Note:
This is a translation of the RSK recommendation entitled "Elektromagnetische Verträglichkeit (EMV) - Nachweisführung der EMV der Leittechnik in kerntechnischen Anlagen". In case of discrepancies between the English translation and the German original, the original shall prevail.

RSK RECOMMENDATION
13.06.2002

Electromagnetic compatibility (EMC)
Demonstration of EMC for instrumentation and control systems in nuclear installations

1 Advisory request and approach

At the 142nd meeting of the RSK Committee on ELECTRICAL INSTALLATIONS on 17 October 2001, the expert from TÜV Süddeutschland Bau und Betrieb GmbH reported on various aspects of EMC issues and presented the EMC guideline "Electromagnetic Compatibility (EMC), Demonstration of EMC in Nuclear Supervisory and Licensing Procedures" published by the Technical Inspection Associations (TÜVs), and the EMC requirements specification "Verification of electromagnetic compatibility for legacy instrumentation and control systems" published by VGB [1, 2]. During the discussions, it was noted that, with regard to EMC issues, there are no rules or guidelines that describe the qualification, demonstration and testing of electromagnetic compatibility for electrical installations, specifically in nuclear installations. In the Committee's view, it should be examined whether the approach to demonstrating EMC in accordance with the TÜV EMC guideline and the VGB EMC requirements specification can be recommended as appropriate. The BMU supports this initiative and has asked the Committee for a recommendation on this matter.

At the 143rd meeting of the RSK Committee on ELECTRICAL INSTALLATIONS on 5 December 2001, VGB reported on the EMC requirements specification [3]. At the 146th meeting of the RSK Committee on ELECTRICAL INSTALLATIONS on 27 March 2002, the committee adopted the draft/RECOMMENDATION for submission to the RSK. The RSK concluded its deliberations on this recommendation at its 352nd meeting on 13 June 2002.

2 Background

The expert explained that, at international level, the information had only been published in the form of an IEC report of an informative nature.

The European EMC legislation ('EMC Directive 89/336/EEC' of May 1989) was enacted to harmonise legal provisions across the individual Member States. However, the primary focus was on removing barriers to trade. In Germany, this legislation was transposed into national law by the German EMC Act (EMVG) and is

currently in force in the version dated 18 September 1998. However, the EMVG does not provide any guidance on EMC demonstration in procedures under the Atomic Energy Act (AtG). The fundamental aspects of EMC testing in AtG procedures include:

- distinction between generic and plant-specific testing
- differentiation of the testing depth according to safety significance
- sub-assembly testing (in the past) vs. equipment testing (today)
- internal and external EMC (mixed configurations of old and new systems within a single enclosure).

Overall, there was a lack of a strategy for testing EMC in nuclear regulatory procedures. This led TÜV Süddeutschland Bau und Betrieb GmbH to draw up the EMC guidelines. The Instrumentation and Control Technical Working Group (FAK LE) of VdTÜV (Nuclear Coordination Office) formed the 'EMC' working group, which finally adopted the EMC guideline on 31 March 1998 and published them in the TÜVIS Testing and Certification Regulations.

According to the TÜV guideline, for the purpose of demonstrating EMC compliance in nuclear regulatory procedures, modifications are essentially classified into three safety-related categories, each requiring a different level of detail in the EMC demonstration. Detailed EMC test reports, setting out the test conditions and allowing verification of compliance with the values specified in the EMC analysis to be demonstrated, must be submitted when modifications are made to electrical equipment of the safety system in Categories 1, 2 and, in principle, Category 3 in accordance with the RSK guidelines, as well as when new installations or parts of installations containing electrical equipment forming part of the safety system are set up. In the case of modifications to operational electrical equipment, EMC demonstrations are not required under the nuclear regulatory procedure or require only manufacturers' declarations regarding tests on electromagnetic interference and immunity. The latter approach is also applicable in individual cases to Category 3 installations in accordance with the RSK guidelines, provided that the safety significance of these installations is assessed as being low.

In accordance with the standard procedure for plant-specific EMC demonstration, the electromagnetic requirements are first determined on a plant-specific basis from the environmental conditions at the equipment location (EMC analysis), or the standard requirements are adopted from the basic EMC standards for the industrial sector, together with any specific additional requirements. Based on the aforementioned data, an EMC test plan is drawn up and the EMC tests are then carried out. Finally, the results of the EMC test report are assessed as part of the AtG procedure.

The EMC requirements specification "Verification of electromagnetic compatibility for legacy instrumentation and control systems" of VGB describes an EMC analysis. The analysis is based on a plausibility check and EMC tests (regarding surge voltage immunity) for the "legacy instrumentation and control systems" currently in operation at the plants (this applies to all nuclear power plants built by Siemens KWU in Germany). According to information provided by VGB, initial plans to upgrade lightning protection measures at the Biblis Nuclear Power Plant (KWB) subsequently led to the drafting of the EMC requirements specification. Subsequently, the demonstration of compliance was extended to cover all electromagnetic interference in

accordance with a structured procedure and was set out in the requirements specification. In the expert's view, even when retrofitting new instrumentation and control systems, the description of the electromagnetic environment in the EMC requirements specification provides a sound basis for detailed EMC assessments.

The EMC requirements specification was first incorporated into a nuclear regulatory procedure by VGB in connection with KRB II in 1998. TÜV Süddeutschland Bau und Betrieb GmbH subsequently drew up a generic expert opinion for German nuclear power plants, including guidance for plant-specific expert opinions. In 1999, the generic expert opinion was coordinated with the other nuclear experts. Subsequently, plant-specific expert opinions were drawn up based on the agreed generic documents (from 2000 onwards).

VGB presented the EMC requirements specification. In addition to a general section describing the protection objectives and applicable standards, it contains the interface model for defining the EMC requirements for instrumentation and control systems in nuclear power plants. Furthermore, the requirements for the interfaces describe the influence of ambient and installation conditions, specify the severity levels, define malfunctions, and set out the status of qualification and the testing requirements. Subsequent chapters present a representative selection of test specimens, describe practical tests, and provide guidance on documentation.

A table from the requirements specification can be used to identify a selection of electromagnetic disturbances defined in EMC standards. The severity levels corresponding to the disturbance potentials can also be derived from the standards. This list must be constantly updated as new EMC standards are introduced. The interfaces defined in accordance with the interface model are assigned to the EMC disturbance potentials, the severity levels taken from the standards, and the disturbance criteria. From this, the scope of the EMC tests still required for legacy systems can be determined. Some EMC disturbance parameters can be excluded from consideration through administrative measures. Overall, according to VGB, the surge voltage test remains the practical EMC test for legacy systems.

The procedure in accordance with the EMC requirements specification was agreed upon by mutual consent with the assessors, said VGB. According to the expert, he had already been presented with several EMC analyses in accordance with the requirements specification for major plant modifications and for the FRM-II. In most cases, as with the FRM-II, there is a specific EMC specification for the particular project, which is derived from the general specification. On this basis, the expert reviewed the evidence of EMC compliance after applying the EMC guidelines. In some *Länder*, this approach has proved its worth and is standard practice. The procedure reflects the current state of the art in science and technology.

3 Summary of the background

With regard to the treatment of electromagnetic compatibility (EMC) in nuclear regulatory procedures, the licensees have summarised the procedures and requirements for analysing and demonstrating EMC in VGB's EMC requirements specification [4]. For the purposes of testing, TÜV Süddeutschland Bau und Betrieb GmbH has developed an EMC guideline [1] which is also used by other expert organisations and thus provides a compilation of the requirements and assessment criteria to be applied from an expert perspective, specifically tailored to nuclear regulatory procedures. It should be noted that a key point in TÜV's EMC guideline is the differentiation of the testing depth according to the safety significance.

VGB's EMC requirements specification sets out the scope, implementation and key aspects of the demonstration process as part of an EMC analysis for legacy instrumentation and control systems in German nuclear power plants. It therefore also serves as a tool in the context of retrofits or modifications involving new instrumentation and control systems.

According to VGB and TÜV Süddeutschland, the documents presented during the consultations – VGB's EMC requirements specification and TÜV's EMC guideline – cover the necessary scope of analysis and testing for EMC issues in nuclear regulatory procedures.

4 Assessment by the RSK

With regard to electromagnetic compatibility (EMC), the RSK notes that, apart from the overarching requirements set out in the RSK guidelines, there are no specific rules or guidelines governing the qualification, demonstration and testing of electromagnetic compatibility for electrical equipment in nuclear installations.

On the basis of the consultations among the RSK Committee on ELECTRICAL INSTALLATIONS during which on the one hand the scope and methodology for analysis and demonstration (VGB EMC requirements specification [4]) and on the other hand the underlying requirements and assessment criteria (TÜV EMC guidelines [1]) were presented and discussed, the RSK concludes that the safety-related requirements concerning EMC issues are set out fully and comprehensibly in these documents.

From the point of view of the RSK, these documents set out the current state of the art in science and technology with regard to addressing EMC issues.

Documents

[1] TÜVIS, Berichte der Facharbeitskreise der TÜV-Leitstelle Kerntechnik beim VDTÜV, Bericht 45 „Elektromagnetische Verträglichkeit (EMV), Nachweis der EMV in atomrechtlichen Aufsichts- und Genehmigungsverfahren“ vom 09.11.1998, Fassung 01.99

[2] TÜV Süddeutschland Bau und Betrieb GmbH, „Blitzschutz und elektromagnetische Verträglichkeit für Gebäude und Anlagen“
Dr. Ralf Frentzel, RSK EE – Oktober 2001

[3] Prof. Dr. Kern, „EMV-Lastenheft, ‚Nachweisführung zur Elektromagnetischen Verträglichkeit für Altsysteme der Leittechnik‘, Vorstellung im Auftrag der VGB“
RSK-EE; 143. Sitzung, Bonn

[4] VGB „Lastenheft, ‚Nachweisführung zur Elektromagnetischen Verträglichkeit für Altsysteme der Leittechnik – Vorgehensweise und Darstellung der Tätigkeiten‘, Version E 6. August 2001