Nuclear Regulatory Systems

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Dr. Christoph Pistner, Oeko-Institut e.V., Germany[1]

Introduction

On March 11, 2011, Germany had a total of 17 nuclear reactors in operation located at 12 sites in 5 federal states. Germany is a federal republic, comprised of 16 federal states, so called Länder. These Länder have own constitutions and own governments, as well as own competences given from the federal constitution. Fundamentally, the Federal Government has the power of legislation, whereas the Länder have the administrative powers to execute the laws.

The fundamental Federal law regulating nuclear power in Germany is the Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards (Atomic Energy Act) from 1959. The original aim of the Atomic Energy Act was to promote the use of nuclear energy in Germany.

In 2001/2002 a revision of the Atomic Energy Act has taken place. Since then, the aim of the Atomic Energy Act is to phase out nuclear power in Germany and to ensure that the safety of nuclear power plants is maintained as long as they are still operational. The lifetimes of nuclear power plants have been restricted to about 32 full power years of operation.[2]

In 2010 the Federal Government revised the Atomic Energy Act, in the framework of a national energy policy for the time until 2050. In this context, the lifetimes of German reactors were prolonged for an average of about 12 full power years.[3] But still, nuclear power was regarded as a phase out technology. It was still to be used only for a limited period of time, to support the electricity system during the transition to renewable energy sources.

In the 13th amendment of the Atomic Energy Act of August 2011, the regulator withdrew the longer lifetimes of German nuclear power plants granted in 2010, withdrawing immediately the right to produce electricity of 8 nuclear power plants, and set dates for the termination of operating licenses for the remaining 9 plants up to the year 2022.

The German Regulatory System

Due to the federal nature of Germany, the actual oversight of the nuclear power plants is done by the corresponding Länder government authorities. The regulatory supervision of the Länder authorities and nuclear power in Germany is undertaken by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Coordination between the Länder and Federal authorities is done by the Länder Committee for Nuclear Energy.

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[1] Oeko-Institut is a leading European research and consultancy institute working for a sustainable future. Founded in 1977, the institute develops principles and strategies for realizing the vision of sustainable development globally, nationally and locally. Oeko-Institut is a non-profit association. Financial resources come mainly from third-party, project-based funding. The views expressed in this paper are those of the author and do not necessarily reflect the positions of the Oeko-Institute.

[2] An amount of electricity to be produced by each nuclear power plant was determined. After the production of theses electricity amount, the licenses for electricity production would expire.

[3] The lifetimes of the oldest seven reactors were prolonged for about 8 years, those of the newer plants for about 14 years.

In the Federal Ministry BMU, the Directorate-General RS is responsible for nuclear safety. A Directorate-General is subordinate directly to the state secretary and the Minister. The Directorate-General RS consists of three Directorates and several subdivisions. The Directorate RS I, responsible for the safety of nuclear installations, has about 20 staff members. Furthermore there is the Federal Office for Radiation Protection (BfS), a scientific-technical Superior Federal Authority subordinate to the BMU.

For additional technical expertise, the Federal authorities consult authorized experts, their main technical support organization being the Gesellschaft für Anlagen- und Reaktorsicherheit (GRS), an independent organization of technical experts.

An exemplary Länder authority is that of Baden-Württemberg, the Ministry of the Environment, Climate Protection and the Energy Sector being responsible for 5 nuclear power plants at 3 sites. The nuclear oversight branch of the ministry is organized in a division with six sections, with a total stuff of about 50 people.

For additional technical expertise, the Länder authorities consult authorized experts, their main technical support organizations being the technical service providers (TÜVs).

Several other institutions like the Oeko-Institut are also working on behalf of the Federal and Länder authorities as authorized experts.

Fundamental scientific and organizational work of the federal and Länder authorities are financed through the respective states budgets. The majority of the costs of the nuclear oversight process, including the cost of additional experts, have to be covered through direct fees by the licensees.

Apart from the federal and Länder authorities, there are also independent advisory committees to the Federal Government: the Reactor Safety Commission, the Commission on Radiological Protection and the Nuclear Waste Management Commission. These Commissions are working as independent advisors to the BMU in determining the state of the art in science and technology in their respective fields. They consist of experts from authorities, operators, manufacturers and further authorized experts.

With respect to the work of the Commissions, the work program and the final recommendations are publicly available. At the same time, the actual consultations remain secret, based on the argument of confidentiality requirements and the risk of an undue external influence on the consultation result.

The development of nuclear standards in Germany is performed by the Nuclear Safety Standards Commission (KTA), founded in 1972. This commission is composed of manufacturers, operators of nuclear power plants, authorized experts and state officials.

Germany implements international provisions like the IAEA safety framework and European directives in its nuclear regulation. Furthermore, a set of European safety standards called “Reference Levels” of the Western European Nuclear Regulators Association (WENRA) are to be implemented in Germany.

To enforce the necessary safety in nuclear power plants, the authorities have in principle a set of sanctions available. The Länder authorities have the right to issue orders, to impose penalty payments, to suspend operation and to revoke the license of nuclear power plants, depending on the severity of the violations. Furthermore, legal sanctions based on federal laws are possible, leading to fines or even to imprisonment for up to five years. While the

issuance of orders and even suspension of operations of nuclear plant have taken place in Germany, other means of enforcement are basically never used.

But even if orders are issued, the implementation of orders may take considerable time. For example, orders for backfitting the Biblis Plant with respect to seismic safety had been issued in 1991. But even in 2010, only a part of these orders had been implemented in the plant. Even more, the technical and scientific development leading to orders being issue will last for a considerable time. For example, an event in the Swedish BWR in July 1992 revealed considerable problems with the fundamental safety function of core cooling. Even in 2008, new requirements have been formulated by the German Reactor Safety Commission based on this event and the correspondent investigations.

Countermeasures against Sever Accidents implemented in Germany

In Germany two levels of beyond design basis events are distinguished. A first group of events is considered as being extremely unlikely but still has to be taken into account. These events are anticipated transients without scram (ATWS), aircraft crash, plant-external explosions, plant-external fires, intrusion of hazardous substances, functional failures of the control room and impacts of multi-unit plants or neighboring plants. These events have to be dealt with by design considerations or dedicated emergency systems such as

- a specially bunkered secondary side cooling system
- a diversified set of emergency diesel generators
- the additional supply of external energy by means of a third grid connection via underground cables.

Starting in the early 1980s, in reaction to the Three Mile Island accident and even more so after the Chernobyl accident in 1986, measures to deal with further beyond design events have been developed and implemented in German nuclear power plants. These measures include the backfitting of equipment as well as the development of procedures and strategies for the use of existing equipment under beyond design circumstances. No detailed formal regulatory requirements exist in Germany concerning this equipment, although approvals by the Länder authorities were required.

As major backfitting measures with respect to (other) beyond design basis accidents, the following measures have been implemented in German power plants:

- Measures to ensure the integrity of the reactor pressure vessel in boiling water reactors (BWR) such as independent water injection and heat removal systems.
- Provisions for secondary and primary side bleed and feed in pressurized water reactors (PWR) by means of upgraded safety valves and relief valves at the pressurizer to blow down steam-water mixtures.
- Enhancements in emergency power supply by connections between neighboring units and increased battery supply.
- In BWRs, the containment is filled with an inert atmosphere to avoid hydrogen explosions.
- In PWRs, passive recombiners are used to reduce the hydrogen content in the atmosphere to non-critical concentrations.
- All power plants are equipped with filtered containment venting systems.

- A sampling system to analyze the containment atmosphere is in place.

By means of these systems, for example a station blackout of not more than two hours should be mastered. No situation in which DC current is lost at the same time as AC current is taken into account in German nuclear power plants up to now.

New regulation with respect to backfitting in Germany has been introduced in the course of the change of the Atomic energy law in 2010. A new paragraph §7d has been introduced, requesting nuclear power plant operators to realize safety provision beyond the necessary precautions against damages, according to the state of the art in science and technology. But this provision is still limited to a certain degree, as it refers to those provisions *"which are developed, suitable and adequate for providing not only an insignificant contribution to further precaution against risks for the public,…"*. A requirement, however, based on terms not explicitly defined. Thus, the implementation of backfitting technologies is subject to concretion by the authorities.

The Aspect of Independence of the Regulatory Body

With respect to the independence of the regulator, several aspects have to be taken into account.

In a first step, the regulator has to be independent from politics to a certain degree.

- Fundamental aspects have to be decided by legislation, such as the question whether nuclear power shall be promoted, accepted or forbidden.
- With respect to safety, the regulator will have to be largely independent from politics, although a final oversight by society is necessary (see below).

An important second aspect relates to the organizational independence of the regulator.

- The organization in charge of the nuclear oversight must have safety as the only priority.
- The promotion of nuclear power, if part of the national policy, should not be part of the work of the regulatory authority. The regulatory authority must not be subordinate to the authority in charge of promoting the use of nuclear power.

A third aspect with respect to the independence of the nuclear regulator covers the financial independence.

- The nuclear oversight process must not be dependent on the general up and down in states income. The financing of the regulator will have to be maintained, no matter how good or bad states incomes at a certain point in time are.
- The size of the regulatory authority will depend on the size of the nuclear fleet. Thus, two means of financing may be beneficial: money for independent research and scientific support should be financed from state budgets, the cost of the oversight process including related technical experts, should be financed through fees directly from the operators.

A fourth aspect of independence relates to the organizational independence of the involved experts.

- Especially changes of personal from the regulator to the operator (and vice versa) have to be strictly controlled. While such an exchange might have positive aspects with respect to the technical knowledge of the people in the regulatory authority, there is the high risk of the individual to be biased due to its former work.

- In any case, an individual in the regulatory system shall not be allowed to work on questions he was already engaged in while working for an operator or a vendor.

A fifth aspect covers the individual independence of the experts in the regulatory authorities.

- During the regulatory oversight process, the individual expert will have to deal with the operators and the nuclear power plants on a day to day basis. Thus, the expert will get accustomed to the current situation in the plants and the technical and organizational structures they find themselves in. All of this will make it more difficult for the individual to continue asking critical questions, suggesting reforms and continue to request the highest safety.

For all these reasons, it is of paramount importance, that the regulator will have another counterpart besides the operator and vendor, to introduce some sort of checks and balances: the society itself. Means of public involvement in the regulatory process are thus of utmost importance.

Public Involvement in the regulatory process

In Germany, the role of nuclear power has been intensely debated since the 1970s. While in the beginning, basically no independent expertise besides vendors and operators existed, in the last four decades non-governmental organizations as well as independent research institutes developed in Germany.

Today, public involvement in the regulatory process is possible by various means and in different phases, some examples of which are:

- During legislative processes, there are established processes for stakeholder groups to have the possibility to comment on new regulations.
- During licensing procedures, hearings open to the public with the possibilities to ask questions and formulate administrative appeals have to be held.
- During operation, a system for reporting and evaluating the operational experience is in place, with fundamental information being open to the public.
- Based on the Aarhus-convention and implemented via European and German Federal Laws, the general public and stakeholder groups have the right to access environmental information.
- The Federal and Länder parliaments are in a position to request information from the Ministries concerning events in nuclear power plants or the development of nuclear safety in Germany.

A broad range of general information can be found on the websites of the federal and the Länder authorities. These comprise information on events in nuclear facilities, radiation monitoring as well as radioactive waste management.

Since 2008, first federal states have started do establish “information commissions” at the sites of the nuclear power plants. They are built upon members of local communities, trade unions and other local organizations to receive information on the site. These commissions are also open to the public.

Final Remarks

Nuclear power plants are very complex technical systems with the potential for catastrophic consequences in case of a severe accident happening.

Even with an optimized regulatory system, no absolute safety is achievable in nuclear power production. The probability of accidents may be reduced. But internal and external events, in combination with human and technical failures, will continue to happen, with the ultimate chance of developing into a severe accident.

Thus, society has to decide whether the risk of nuclear power is deemed as being acceptable or not. In Germany, the government in 2001 has decided, that nuclear power production will only be tolerable for a limited period of time. Even in 2010, when a newly elected government decided to prolong nuclear power plant lifetimes, they did not question the fundamental decision to phase out nuclear power in Germany. After the Fukushima event, a fast majority of the German parliament has decided again on the phase-out of nuclear power in Germany.

Japan will have to decide on its own nuclear future, the improvement of its nuclear oversight being only one important topic in this discussion.

Literature

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