Final 14TH September 11.30

Stress test peer review
Follow-up fact finding site visit

Germany

1. BACKGROUND/INTRODUCTION

In the context of the ENSREG action plan to follow-up the implementation of safety improvements resulting from the stress test peer review process, a limited number of fact-finding site visits have been organized. The objectives of these fact-finding visits are summarized as follows:

- Information regarding measures taken, planned or under consideration at the site level to improve safety as a result of the stress test and peer review processes focusing on the three topics: natural hazards, loss of safety systems and accident management.
- Identify good practices, noteworthy successes and any lessons learned on implementing these measures.

This report summarises the fact-finding visit to Germany at the site of NPP Gundremmingen (KRB II) on 12th-14th September 2012. The four members of the fact-finding team had been part of the initial peer review visit to Germany. The counterparts for the visit included KRB II management and the staff, representatives of RWE and E.ON (owners of the plant) as well as regulatory authorities (Federal ministry for environment BMU and Bavarian regulatory authority-BStMUG) and TSOs (GRS and TÜV SÜD). The mission was conducted in a friendly and open atmosphere, with the team provided information and access without limitations.

2. GUNDREMMINGEN NPP

At the Gundremmingen site there is a twin unit with boiling water reactors (KWU BWR72 series). Unit B was put into commercial operation in 1984, Unit C in 1985 (Unit A on the same site is under decommissioning). The licensee is the Kernkraftwerk Gundremmingen GmbH. Each reactor has a nominal thermal output of 3,840 MW and an electrical output of 1,344 MW.

The relevant safety systems are 3 x 100% per unit and independent, physically separated, redundant and protected against external events. The seismic resilience of all redundant safety systems (except train 1), including power supply, control systems and relevant supporting systems, is ensured and consistent with the German KTA rules. An additional independent residual heat removal system (ZUNA) per unit was erected in 1994, also protected against external events.
Major upgrades of the plant implemented in 1990's comprised a filtered containment venting system, passive hydrogen recombiners, inertisation of the wetwell, a 20 kV underground cable to the public low voltage grid, and filtered overpressure ambient air in the control room. Other upgrades were implemented as a result of periodic safety reviews, e.g. ZUNA system, diverse reactor pressure vessel low level signal, diverse pressure release valves.

Each reactor is enclosed in a primary containment. The spent fuel pools are located in the secondary containment with 1.8 m reinforced concrete walls. The ultimate heat sink for the essential service water systems (ESW) is the Danube river. In case of failure of ESW there is an additional cooling tower for the ZUNA system, with at least 10 hours autarchy.

Each unit is connected to the external electrical grid by two 400 kV lines. The plant is also connected to the 110 kV grid. At each unit there are 3 safety grade diesel generators, two additional 'availability diesel generators' and an additional one for the ZUNA system. Every diesel can be manually switched to every train as an accident measure. An additional 20 kV underground cable can be manually switched to every train as accident measure, too.

Furthermore, there are five separate power connections between the respective emergency power trains of both units.
There are various accident management measures compiled in an accident management handbook, using existing installed equipment as well as mobile equipment.

3. SUMMARY OF OBSERVATIONS

3.1 Measures already decided or considered

The list of measures for post Fukushima improvements at KRB II has been determined considering inputs from the licensee's own analysis, the authorities and independent TSOs. Immediately following the Fukushima event, the NPP, compiling the input from its own staff, identified a long list of possible improvement measures. That was followed by a "Targeted Safety Review" mandated by Reactor Safety Commission (RSK) and focusing on robustness for beyond design basis (BDB) events, completed in May 2011. This resulted in some plant specific measures. This was expanded upon during the EU Stress Test where some measures were refined or further measures identified. Compiling analyses by all NPPs and considering the actual design of the plants, VGB looked into the generic safety concept for further improvements for beyond design basis events that would need to be refined by plants for individual implementation.

Immediately following Fukushima, the responsible regulator BStMUG, supported by the TÜV SÜD, undertook a detailed inspection that mandated specific improvements. On behalf of the BMU, the GRS undertook generic assessment of the Fukushima event taking into consideration further seismic related issues. This assessment resulted in the GRS "Information Notice" 2012/2, containing 22 specific recommendations. Following the established process, the licensee checked these recommendations for implementation and reported to the BStMUG, that some recommendations are already implemented. The BStMUG is evaluating the licensee's position on remaining recommendations. In addition, the RSK is working on further issues for improving the robustness for BDB events and reassessing the adequacy of the existing accident management approach. The RSK statement on "Loss of primary ultimate heat sink" has been prepared and additional recommendations are expected later in 2012.

The plant specific list of measures needs to consider all this. To this end, the measures to address the GRS Information Notice as well as the expected additional RSK recommendations could not, at this stage, be included in the list. Therefore, the list as indicated below cannot be considered complete nor final. The need for additional plant specific safety improvements will be approved by the responsible regulator, BStMUG.

ENSREG
European Nuclear Safety Regulators Group
Stress Test Peer Review Board

Topic	Improvement Measures	Status	Planned completion
	Analysis of the earthquake intensity against which the plant is protected		
1 - earthquake	- Seismic margin assessment by engineering judgment	Implemented	2011
1 - earthquake	- Revision of the Seismic PSA (independent check by TÜV SÜD in progress)	Implemented	2011
	New Flooding Analysis for the 10^{-4}/a-level		
1 - flooding	- Analysis of the impact of Danube river having double maximally estimated flow rate	Implemented	2011
1 - flooding	- New level measurement of surrounding landscape (lower flood height)	Implemented	2012
	Access to plant/buildings during flooding		
1+3 - flooding	- 3 boats on site	Implemented	2012
1+3 - flooding	- Mobile bulkhead plates - for these safety related entrances where flooding protection (stairways) is inside buildings	Ordered/in progress	2012
1 - extreme weather	Procedures for extreme weather in the organization manual		
	- Additional checks for all site specific hazards, e.g. snow loads	In progress	2013
2 - SBO	Acquisition of 2 additional mobile diesel generators to recharge the batteries and to supply selected safety relevant components in case of SBO	In progress	2013
2 - SBO	Optimization of the procedures for reestablishment of the AC power supply	Planned	2013
	Revision of Severe Accident Management Procedures (SAMG)		
3 - SAMG	- Checking existing procedures and adding long term measures	In progress	2013
	Spent fuel pool		
2+3 - UHS	- Integrity verification for 100 degrees Celsius	In progress	2012
2+3 - UHS	- Heat transfer inside the containment	In progress	2013
	Implementation of new/refined accident management measures:		
3 - SAMG	- Early opening of three motor-driven pressure vessel relief valves	Implemented	2012
3 - SAMG	- Locking of safety valves in the emergency cooling water system for increasing pressure during injection with mobile (submergible) pumps	Planned	2013
3 - SAMG	- Using fire trucks for injecting water in the RPV in case of accident in both units	Implemented	2012
2 - SBO	- Singular shut down of diesel generators to spare onside fuel resources	In progress	2013
2+3 - UHS	- Earlier preparation of the measures to refill the spent fuel pool	Implemented	2011
2+3 - UHS	- Additional possibility to refill the spent fuel pool without access to hazardous areas	In progress	Concept in 2013
3 - SAMG	- Modification of the emergency organization in the case of an accident in both units	Implemented	2012
	Filtered vent system		
3 - SAMG analysis	- Analyses for sequential/alternate venting for both units	Implemented	2012
3 - SAMG analysis	- Evaluation of Iodine retention in case of sequential/alternate venting for both units	In progress	2013
3 - SAMG	Autocatalytic recombiners in the reactor building (secondary containment)	In progress	2013 - 2014

3.2 Good practices and noteworthy successes

The safety improvement process at KRB II reflecting the Periodic Safety Reviews findings as well as systematic evaluation of operational experience resulted in numerous improvement measures implemented over the years. Many of those, in particular those focusing on common cause failures, increased the safety margins for the areas addressed by the EU Stress Test. As a result, relatively few new improvements could be identified. Furthermore, KRB II immediately initiated the evaluation of the applicability of the Fukushima scenario on the plant.

The VGB-lead initiative, where the range of safety improvements is considered in view of the overall plant's safety concept, seems to be a good practice. This systematic approach is meant to assure any safety improvement is assessed with proper consideration of the design basis, previous modifications as well as organizational, cultural and training issues of relevance.

3.3 Lessons learned while implementing measures

A thorough and systematic approach needs to be applied when identifying improvements needed. Well balanced assessments have to be performed prior to implementing specific measures. Preventive measures should have priority and should be complemented with mitigative measures as necessary. When implementing measures it is essential to keep the core knowledge of the plant, its design basis and its behavior in all plant states (including BDB) with the personnel at the site. The documentation (operating procedures, SAMG, various manuals, etc.) should be prepared with intensive involvement of the staff that will use these to ensure that the background is fully understood.

3.4 Difficulties encountered

In relation with the establishment of the overall program of safety improvement, a challenge remains to integrate the results of all reviews undertaken and recommendations provided. To address this challenge, due attention should be given to the consideration of overall safety concept.

A challenge may exist in implementing improvement measures for plants with (legally) limited lifetime. For complex measures requiring long lead time for analysis and implementation, a plant might be close to the end of the life at the time an improvement measure would be in place. Regardless, nuclear safety is an overriding priority and has to be maintained at high level up to the end of the lifetime of a NPP.

4.0 Conclusions

The KRB II plant has a robust design. Nevertheless a list of measures to further increase robustness has been identified by the operator. Some measures have already been implemented, and others are in the process of implementation. Additional improvement measures might still emerge in the future, as a result of the GRS Information Notice recommendations and the upcoming RSK statements.

Within a structured approach, the German licensees correlate potential issues and proposed improvements to the existing safety concept and adapt it where necessary. On that basis, generic recommendations proposed needs to be translated into plant-specific environment to develop individual measures, thus assuring consistency of the safety concept.