REGULATORY APPROACH TO THE LONG TERM OPERATION OF CZECH NUCLEAR POWER PLANTS

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Abstract. There are plans to operate Czech nuclear power plants (NPP) beyond the limits of the design lifetime. The Czech legal environment with respect to the licensing of nuclear installations is briefly described in the paper. The paper also shows the current situation and conditions of long term operation (LTO) in the Czech Republic and describes the regulatory authority’s approach to LTO. The results of the WENRA countries harmonization effort and the results of the IAEA “Safety Aspects of Long Term Operation “ EBP will be implemented into the Czech legal system either through regulations or safety guides. The main principles of the implementation are provided.

1. Introduction

There are two nuclear power plants in the Czech Republic. The Dukovany NPP operates four units of WWER – 440/213 type. The Temelín NPP operates two units of WWER – 1000/320 type with Westinghouse fuel and I&C. Both plants are operated by Czech power utility ČEZ which is the major electricity supplier of the country. The utility intends to operate NPPs beyond their design lifetime.

2. Nuclear regulatory environment in the Czech Republic


Issuance of three basic authorizations (licences) for all nuclear installations, i.e. site permit, construction permit and operation permit from the standpoint of the Construction Act, is within competence of the corresponding Construction Office. It is the local Construction Office for the site permit and the Ministry of Trade and Industry for construction and operation permits.

In the case that in the course of licensing proceedings arise issues protected by special regulations, the Construction Office decides by agreement or with consent of the State Administration Body which protects those particular interests. The nuclear installations licensing procedure includes bodies illustrated in Fig.1. The Body concern may condition its consent on the fulfilment of the conditions established in its decision issued in compliance with authorization of relevant specific law.

Those bodies are in particular:

- Ministry of Interior in respect of fire safety,
- Ministry of Environment - in the case of site and decommissioning licences – Environmental Impact Assessment (EIA)
• Local Authority in respect of waste management, - in respect of water consumption and waste water discharges,
• Ministry of Health - in respect of the occupational health protection,
• State Office for Work Inspection (SOWI) - in respect of the conventional safety, including the safety of the electrical systems,
• State Office for Nuclear Safety (SUJB) - in respect of nuclear safety, radiation protection, physical protection, emergency preparedness and industrial safety (pressure vessels).

The Construction Act is directly imposing on the Construction Office the duty to obtain from the applicant (constructor, operator) the permission issued by State Office for Nuclear Safety in compliance with the Atomic Act still before the issuance of the site permit, construction permit, and of any subsequent permit in respect of the nuclear installations containing project. In compliance with the provisions of the Act the decision of the Construction Office cannot be issued without this permission.

The Atomic Act establishes activities for which an authorization (license) issued by the SUJB is required. Besides siting, construction and operation (the permission is mostly issued for 10 years), a SUJB license is prerequisite also for a number of other activities, as for instance – for individual stages of nuclear installation commissioning, for reconstruction or other changes affecting nuclear safety, for discharge of radionuclides into the environment, etc.
Control activities of the SUJB are set forth in the Atomic Act as well as in the Act No. 552/1991 coll., on state inspection and monitoring.

The means of enforcement used to ensure the compliance with the legislative requirements are regulated by the Atomic Act, and include the SUJB’s power to require a remedial arrangement, to order the execution of the technical inspections, reviews, and tests into the operability, the power to withdraw the special professional capability authorization from the nuclear installation staff members upon breaching of their duties, and to levy the penalties for the violation of the law-imposed duties.

Where a delay is pending, SUJB can order the nuclear installation to reduce its power or shut down the operation at all.

The Act No. 100/2001 Coll. on the environmental impact assessment, orders to evaluate the construction projects in view of their environmental impacts within a specialized procedure in which the public may take its part (public hearings etc.). The state administration authority responsible for the issuance of the decision in respect of the constructed nuclear power plant environmental impact is the Ministry of Environment.
FIG. 1 Schematic diagram of the licensing procedure in compliance with the Construction Act (sitting, construction, operation, decommissioning of nuclear installations)

The inspection activities of SUJB are regulated in more details by the Atomic Act and also by the Act No. 552/1991 Coll., on state inspection, as amended by the Act No.166/1993 Coll.

Concerning the long-term operation of the nuclear installations, not only the above stated acts, but also the lower-level regulations are relevant, such as the Decree No. 214/1997 Coll., on quality assurance, the Decree No. 195/1999 Coll., on nuclear safety assurance in the nuclear installations, and the Decree No. 106/1998 Coll., on nuclear safety and radiation protection assurance in the nuclear installation upon the start-up and normal operation.

The additional documents, the NPP operator can use as a guideline while preparing the regulator-required proofs and arranging for the compliance with the conditions upon which any further operation can be permitted, are the regulator-issued guides, terms and conditions of the regulatory decisions, requirements, and instructions contained in the documents.
published by the SUJB or other organizations (e.g. Association of the Czech Mechanical Engineers).

3. Regulatory authority’s approach to long term operation

Issuance of the nuclear power plant operating license is at the outcome of the approval procedure, within which all the nuclear safety and radiation protection aspects, including the issues of the power plant aging (ageing of components, systems, and buildings), have to be considered.

Service life of an NPP as a whole is given in its technical certificate, but it has no informational value in the contemporary economic and legislative conditions (the responsibility is borne by the holder of the NPP Operating License), as it was taken over from the Soviet philosophy in the field of the maintenance and scheduled replacement of the components and systems and of the manufacturers’ product warranties. In such a technical certificate, the so-called economic life is set out, i.e. the period of time, over which the plant is to be able to function safely and reliably with all the economic assessment related to this period of time. The technical certificate is not included in the Safety Analysis Report, on the basis of which the operating license was issued. But the design service life values of the individual components and systems are meaningful. They are subject of the further accounts below, being listed in the documentation to be considered and approved.

In respect of the nuclear safety, aging of a power plant finds its reflection mainly in the reduced “NPP safety margin” as a result of some worn out systems, components, and buildings. It must therefore be reliably proved, that this residual “NPP safety margin” is high enough and acceptable. Another nuclear safety influencing factor can rest in the development of the codes and standards to be applied while an NPP is being designed. But they are subject to changes that tend to be minor only. Henceforth, it can be deduced \textit{a priori}, that an NPP cannot be operated safely.

In the advanced world, the programs are available, able to control the aging processes and keep them within the acceptable limits, if they are caused by degradation and wear and tear. They can be used as life-extending tools.

From the technical viewpoint, the main issues in connection with the further issuance of the NPP Operating Licenses (so-called “prolongation” of the life of the units beyond the limit rooted in the license and thus also beyond the limit given in the Technical Certificate) can be broken down into the following domains that should be solved:

- consumption of the design service life of the components, systems, and buildings, controlled aging programs,
- solution of the departures from the applicable international standards and application of the operational experience,
- compliance with SUJB requirements,
- innovation programs.
3.1 Consumption of the design service life

Life expectancy of the WWER units as a whole is limited by the component replacement possibilities and avoidance of the building degradation. From this point of view, the only irreplacable part is the reactor pressure vessel (RPV) with its 40-year design service life. The design service life is to be construed here as an exactly determined (e.g. with use of the fraction mechanics algorithms) span of time the manufacture declares as the time over which the equipment must be able to function safely and reliably under the predefined conditions.

The conditions are set out very conservatively, i.e. with a high safety margin, containing, beside others, the RPV material critical fragility temperature, number of the permissible fatigue cycles, and number of the permissible transience. The RPV embrittlement is monitored by the witness program, which meets the strict criteria of the ASTM (USA) standards and US NRC requirements, and there is moreover an additional method used to construct the embrittlement trend curves. If necessary, the RPV material embrittled by action of radiation can successfully be regenerated by the new heat treatment of the vessel material. The RPV regeneration is now a well-mastered process, applied to a variety of the RVPs throughout the world, also by Czech ŠKODA JS (NPPs Jaslovske Bohunice and Loviisa).

Consumption of the other components’ design service life is much more favourable in contrast to the design. In general, the degradation of the safety important buildings is insignificant.

Current condition of the main components is being detected during the service inspections, regular operability tests, and by the degradation phenomena monitoring, using the diagnosing tools. In compliance with the IAEA methodology and international practice, the controlled aging programs have been prepared for some important components in respect of their nuclear safety in the Czech Republic.

3.2 Deviations and their solution

They are mainly the safety problems that are associated with this model line of NPPs and that have been identified by IAEA. The problems relate to the deviations of the WWER model designs from the contemporary international standards and the NPP operational deviations from the current worldwide routine. The issues are categorized, depending on their importance and their solution is required by the SUJB decisions and checked by its inspectors. To be able to obtain an additional operating license, the NPP must document that mainly the problems in the higher level of importance categories have been sorted out.

3.3 Compliance with the SUJB Requirements

SUJB is checking the ways used to ensure the compliance with the conclusions drawn from the SUJB inspections, SUJB decisions, conclusions from the Safety Analysis Reports and other documentation, which is subject to the approving procedure. The individual fields of the NPP operation are also analyzed, using a package of the SUJB safety indicators. These packages are used to establish the development trends that prevail in the various domains of the NPP operation.
3.4 NPP Modernization Programs

In addition to the attention paid prevalingly to the main primary circuit components, the preparation and solution of the actions that relate to component and system troubleshooting, the issue of the in-service inspections and their reliability in compliance with the requirements of the EU methodologies, innovation and reconstruction of the system and components that can affect safety, etc. have ever been discussed between the NPPs and SUJB. Some of these actions carried out in connection with the service life consumption and in conjunction with the pending safety problems, such as the innovation of the testing and control systems, selected emergency modes of operation, diesel generating sets, etc. are highly demanding in technical and investment terms. But this makes a basis for further successful operation in compliance with the license and for the prolongation of its term in the future.

Concerning the development of the “codes and standards”, the activities of the Czech Republic’s Association of Mechanical Engineers are significant. The Association has already prepared a series of the standards for analyzing the life expectancy of the WWER NPPs’ components and systems. The standards with their final goal to harmonize the WWER NPP evaluating processes with those applicable to the PWR reactors in EU and OECD have already been successfully evaluated by the analogous organizations abroad and registered in the appropriate EU committees.

In the field of recommendations and proposals, the SUJB staff members have prepared a series of the documents for evaluation of the life expectancy, integrity, reliability of the operational inspections. The goal is to set forth the base level of the nuclear installation safety requirements in compliance with the tenets described in the IAEA documents. This type of safety must never be compromised.

4. New legal requirements

Dukovany NPP units were put into operation during period 1985 – 1987. Operation licenses were issued based on information included in Final Safety Analysis Report (FSAR) and its revisions after ten and twenty years of operation. The revision after 10 years of operation was performed in compliance with the requirements of the former Czechoslovak Atomic Energy Commission guide on SAR format and content. The revision of FSAR after 20 years of operation was performed using US NRC R.G.1.70.

There is also ongoing elaboration of Dukovany NPP “full scope” PSR which will be submitted to SUJB till the end of the 2007 year. The PSR has been performed in compliance with Reference [4].

Some of regulatory requirements are missing in the Czech nuclear legislation instead of the fact that they have been already implemented in NPPs. The implementation has been asked by SUJB through conditions of regulatory decisions or has been done on the bases of SUJB recommendations.

Thus PSR elaboration is not required by current Czech nuclear legislation, but the SUJB has asked for the PSR through the conditions of operational licenses. The SUJB did the same in the case of issuance of last operation licenses of Dukovany NPP units. The utility is obliged to present to SUJB till the first half of the 2015 results of PSR after 30 years of operation (30
years is design lifetime of the NPP). In the same operation license the SUJB asked also for the strategy of the Dukovany NPP LTO, this document must be submitted to SUJB till the end of 2007.

The comparison of the WENRA reference levels requirements and requirements already included in Czech regulations has been performed. Missing requirements (e.g. on PSR and aging) will be reflected in new regulations. The intension of SUJB is to revise regulations in ten years period (e.g. new regulations on design, QA and operation of NPPs will be issued in 2007 - 2008).

SUJB will prepare guide on LTO based on the US NRC practices and IAEA EBP SALTO results.

5. Conclusions

Presented paper gave overview on the regulatory aspects of SUJB approach to the operation of Czech nuclear power plants beyond the limits of the design life. Legislative framework and main technical issues in connection with the further issuance of the NPP operating licenses are stated in compliance with the international practice in the Czech Republic. Basic documents for those licenses are updated FSARs and PSR.

REFERENCES