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STATUS OF THE FRM-II PROJECT

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ABSTRACT

The concept planning work for the new 20 MW high flux neutron source FRM-II to be built at Garching near Munich has been completed. The Siemens company has been selected to be the general contractor for the facility, whereas the Technical University of Munich as the future operator of the facility also acts as the responsible designer and supplier of the experimental installations. - The design concept has now successfully been examined by the responsible authorities and their experts.This will allow to start construction of the reactor building at about the end of 1995 when the first licensing step will be granted. Design work to obtain the next licensing award is underway. This second step will cover the erection of all the other buildings and the installation of all systems and components and is expected for late 1996. Cold startup is scheduled in 2000 and full power operation in 2001.

INTRODUCTION

The existing 4 MW swimming pool type research reactor FRM, which is in operation since 1957 on the research campus at Garching near München, will be replaced by a new high performance multipurpose neutron source named FRM-II (Forschungsreaktor München II, i.e. Research Reactor Munich II). The design of the 20 MW FRM-II pool reactor with moderator tank has been optimized for beam tube applications of thermal neutrons including the generation of slow, hot or fast neutrons for special fields of research, but it also will contain several state-of-the-art irradiation facilities.

FEATURES OF THE FRM-II DESIGN

The design concept of the FRM-II facility has already been shown on the previous IGORR Meetings /1,2,3/. The essential design feature is a very compact reactor core consisting of a single fuel element which is cooled by light water and surrounded by a large heavy water moderator tank. Fig. 1 shows a photograph of a dummy FRM-II fuel element which is being fabricated by the CERCA company /4/. Because of the small volume of this fuel element the use of highly enriched uranium in combination with high density silicide fuel is imperative. Since this compact core is highly undermoderated, about 50 % of the fast fission neutrons immediately leak out into the moderator tank where they are slowed down to yield a high flux level and a pure spectrum of thermal neutrons in a large usable volume. The ratio of flux to power is particularly high for this "compact core" reactor, the unperturbed thermal flux maximum in the D_2O tank being $8 \cdot 10^{14}$ $cm^{-2}s^{-1}$ at 20 MW power. The cycle length will be about 50 full power days.

Fig. 2 shows a vertical cross section of the reactor building. The reactor pool is placed in the center of the building. Horizontal and inclined beam tubes (not shown) lead into the adjacent experimental hall to provide neutrons for about 17 experiments. Further to the rear end of the reactor pool follows the storage pool which is used for the decay of spent fuel elements and other radioactive equipment. The reactor hall on top is mainly used for reactor and fuelling services, but it also provides access to various irradiation facilities located in the reactor pool or moderator tank. Siderooms on either side of the reactor hall will accomodate components belonging to the experimental installations, the reactor ventilation and reactor safety systems. The basement rooms will be used for cleaning systems, intermediate waste storage, light and heavy water handling and other auxiliary systems. On the right side of the reactor building the combined entrance and energy supply building becomes visible whereas the neutron guide hall which allows to perform more experiments is located in the background.

With respect to earlier designs the outer wall thickness of the reactor building has been enlarged and the form of the roof has been modified in order to provide full protection against a hypothetical air plane crash accident. One also can notice small gaps and floating connections between the pool shielding walls and the adjacent floor structures. This feature is to isolate the pool from the shocks of the postulated airplane crash, thus guaranteeing the integrity of the pool. Therefore even under such highly unlikely circumstances the fuel element would still be covered with water.

The FRM-II will be equipped with a number of integrated experimental facilities:

10 horizontal beam tubes partially in combination with neutron guides
2 inclined beam tubes
1 cold neutron source (liquid deuterium) with vertical guide tube
1 hot neutron source (graphite)
1 converter facility (uranium) for fast neutron production
2 silicon doping devices (nuclear transmutation)
2 pneumatic systems for sample irradiations
1 high flux pneumatic system for sample irradiations
1 capsule facility for longterm irradiations
1 positron source.

STATUS OF THE PROJECT

The public hearing act based on the final version of the Nuclear Safety Report took place during five days of May 1994. Questions from citizens and institutions concerning safety-related aspects of the project were answered by the licensing authority assisted by the Technical University of Munich (TUM) and the Siemens company.

In June 1994 a general supplier contract was signed with Siemens, covering all detailed engineering and necessary license-related activities, complete construction of the facility, cold and nuclear startup as well as a fifty days full-power test run of the reactor. This contract will become valid once the first nuclear licensing permit has been awarded by the authority, which is expected for November 1995. The TUM, however, as the future operator of the facility has to plan, supply and obtain licenses for all the experimental installations as mentioned above.

To obtain this first partial license (i.e. approval of concept and start of construction) in November 1995 all necessary informations were prepared and given to the technical surveillance company "TÜV Bayern Sachsen", the independent assessor as nominated by the licensing authority, the Bavarian Ministry of Environment. The TÜV recently completed the evaluation and presented the draft of its assessment to the authority. Now another positive statement is expected from the Reactor Safety Commission (RSK), the assessor of the German Federal Ministry of Environment.

Based on this status a report has been prepared for the German Scientific Council which gives recommandations on the application of funds for science-related projects in the university sector. A positive vote of this council would finally confirm the funding of the whole project FRM-II.

Parallel to the nuclear licensing there are further licensing procedures in progress, such as for hydrological and environmental aspects. Also for those procedures public hearings have to be performed.

The TUM and Siemens are now preparing all the detailed informations necessary for the construction of the remainder of new buildings and for the supply and installation of all components of the facility.Those papers will again be examined by the TÜV and other independent experts of the authorities and are expected to lead to the award of a second licensing step towards the end of 1996 which covers all work before the insertion of the first nuclear fuel element.

During the course of the year 1995 preparational work has to be carried out on the campus of the existing research reactor FRM in order to clear for structural interfaces between the FRM and its adjacent facilities and the site requirements of the new FRM-II.

The cold startup of the plant is scheduled for 2000 and its first criticality for 2001.

ACKNOWLEDGEMENTS

This paper represents a summarizing report on a project which many colleagues and co-workers from various institutions have contributed to. These include numerous members of the Faculty of Physics E21 of the Technical University of Munich as well as of the Siemens AG (previously Interatom GmbH) company.

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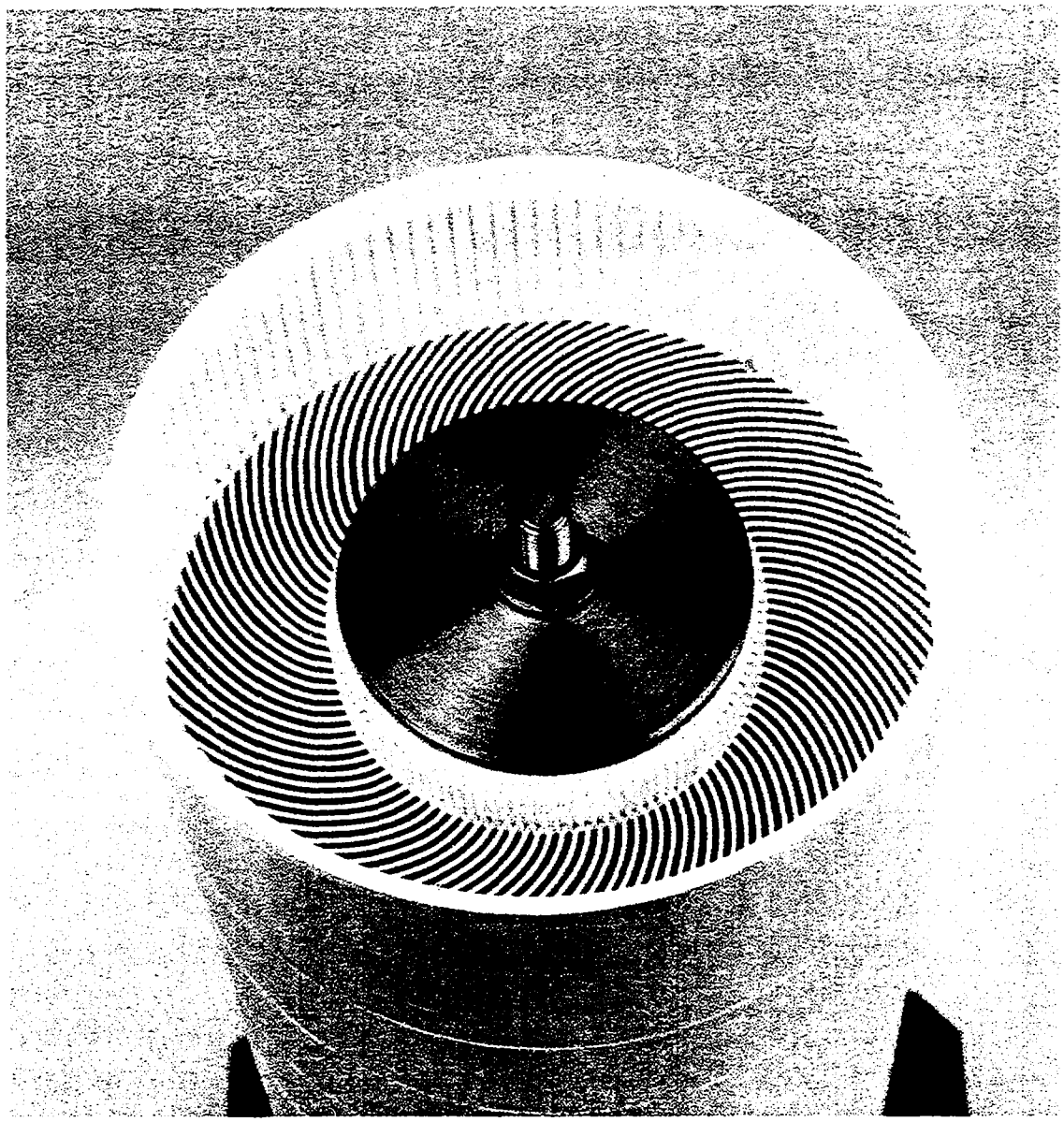

Fig. 1: A dummy FRM-II fuel element presently under construction at the CERCA company. The outer and inner diameters of the two core tubes are 243 and 118 mm, respectively. The 113 fuel plates have involute curvature, the axial dimension of the fuel zone being 700 mm and its volume 17.6 liters.

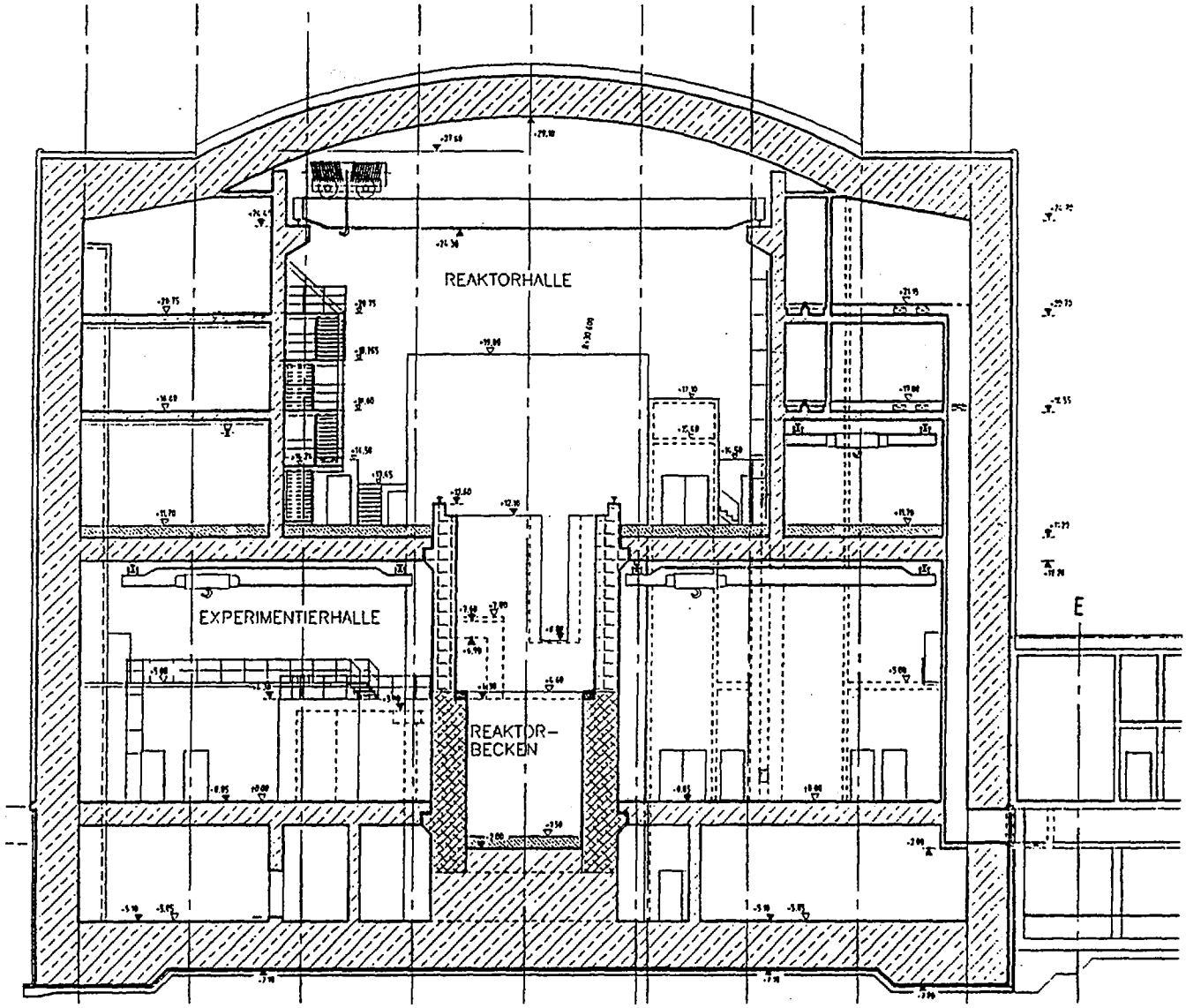

Fig. 2: Cross sectional view of the FRM-II reactor building. The thickness of the outer walls and the form of the roof have been modified to withstand a postulated airplane crash. The pool in the center has been mechanically isolated from the building structures by gaps and floating supports to minimize crash shocks.