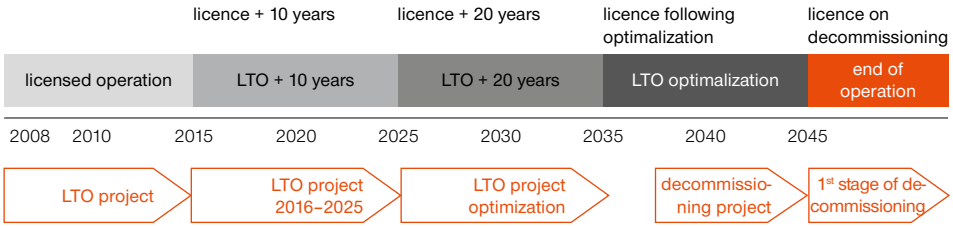
Improving human performance

During operation of our nuclear plants, we place great emphasis on the minimization of influence of human error. At both nuclear power plants, specific projects were launched to achieve excellence in human performance

Exchange of the generator stator at Unit 3 of Dukovany NPP – as a part of modernization and LTO programs

View to the turbine hall of Dukovany NPP, Unit 3 during the outage

10 **Long-Term-Operation Management Project; Implementation Stages, Dukovany NPP**



(QLV) with respect to the specific needs of each NPP, considering their lifespan. The goal is to improve the professionalism of our employees and suppliers with special attention paid to safety and responsibility. All tasks should be carried out when planned and with minimum faults. The human performance excellence program at Dukovany NPP is based on the following fundamentals:

- Monitoring and regular evaluation of human performance factor in operation,
- Adoption of the necessary measures based on the results of the monitoring,
- Consistent use of the "human error prevention tools" on premises (strict use of operational documentation, preliminary meetings before important activities, self-checking, permanent awareness, correct operating communication, independent check-ups, etc.),
- Control and monitoring of the correct use of the above-listed tools by management,
- Ongoing education of employees; regular and repeated training focused on human performance factor and error prevention based on the best international practices as well as our own experience,
- Use of the Just-in-time and Near Miss control systems,
- Permanent improving of operational documentation by adding new experience,
- Collaboration with colleagues in other departments.

Long-term-operation management

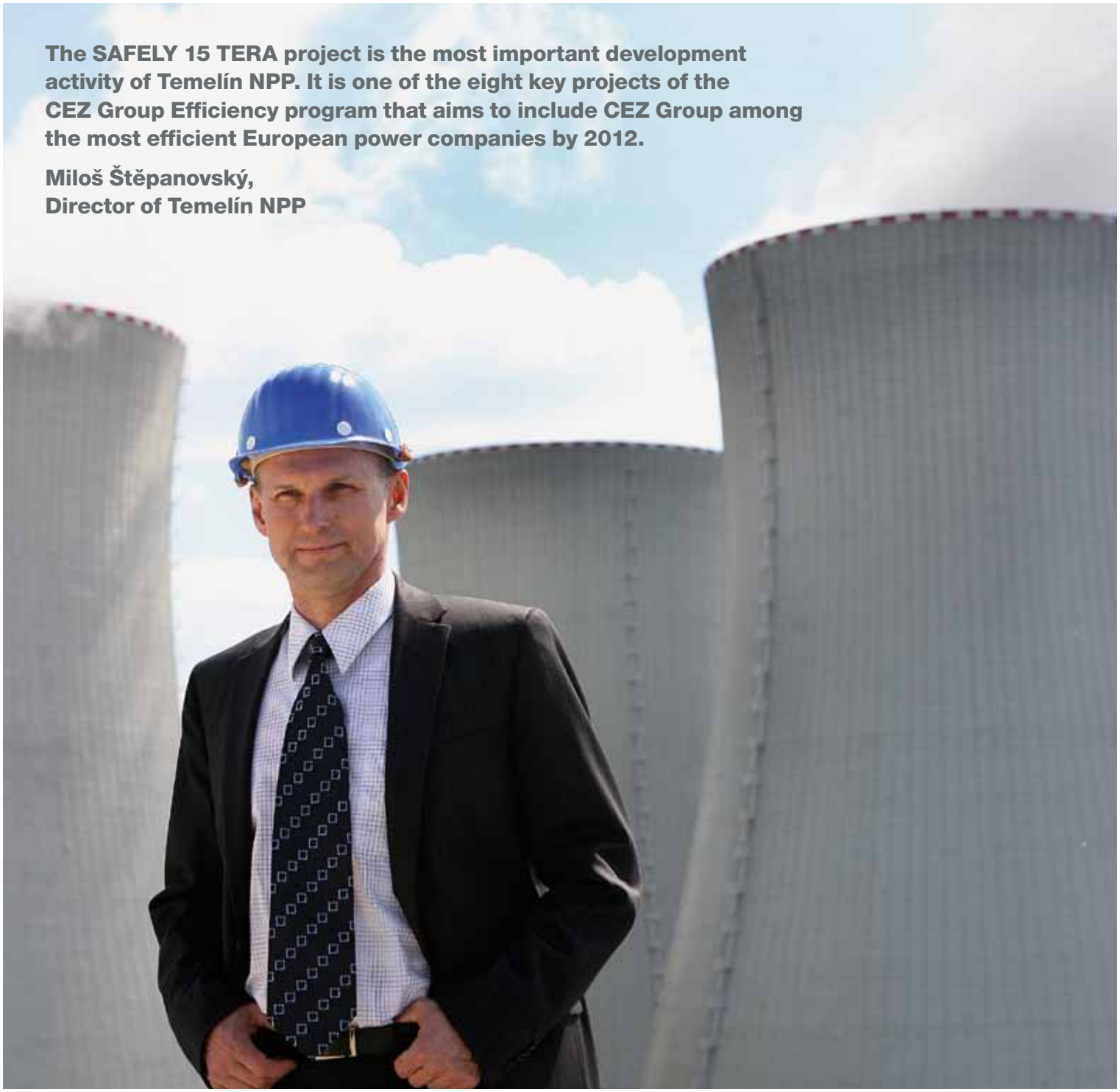
The Long-Term-Operation (LTO) project counts among the most extensive projects of the CEZ Group. It consists of approx. 230 smaller sub-projects with costs over 14 billion CZK. Their coordination and correct implementation from 2009 to 2015 is the biggest challenge of the project as it influences all activities of the Dukovany NPP.

The goal of the project is to prepare the power plant to operate beyond its original designed lifespan. This means it needs to receive operational license past 2015 and to fulfill conditions needed to operate the plant until 2035–2045. On January 19, 2009, the Board of Directors ratified the "Long-term-operation strategy of Dukovany NPP". At the same time, the project objective "Providing the license and readiness of Dukovany NPP for operation between 2015 and 2025" was ratified. The project has become the eighth key initiative of the CEZ Group Efficiency program.

This program considers all safety aspects of the LTO and it defines the necessary measures for fulfilling all the requirements of the regulator SUJB in order to issue the operation licence for after 2015. The correct approach of Dukovany NPP towards the LTO program preparation was confirmed by an IAEA review in 2008. A technical and economic feasibility study confirmed technical feasibility of the plan as well as its economic benefits. Prolonging the operation of the power plant in 2015–2025 will bring significant operational profit that will help fulfill the strategic goals of the CEZ Group. The LTO project also consists of the **human resources generation** resumption designed to maintain qualified professionals until 2045, to prepare personnel for new Units as well as to keep required level of knowledge and experience of in the power plant.

The SAFELY 15 TERA project is the most important development activity of Temelín NPP. It is one of the eight key projects of the CEZ Group Efficiency program that aims to include CEZ Group among the most efficient European power companies by 2012.

Miloš Štěpanovský,
Director of Temelín NPP

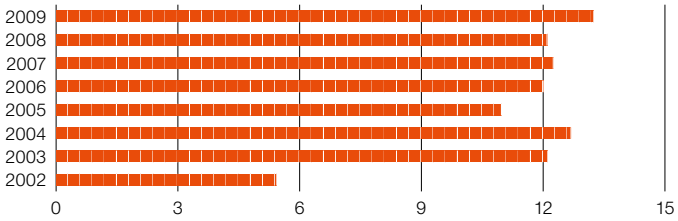


Temelín nuclear power plant

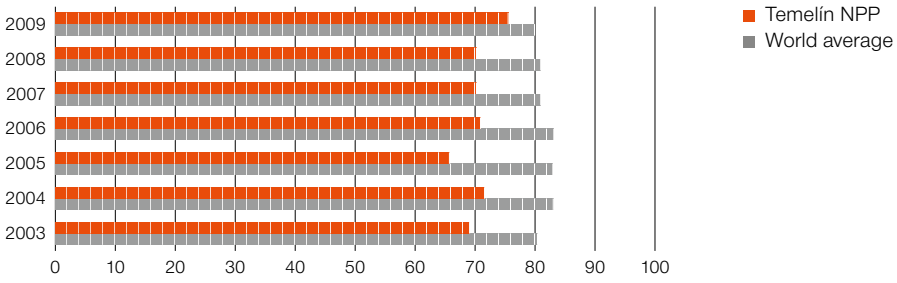
OPERATION

In 2006, the power plant showed a record performance in all ten years of its operation. By producing 13.25 million MWh of electricity, the power plant surpassed the record output from 2004 (12.7 million MWh) by 0.56 million MWh. The number of unplanned outages was reduced, the Units availability increased and reached 75.3% capacity. Similarly to last year, 2009 was a year of improving human performance capabilities at Temelín NPP as well as a year of investments into further improving the reliability of technologies and increasing the safety of the power plant. Thanks to the Achieving Excellence in Human Performance program (QLV), events caused by human factor were cut by four times when compared to 2008. The operating results were also improved thanks to the modernization of the high-pressure parts of turbines carried out in the past years – it improved the efficiency of power production. Also, the length of the planned refueling outage on Unit 2 was reduced.
Since the launch of operation of Temelín NPP in December 2000, its reactor Units has generated the total of 92,032,514 MWh of electricity. At the same time, the plant supplies heat to the nearby town of Týn nad Vltavou and to the facilities in the plant's premises. In the course of 2009, it supplied 171,181 GJ of heat to its

11 **Power generation**
(million MWh)



12 **Unit Capability Factor**
(percent)



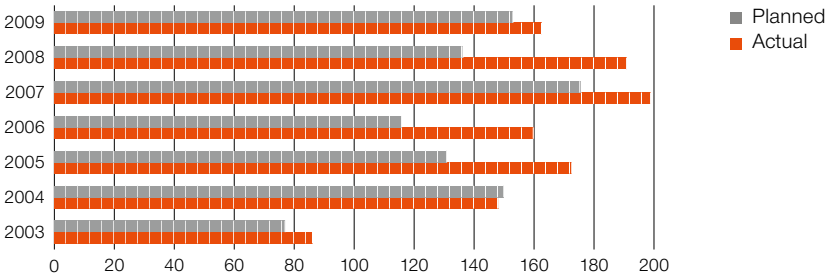
Construction of the Spent Fuel Storage at Temelín NPP was launched in March 2009. Start of operation is planned in 2010.

customers. Despite these satisfactory results, the capability of the power plant could be further exploited. The operational indicators have a potential for improvement, mainly through improving the reliability of technologies and the cutting of planned refueling outages. Recently, the operation of the plant has stabilized, as indicated by positive qualitative results. The Unit Capability Factor (WANO performance indicator) has reached the level of 75.58% (average of both Temelín Units) in 2009.

MAINTENANCE

In 2009, both Units underwent planned refueling outages. During these, a number of investment activities were carried out. For example, blades of five out of six turbine low-pressure rotors were diagnosed and replaced in reaction to a breakage that occurred in 2008. Also, a technically challenging modification of the pressure vessel in the reactor of Unit 1 was carried out. The scope of carried out activities, equipment reliability and the new system of maintenance organization caused some work to last longer than expected. We had to repeat pressure tests at both reactor Units and at Unit 1 we resolved an issue with the turbine-generator unit. The total length of outages was 162.6 days in 2009.

13 **Length of Planned Outages (Temelín 1, 2)**
(total days)



In terms of equipment fault rate, last year was successful. The plant reached a level of 1.75%, showing an improving trend ever since the beginning of Temelin NPP operation.

INVESTMENT

In line with the goal to further improve the performance of the power plant, a number of investment projects were carried out in 2009 aimed at increasing the nuclear safety levels as well as the reliability of the power generation.
Most important activities in 2009:

- **Replacement of low-pressure flow parts of the turbine 1000 MW** – the new parts will improve the safety and reliability of the low-pressure turbine, thus increasing the thermo-dynamic efficiency (and boosting the output of the turbine system by approx. 22 MWe per turbine). The turbine system will be prepared for the considered increased nominal heat output of the reactors. In the course of the year, this project was in the process of preparation and contracts were signed to carry out the replacement in the upcoming years.
- **Modernization of refueling machines at both reactor Units** – adjustment of

Quality of reactor vessel internal surface is regularly monitored

the existing rods, replacement of the telescopic rod, cables and driving unit. The replacement process was completed on both Units.

- **Reconstruction of the portal jib crane SKET 320 t** – replacement of the control system of the crane which will permit the synchronization of parallel running of both drivers, 160 t + 2 × 70 t, used in the transport of cassettes for spent fuel.
- **Replacement of arc-flash protection system at the 6 kV switch rooms** – replacement of a set of short-circuit flash protection elements in 6 kV switch rooms consisting of optical cable loops sensitive to the light flash along full length of the cable was carried out. The replacement was mostly carried out in 2008 and it was finished in 2009.
- **Replacement of protection systems of the generator and self-consumption supply at Unit 1.**
- **Spent fuel storage facility** – in 2009, the preparation of the spent fuel storage facility continued according to the plan that counts with the launch of operation of the facility in 2010. The construction of the storage facility begun, the first packaging sets were manufactured, and the process of authorization by the State Office for Nuclear Safety continued as planned.

SAFELY 15 TERA PROJECT

The SAFELY 15 TERA project launched in 2007 is the most important development activity of Temelín NPP. It is one of the eight key projects of the CEZ Group Efficiency program that aims to include CEZ Group among the most efficient European power companies by 2012.

The main goal of the SAFELY 15 TERA project is to improve safety indicators, to increase availability and to reduce fault rate of technologies. The project also aims to improve internal communication and to improve the awareness of all departments including those outside the influence of the director of the power plant.

Five areas of possible improvement were mapped and the goals, resources, possible risks and responsible personnel were defined. As a whole, the project aims to fulfill the following safety, reliability and generation efficiency goals:

1. **Selected safety indicators will reach a mark comparable with 25% of best-performing nuclear power plants worldwide by the end of 2010.**
2. **The yearly output of Temelín NPP will surpass the benchmark of 15 TWh in 2012 and will be able to maintain the value for the following 30 years (reliability indicators).**

The SAFELY 15 TERA project consists of the following sub-projects:

Equipment

The goal of this project is to improve the equipment and technologies of the power plant so as to provide safe and reliable operation with high capability and the output of 15 TWh per year.

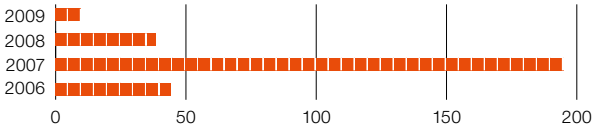
The project covers eight areas:

- Increasing the reliability of nuclear fuel (new, improved fuel from a new supplier TVEL).
- Replacement of the high-pressure parts of the turbine (finished).
- Reduction of vibrations of the turbine supply pipelines (finished).
- Maintaining the long-term reliable operation of containments (carried out according to plan).
- Optimization of outages: a new strategy of outage organization, increased capability of Units, changed periodicity of control checks for important equipment and the reduction of outage length after 2010 (fulfilled continually).
- Investments (reconstruction of the refueling machines, reconstruction of the portal jib crane, replacement of protection systems of the generator output system and of the 6kV switch rooms). Transformers monitoring system was installed (finished).

View to the Temelín NPP turbine hall during outage; exchange of the low-pressure parts of the turbine.

Reactor hall of Unit 2 during refueling outage. Outages are opportunities for a number of tests.

14 **Loss of Generation Caused by Human Factor**
(thousand MWh)



- Replacement of linear step-motors and position indicators on reactor control rods (planned implementation 2011 and 2012).
- Equipment reliability analyses (under way).

Organization and Management

In this area, the process management system of the power plant is being optimized and new software tools for support of activities and outage management are being built. An important step in this direction was the launch of the communication coordination system and the automatic enquiry system for organization of outages. These applications help improve the efficiency of outage preparation and management. New shift maintenance co-ordinator positions were deployed; the task of these workers being to coordinate activities during outages. The effort of the team further focuses on the creation of conceptual long-term management system. A conceptual management board was founded and the system for evaluating efficiency of processes and operation indicators is being developed.

Suppliers – partnership project

The project is focused on participation of suppliers in solving problems at the power plant related to works underway, in sharing the safety culture and values and their motivation in the safe and reliable operation of the power plant. This project includes the following activities:

- Revision of shared documentation,
- Regular suppliers training,
- Joint work meetings of employees, management and suppliers,
- Gradual implementation of the improving human performance project with key suppliers,
- Evaluation and feedback of important operation-related events,
- Knowledge management system in collaboration with suppliers was launched,
- New spare parts supply system for repairs is being implemented (a new supplier system).

Personnel – we are building a professional team

The priority of this project is to improve human performance. In the past the main focus lay in maintenance and modernization of equipment. Now, the time for investment into the reliability of the human performance has come. This task will be focussed on change of attitude to mistakes and human failures, which must be perceived as an opportunity for learning. This is what the Achieving excellence in human performance program is aimed at. It is a logical next step in the path towards improved reliability and safety of Temelín NPP operation. It will use techniques and procedures which will help prevent human error or to discover it in time.

In 2009, all departments were to minimize human-error related events, both in terms of the employees of the power plant and of suppliers. A co-ordination team consisting of the power plant's management co-ordinated this effort. For 2009, the criteria for the successful fulfilling of the program were set. One of the indicators of the success of the program was the decreasing number of events with root cause being the work practices of the personnel, when compared to 2008.

In support of the program, its sub-project included several further activities in the **training** and **knowledge management** areas. The main goal of knowledge management is to ensure sharing of knowledge and preservation of important information and experience among the employees of the power plant.

Communication

This project aims to present Temelín NPP to the broad public as a safe, continually improving power plant. In the second part the project analyzes and optimizes internal communication tools in order to make communication among employees more efficient.

asset management

a new maintenance system

Last year a new Asset Management system was launched at both CEZ's nuclear power plants. The system is designed to strengthen supplier responsibility for the complex management of logical parts of technology and it motivates suppliers to fulfill safety requirements and selected technical parameters of the maintained facility. In connection with this project, the interface between CEZ and suppliers for the maintenance of logical parts of technology was unified. Based on a selection process carried out in 2009 and new supply contracts signed, the new asset management system was implemented in most technologies in the following five important logical parts:

- REACTOR BUILDING – Škoda JS, a. s.
- TURBINE BUILDING – Škoda Power, a. s.
- OUTSIDE FACILITIES – ČEZ Energoservis, s. r. o.
- ELECTRICAL SYSTEMS – I & C Energo, a. s.
- I&C SYSTEMS – I & C Energo, a. s.

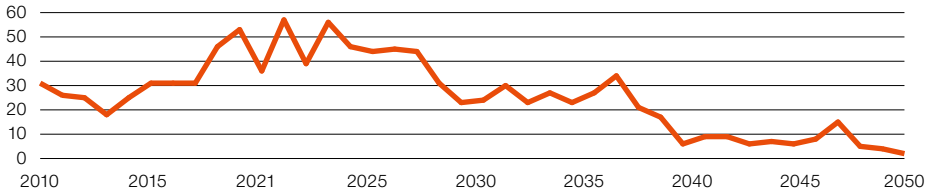
In close collaboration with these suppliers, a Conceptual Maintenance Program was designed, used as a basis for economic and technical specification of maintenance works planned in 2010. Great attention was paid to the program of Achieving excellence in human performance aimed at reducing risk in worker's behaviour and repeated faults of critical and components equipment.

Workers of EGE s.r.o. (sub-contractor of I & C Energo) assembly encapsulated power outlet from the reactor Unit of Dukovany NPP


1

personnel

15 **Number of Employees to Retire at Dukovany NPP, as of 30. 09. 2009**



Owing to the planned renewal of existing Units and construction of new ones, one of priorities of the HR department was the recruitment of employees. In Temelín, 25 new employees were hired to join the Division Investment, responsible for the building of new reactor Units, and 22 employees were hired to join the Division Generation where they will train to operate the new nuclear power Units. In order to built Unit 3 and 4 in the Temelín location, a large number of new experts will be hired and trained in 2010–2020 (365).

Similar scope of recruitment is planned for the Dukovany NPP. In addition, there is a need for employee generation resumption at Dukovany NPP. At present, the average age of employees is 48 years; from 2018 to 2028 half of the employees will retire (see chart 15).

Taken the time needed to educate and train new experts, both power plants have begun recruiting now. Close collaboration with 24 secondary schools begun: 11 in the surroundings of Temelín and 13 in the Dukovany area. Moreover, we collaborate with eleven faculties of technical universities throughout the Czech Republic. We participate in job fairs and corporate open days at universities. For technically oriented secondary school and university students interested in the program, we offer full-day field trips and workshops. In 2009, over a thousand young people interested in nuclear power careers took part in these events.

In spring, both power plants organized so-called **Atomic Graduations**, a three-day series of lectures and internships on the premises of both nuclear power plants designated for secondary schools students. In the end, the students took a test similar to the one they take during a real graduation. The event had a very positive feedback both from students themselves and from their teachers. At Temelín NPP, 80 students and teachers took part; at Dukovany, 45 students and teachers attended.

Similar event aimed at university students was our **Summer University**. Summer University was a two-week course and attendees gain broad knowledge about the operation of nuclear power plants and related facilities. During a tour of the power plant, they had the opportunity to see the Units during operation and also during an outage. For students of technical universities, this constitutes very interesting and welcome experience and it may influence them in choosing their future career.

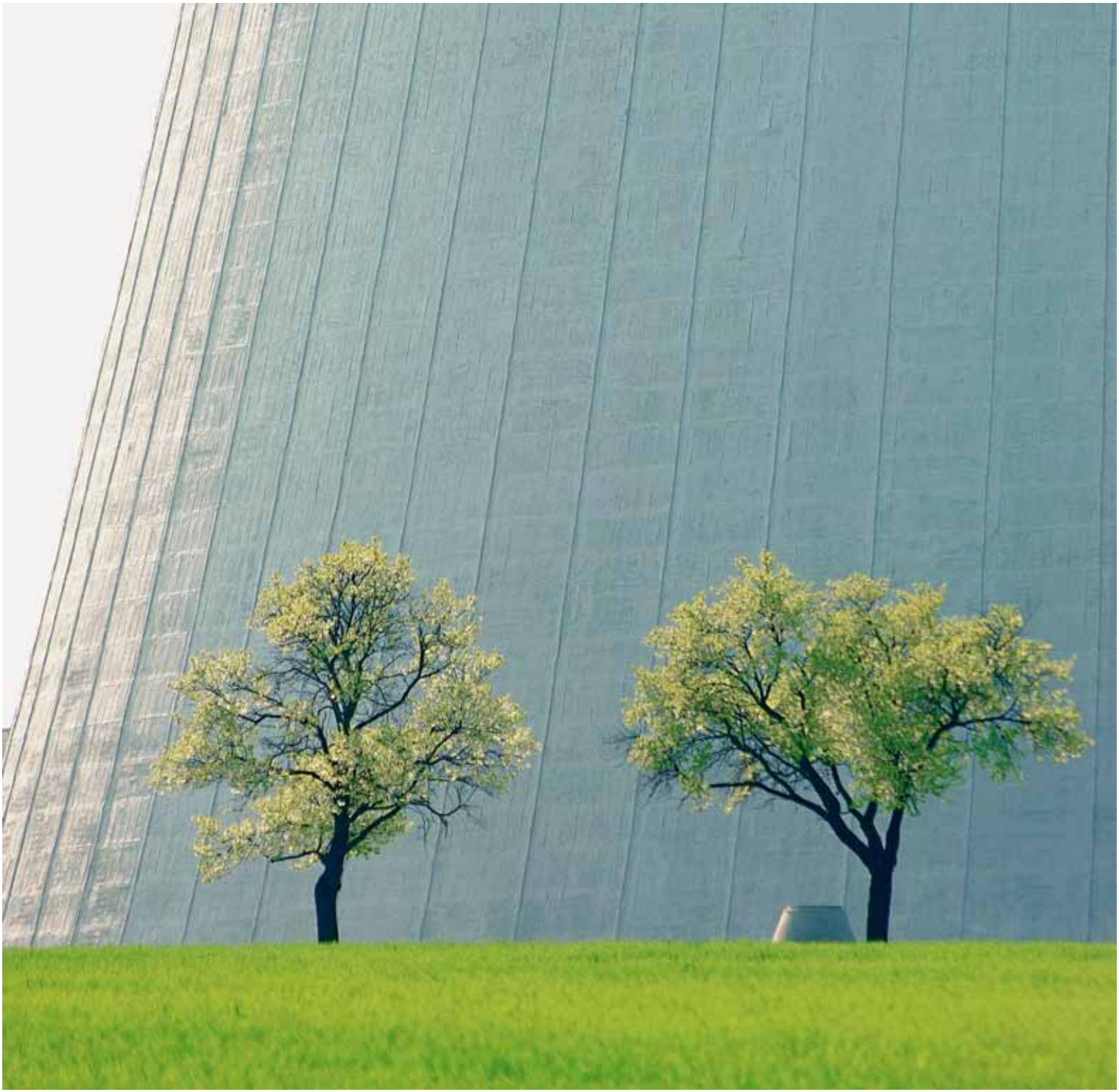
For university students who would like to become secondary circuit operators, we launched a scholarship program; through this scholarship, the students receive the security of an interesting career of the NPP operator while they still study.

At the Secondary School in Třebíč, a new program for 30 students called POWER ENERGY has been opened in the academic year 2009/2010. The patrons of the program are the regional authorities of the Vysočina region and the CEZ Group. Similarly, in Sezimovo Ústí at a college (secondary technical school) a new study program was launched for the first semester study of Technical University, faculty of machinery and electrical engineering.

nuclear fuel

Testing of equipment in the reactor hall of Temelín NPP during outages.

Nuclear fuel is the crucial commodity necessary for producing nuclear power. In this respect, the year 2009 was a breakthrough. In connection with the increase of capacity from 440 to 500 MW, Unit 3 of the Dukovany NPP finished the transformation to more advanced fuel. In the upcoming years the same transformation awaits the three remaining reactor Units.
Ever since the beginning of operation, Dukovany plant has been using fuel supplied by the Russian company TVEL. Over the years, the fuel underwent significant evolution. The original fuel was enriched to 3.6% U235, it was replaced in three-year cycles, and its average burn-out value was 30 MWd/kgU. Gradually, the neutron loss was limited and the enrichment increased to 3.8% U235. Next, the enrichment was further increased to 4.25 and 4.38% U235 and the fuel assemblies were fitted with a burn-out absorber. Increased weight of Uranium in the fuel assembly permitted to prolong the burn-out cycle to five years. In practice this means that every year only 1/5 of the total amount of fuel assemblies need to be replaced, only 72 assemblies per reactor Unit per year. In the five-year cycle, the average burn-out value now increased to up to 51 MWd/kgU.
Another important effect of this change is the dramatic drop in the generation of spent fuel from the initial 114 fuel assemblies to only 72 assemblies per reactor Unit per year, which leads to significant storage savings. The burn-out absorbers reduced the production of Tritium by 20%. Campaigns increased from 300 to 330 effective days and as a result, the usage of installed output as well the production capacity further increased.
At Temelín NPP, the contract with American supplier Westinghouse ran out last year. In the ensuing selection procedure, the Russian supplier TVEL was selected. Now the plant is preparing for the new fuel. Both Units will refuel the full set of fuel at once; at Unit 1, this will be carried on in 2010, at Unit 2, the process will take place in 2011. At the same time similar measures as at Dukovany are being taken at Temelín in order to increase the output of both Units. The new fuel fulfils all requirements for the increase of the output.



environment protection

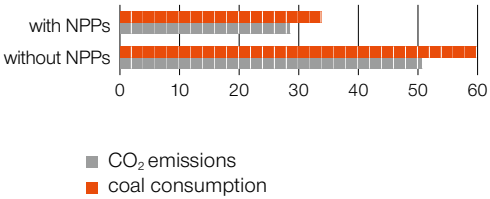
Nuclear power plants count among the most environment-considerate power generation resources. In their operation no greenhouse gases are produced and they do not consume non-recoverable raw materials (oil, coal). If nuclear power plants were missing in the Czech power portfolio, the emissions of CO_2 as well as the consumption of coal would increase by 77% if we were to maintain the same amount of electricity and a similar composition of other production means with average emissions 111 kg of CO_2/GJ (see picture 16).
The emissions of CO_2 are further reduced by using of design reserves of power at present nuclear power plants.
At Dukovany NPP, an Environmental Management System (EMS) was certified in 2001, at Temelín NPP in 2004. The program is based on the principle of prevention and constant improvement of the environment protection. In 2007, the system was re-certified and in 2009, regular EMS audits were carried out successfully at both nuclear power plants.

WASTE MANAGEMENT

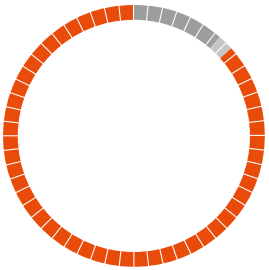
Materials and waste tested to be virtually free of radio-nuclides is subsequently released into the environment under strict control and recycled as much as possible.
Waste from the operation of nuclear power plants is bitumenized or pressed and it is deposited into the Radioactive Waste Storage Facility (URAO) at Dukovany where it is safely separated from the surrounding environment. The Radioactive Waste Storage Facility at Dukovany has sufficient capacity not only for the disposal of all the radioactive waste produced during the operation of the NPPs, it also allows the safe deposition of waste which will be produced as a result of their decommissioning. By the end of 2009, 15 out of the total number of 112 cells were filled up (see picture 17).

EMS Certificates

16 **CO_2 Emissions and Coal Consumption**
(million tons)



17 **Filling of Rad Waste Depository**
(total 112 cells)



filled until 2008 **13**
filled in 2009 **2**
empty **97**


NÁVŠTĚVA

international relations

WANO Peer Review at Dukovany NPP, at the turbine hall

Traditionally, Czech nuclear power plants maintain strong international relations. We collaborate with foreign bodies in a variety of ways, through active membership in international organizations such as IAEA, WANO, FORATOM, EURATOM, WNA, Eurelectric, OECD NEA and others that run a variety of nuclear international programs. Thanks to this, both nuclear power plants have access to technical information and know-how and they can follow the most recent professional trends and evolution of nuclear industry.

The worldwide WANO network allows the participants to share information with hundreds of others. Active participation in its programs shows the best worldwide practices and allows the benchmarking of safety indicators with other power plants worldwide. We can invite foreign experts for technical support missions or have our plants reviewed by the WANO Peer Review or by the OSART mission (a review run by IAEA).

In 2009, a number of events with participating experts from abroad took place:

- International regional training in physical protection at Temelín NPP,
- WANO Peer Review Follow-up at Dukovany NPP which reviewed eight key areas of operation and provided the plant's employees with valuable feedback,
- WANO workshops for management at Dukovany and Temelín, topics such as „Self-assessment“ (a lecturer from British Energy, UK) and „ S-A and Corrective measures“ (lecturers from WANO-AC, USA),
- Expert workshop at Temelín NPP on „Nuclear Fuel Rod Cladding Monitoring and Evaluation“ (professionals from seven countries participated),
- IAEA Knowledge Management workshop at Temelín NPP.

Apart from this, both Czech nuclear power plants maintain close relations with foreign partner nuclear power plants. This allows a direct exchange of information via e-mail, technical enquiries, benchmarking or technical visits of similar facilities. We collaborate with nuclear power plants in Slovakia, Hungary, France, USA, Russia, Ukraine and Finland. CEZ is also active in the countries of Central and South-East Europe – Poland, Romania, Bulgaria, and the Balkans.

public relations

we help where we operate

For a long time now, the relations with surrounding communities of both our nuclear power plants has evolved successfully and displayed good neighbourhood practices. The public becomes a true partner of the nuclear power facility. Apart from ongoing, open communication with the public, the power plants support numerous valuable projects related to culture, travel, sports and community life in the surrounding communities. The citizens, in turn, support the power plants, their operation and the possibility of new construction.
Information centers of both power plants play an important role in improving nuclear power awareness and they are mostly visited by young people. In 2009, the Dukovany information center welcomed its 400,000th visitor since it opened fifteen years ago.
The information center of Temelín welcomed 28,240 visitors last year. Out of this number, 1,640 were foreigners and 6,280 people had a chance to visit internal premises of the nuclear power plant. The Temelín NPP is a popular venue for weddings as well; the information center located in the Vysoký Hrádek castle hosted its 9th wedding ceremony in 2009. Since August 2009, the information center of Temelín NPP offers a guided, sound-based tour for visually impaired people. In connection with the planned construction of new Units, both information centers plan an update of their displays.

In 2010, Dukovany NPP will celebrate 25 years of safe and reliable operation. The milestones of its history are the following:

April 30, 1970	Decision to build two reactors 2 × VVER 440, 230 model
1975	Project was redesigned to build four more advanced reactors 4 × VVER 440, newer 213 model
1982	Reactor vessel was installed at Unit 1
December 31, 1984	Unit 1 was first fueled with nuclear fuel
February 12, 1985, 23:21	Minimum controllable power achieved
May 5, 1985	Reactor reached 100% power, start of Unit 1 trial operation
1986	Start of Unit 2 operation
1987	Start of Units 3 and Unit 4 operation

The regional authorities in both Dukovany and Temelín areas have continued their positive approach to both facilities.
In the beginning of April 2009, the authorities of the South Bohemia Region authorized the future building of two further Units in Temelín location, and general collaboration agreement between CEZ and the South Bohemian Region was signed. In the course of the upcoming ten years CEZ will support the development in the area through the construction of new infrastructure, new living facilities and also it will support a number of cultural and sports events.

Similar agreement has been signed with towns and villages in the close surroundings of both our nuclear power plants. Týn nad Vltavou, Dříteň, Všemyslice and Olešník in the proximity of Temelín NPP, and Dukovany, Rouchovany, Mohelno, Slavětice, Rešice and Horní Dubňany near Dukovany NPP can thus invest in a number of local development projects. They can also receive more support from European Union funds.
Traditionally, the Vysočina region supports the operation and development of Dukovany NPP. At the end of 2009, talks advanced about further collaboration between the regional

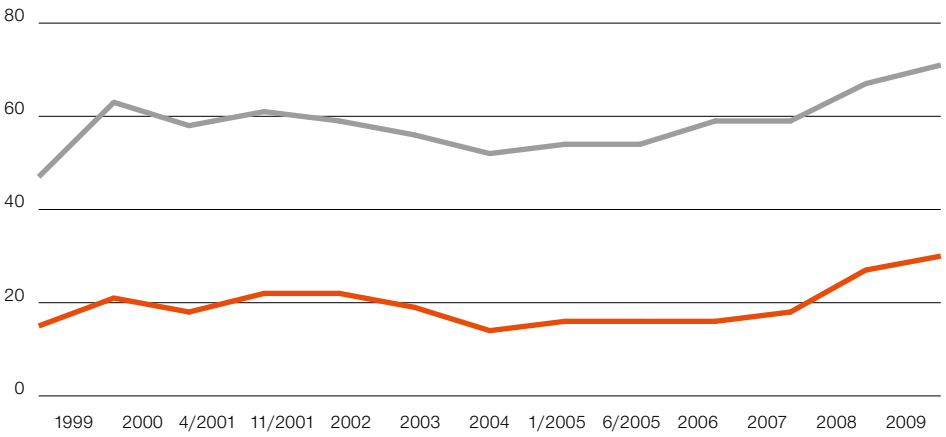
"Orange Ride" – CEZ supports the regions of its power plants by organizing cultural and sport events

authorities and CEZ. The talks will continue in 2010, the 25th anniversary since the launch of operation of Unit 1 at Dukovany.
Nuclear power plants support also other towns and villages in their surroundings. For fourth year in a row, the Orange Year project continued, dedicated to the development of an active cultural and social life and sports in the communities.
In 2009, we supported old projects but also launched new ones. One of the new activities is the construction of a bicycling path from Hluboká nad Vltavou to Týn nad Vltavou. The path is under construction now. The part near Hluboká is set to be finished this year and it is to continue to Týn nad Vltavou. Near Dukovany NPP, we initiated a study for a „Energy bicycling path" Třebíč – Dalešice hydro power plant – Dukovany NPP.
In such a way both power plants actively support tourism in their attractive surroundings.

CZECH PUBLIC OPINION ABOUT NUCLEAR POWER

Public opinion polls first started in 1994, the last poll took place in March 2009 and over 1200 Czech citizens over the age of 18 participated. Selected topics included: power strategy of the Czech Republic, development of nuclear power in the Czech Republic, the

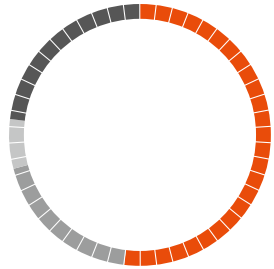
18 **Are you personally in favour of nuclear power development in our country?**
(percent)



Source: STEM, trends 1994–2009

Czech famous sportsmen visiting Temelín NPP in occasion of the "5th Temelin Olympic Games"

19 **Public Support for Nuclear Power**
(percent)



- for nuclear power, it is irreplaceable **52**
- for nuclear power, but it could be replaced **19**
- against nuclear power, but it is irreplaceable **6**
- against nuclear power, it could be replaced **23**

Source: STEM, survey 3/2009,
1,276 respondents over the age of 18

views about Temelín NPP and awareness of public about nuclear power. Approximately 70% of people responded that they are in favour of further development of nuclear power in the Czech Republic. This constitutes a 4% rise in support from the last year.

Main arguments for nuclear power development:

- Drawbacks of coal mining and burning – 84% of citizens
- Dependence on oil and gas imports – 88% of citizens
- Greenhouse gas emissions from coal-fueled power plants – 79% of citizens

A half of Czech population believe that nuclear power development is necessary and nuclear power is irreplaceable.

CONCLUSION

1. According to most citizens, power strategy of the Czech Republic must strive for power energy independence and the possibility to choose our own power strategy.
2. By 2030, the biggest share of Czech power production should be covered by nuclear power plants (51% of citizens believe) or renewable resources (36% of citizens believe).
3. About 70% of citizens support the development of nuclear power.
4. Over three quarters of citizens think that Temelín NPP is safe and comparable to other nuclear power plants worldwide.
5. In a referendum about the new construction of nuclear power Units, 69% of citizens would agree. It is likely that over 70% of citizens would participate in the referendum.
6. Over a half of Czech citizens think that the operator of Temelín NPP is open and communicative, but most citizens still claim they do not receive enough information about its operation.


Amsterdam
Varšava
Praha
Mnichov
Bratislava
Budapešť
Bukurešť
Bělehrad
Sarajevo
Sofie
Istanbul
Tirana
power-related operations
trading
countries of conditional interest
active subsidiaries

Nuclear power plants in 2009

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