

## Safety Reviews of Research Reactors in Germany – Graded Approach for the periodic safety review according to § 19a of the Atomic Energy Act

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In Germany, a total of 46 research reactors were built and operated. In the meanwhile, most of them are in decommissioning or have already been dismantled completely. At present, only 7 research reactors are still being in operation. They include:

- 2 large pool reactors: FRM II in Garching near Munich with a thermal output of 20 megawatts (MW) and BER II in Berlin with a thermal output of 10 MW.
- 1 TRIGA Mark II reactor in Mainz with a thermal output of 100 kilowatts (kW).
- 4 smaller training reactors, the so-called zero-power reactors: AKR-2 in Dresden with a thermal output of 2 watts and 3 SURs (Siemens training reactors) in Stuttgart, Furtwangen and Ulm with a thermal output of 100 milliwatts (mW) each.

These research reactors differ from each other not only with respect to their design, thermal power and radioactive inventory but also with respect to the nuclear fuel used, the mode of operation as well as to the site (e.g. central location in a city or in a suburb). Consequently their risk potential is also very different.

To assure the safety of German nuclear installations, a comprehensive national legislative and regulatory framework has been established. The most important document is the Atomic Energy Act [1] together with its associated ordinances. They constitute the legal basis and are directly binding to all kind of nuclear installations in a common approach, including research reactors.

Within this national legal framework, the licensee has the prime responsibility for the safe operation of its own nuclear facility. To ensure safety over the entire lifetime of the facility, the operator is obliged among the other to perform particular safety reviews:

- within the licensing procedure according to the paragraph 7 of the Atomic Energy Act, i.e. in case of construction, operation, essential modifications of the installation or its operation as well as for decommissioning of the facility
- safety upgrades, which are carried out within the continuous regulatory supervision pursuant to paragraph 19 of the Atomic Energy Act.

Moreover, according to the paragraph 19a of the Atomic Energy Act, which was introduced in its 12th amendment in 2010:

“(3) Anyone who operates any nuclear installation [...] shall perform a verification and evaluation of the nuclear safety of the respective installation every ten years and shall improve nuclear safety of the installation continuously. The results of the verification and evaluation shall be submitted to the supervisory authority.

(4) The evaluation according to para. (1) or (3) shall encompass the verification that measures are taken to prevent accidents and to attenuate the effects of accidents including the verification of the physical barriers as well as of the administrative preventions of the licensee which would have to fail before life, health and material assets are damaged by the effect of ionising radiation. The competent supervisory authority can issue orders concerning the extent of the verification and evaluation by the licensee.”

This means, that the regular safety reviews similar to the Periodic Safety Reviews for nuclear power plants become mandatory for all kind of nuclear facilities, which includes also research reactors.

The focus of the paper presented here is the evaluation of the risk potential of individual research reactor facilities and the development of an appropriate graded approach to perform the safety reviews according to the paragraph 19a of the Atomic Energy Act.

[1] Act on the Peaceful Utilisation of Atomic Energy and the Protection against its Hazards (Atomic Energy Act) of 23 December 1959, as amended and promulgated on 15 July 1985, last amendment by the Act on 28 August 2013, BFS Safety Codes and Guides, Translations Edition 08/13

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