Note:
This is a translation of the RSK statement entitled
"Aspekte der Qualitätssicherung bei wiederkehrenden Prüfungen und Instandhaltungsmaßnahmen sowie beim Einsatz von Fremdpersonal"
In case of discrepancies between the English translation and the German original, the original shall prevail.

RSK statement
(508th meeting of the Reactor Safety Commission (RSK) on 6 February 2019)

Aspects of quality assurance with regard to surveillance testing and maintenance measures as well as the use of external personnel

1 Background and consultations

At its 245th meeting on 29 September 2016, the Committee on REACTOR OPERATION (RB) dealt with the GRS information notice *(Weiterleitungsnachricht)* WLN 2016/12 on irregularities regarding surveillance testing in Units 1 and 2 of the Philippsburg nuclear power plant of 8 September 2016 [1] relating to deceits and further irregularities in surveillance of the radiation/activity monitoring in KKP-1 and KKP-2. As stated by GRS, indications of weaknesses in the management system and in the plant operator's organisation were identified during investigations of these events.

Symptoms for those are:

- violation of administrative operational procedures,
- insufficient assessment of updates when modifying the test instruction,
- no issue of a fault report after first findings of a wrong parameter setting
- unauthorised group behaviour by violating operational regulations,
- inadequate application of control and quality assurance mechanisms, and
- weaknesses in the evaluation of operating experience feedback (OPEX) and in the implementation of modifications.

This is due to weaknesses in safety culture, in particular

- weaknesses in the control of personnel actions and in the structuring of processes,
- insufficient control by superiors at all levels,
- inconsistent operational regulations (e.g. inconsistencies between operation manual, maintenance regulations and operating instructions), and
- inadequate use of the computerised operation management system (CMS) for recurrent surveillance tests.

At its 488th meeting on 7 December 2016, the RSK Committee RB reported to the RSK on GRS's conclusions in WLN 2016/12 [1] and the history of the measures initiated at the KKP site since 2001 to enhance the safety culture. As a result of its consultations, the Committee RB decided to prepare two statements. The present statement relates to aspects of quality assurance of surveillance and maintenance measures and of the use of external personnel (subcontractors). In a later statement, the topic of assessing the effectiveness of measures to prevent recurrence of events will be addressed. Further events in other nuclear installations in which the above-mentioned aspects were of relevance are considered in this statement. The international experience of manufacturers and suppliers regarding counterfeit items or falsified documents is not part of this statement.. This is addressed, among others, in IAEA-TECDOC-1169 "Managing suspect and counterfeit items in the nuclear industry".

Subsequent to it, at its 248th meeting on 16 February 2017, the Committee RB discussed the aspects of

- quality assurance measures for surveillance programmes,
- monitoring the activities of external personnel, and
- prevention of faulty measures including deliberate wrong actions,

which are considered relevant with regard to recurring causes. These were discussed in six further committee meetings.

At the 257th meeting on 28 February 2018 and 260th meeting on 6 June 2018, the Committee RB discussed a draft statement on this subject, which was adopted at the 261st meeting on 4 September 2018. The draft statement of the Committee RB was first presented at the 504th RSK meeting on 27 June 2018, discussed at the 506th RSK meeting on 7 November 2018 and adopted at the 508th RSK meeting on 6 February 2019.

2 Facts and circumstances

Information notice WLN 2016/12 on irregularities in surveillance tests in Units 1 and 2 of the Philippsburg nuclear power plant of 8 September 2016 [1] is based on three reportable events (*meldepflichtige Ereignisse* – MEs) in the scope of radiation/activity monitoring issued by KKP nuclear power plant: ME 01/2015 on incorrect parameter setting for the start of concentration calculation after filter exchange at aerosol measurements on 2 February 2015 in KKP-1, ME 02/2016 on unavailability of an aerosol/iodine monitor for accident conditions on 1 March 2016 in KKP-2 as well as ME 07/2016 on incorrect setting and checking of a limit signal transmitter for monitoring the noble gas activity concentration for the stack exhaust air on 29 April 2016 in KKP-2. During the performance of the tests addressed in the above-mentioned reportable events, partly external personnel was involved. The following subchapters present the reporting of the events from the monthly reports of the Incident Registration Centre at the BfE. In addition, a short summary of the facts and circumstances of improperly performed tests at the Biblis nuclear power plant, Units A and B, [2] as well as of manipulations of documents on background checks for trustworthiness at the Jülicher Entsorgungsgesellschaft für Nuklearanlagen (JEN) [3] is given below.

2.1 ME 01/2015 on incorrect parameter setting for the start of concentration calculation after filter exchange at aerosol measuring points in KKP-1

During the weekly filter exchange at the aerosol activity measurements of the stack exhaust air monitoring, a too high parameter for the volume flow limit was determined. Due to the incorrect setting, the corresponding alarms at the control room could not have been triggered if the specified aerosol activities had been exceeded. This concerned the aerosol activity concentration measurements of the stack exhaust air monitoring system as well as the monitoring of the turbine building exhaust air. The reason for the incorrect setting of the volume flow limit was a misunderstanding of the significance of this parameter and the subsequent false modification in the corresponding test instruction. This error was noticed shortly after the modification in 2012. Incorrect settings made at several measurements were subsequently reversed, but not at the aerosol activity measurements affected in the present case. This was only recognised when the filter was changed in 2015 and then corrected.

The corresponding messages (alarms) were not available for the duration of the faulty parameterisation. Other measurements for aerosol activity monitoring, such as the pulse rate measurement, which can also indicate an increase in the activity concentration, and the balancing of activity discharges via the stack exhaust air by weekly evaluation of the aerosol filters were still available. The evaluation of the balance showed that the permissible discharge values had not been exceeded during the period of the faulty parameterisation.

2.2 ME 02/2016 on unavailability of an aerosol/iodine monitor for accident conditions in KKP-2

During a surveillance test, it was detected at the measuring channel of an activity measurement for aerosols and iodine within the activity monitoring system of the nuclear ventilation systems that the measured value of the tracer gas flow rate was not transferred to the measuring channel. The cause for this was first assumed to be an increased contact resistance of an isolating terminal, which is why it was replaced. In the further investigations, however, it was found that the power supply units of the measuring point were defect. This was caused by aged capacitors. The power supply units were replaced.

During the analysis of this reportable event (ME), manipulations in surveillance tests of the radiation/activity monitoring were detected. In a total of nine cases, including one of it in KKP-1, a surveillance test protocol was prepared and documented as free of findings without having performed the surveillance tests. For 15 further surveillance tests that have demonstrably been performed, a time discrepancy between the registered and the actual date of performance was found. During the investigation of the causes, it was identified that the superiors responsible for the execution of the work had not performed their function with regard to control, work planning and preparation of surveillance tests.

2.3 ME 07/2016 on incorrect setting and checking of a limit signal transmitter for monitoring the noble gas activity concentration for the stack exhaust air in KKP-2

During surveillance testing of a noble gas measurement for stack exhaust air monitoring, it was detected that a signal (exceedance of the daily limit value) had not been actuated. This was due to an incorrect setting of the voltage value of the limit signal transmitter. The incorrect setting was corrected. The incorrect setting had not been detected during several previous tests because the internal test compound of the measurement device, which generates a higher measuring signal, was used instead of the test compound specified in the test instruction. The incorrect limit setting was due to no update of the work instruction when the type of measurement device had been modified in the past.

The test was part of a series of repeated tests performed by the operator during the analysis of surveillance test manipulations on radiation measurement equipment. In the particular case, an increase of the noble gas activity would have been reliably detected due to an upstream limit set point of the measurement device concerned as well as the availability of a redundant noble gas measurement..

2.4 Tests at KWB not carried out properly

In 2015, the operator informed the supervisory authority that an employee of the Biblis nuclear power plant (KWB) of the radiation protection department had not properly carried out the tests as required according to the testing manual (*Prüfhandbuch* – PHB) [2]. The employee did not carry out necessary technical tests in 2014 and 2015. These were in particular related to tests of portable and laboratory measuring devices, tests of sealed preparations and dosimeter tests. The operator concluded that due to these safety and radiation protection related deficits in the performance of the tests no effects with regard to incorrect or incomplete recording of personal doses or discharges have to be assumed. This was confirmed by the authorised expert (technical support to the regulator)

The investigations conducted by the operator´s Internal Audit Department have revealed a need for further action beyond the verification and partial repetition of the tests carried out in 2014 and 2015. The following recommendations were issued:

1. In future, the inventory lists used for the test “sealed radioactive preparations” shall be provided with test notations for the respective preparations and those shall be also documented/archived as part of the test certificate.
2. Within the framework of the “evaluation of the test result” of the respective test certificates, it shall be determined whether a process for random verification of the actual performance of the respective tests has to be defined and mandatorily implemented.

2.5 Manipulation of documents on background checks at the Jülicher Entsorgungsgesellschaft für Nuklearanlagen (JEN)

It is prescribed by law that personnel employed in nuclear facilities must first be subjected to so-called background checks by the security authorities. Confirmation of trustworthiness is a prerequisite for access to a nuclear facility.

An internal JEN review revealed manipulations of documents on background checks. Due to these manipulations, persons were considered to have been checked for trustworthiness even though the security authorities had not carried out the checks. The Ministry of Economic Affairs of North Rhine-Westphalia, as the competent nuclear supervisory authority, was informed immediately.

The manipulations were carried out internally at JEN. The staff member responsible for background checks was then released from his duties. The extent of the manipulations was investigated. So far, manipulations of documents have been detected in several cases. There are no recognisable safety-relevant effects.

3 Assessment basis

The relevant requirements in the German nuclear rules and regulations as well as in relevant IAEA recommendations are the basis for the assessment of the issues dealt with here and the recommendations made in this respect, in particular

- Safety Requirements for Nuclear Power Plants [4],
- IAEA Safety Standards Series GSR part 2 “Leadership and Management for Safety” [5],
- KTA 1202: Requirements for the Testing Manual [6],
- KTA 1402: Integrated Management System for the Safe Operation of Nuclear Power Plants [7],
- Guideline concerning the proof of the technical qualification of nuclear power plant personnel [8],
- Guideline relating to the assurance of the necessary knowledge of persons otherwise engaged in the operation of nuclear power plants [9], and
- Guideline relating to the procedure for the preparation and implementation of maintenance work and modifications at nuclear power plants [10].

4 Consultation results

Based on the recommendations from GRS information notice WLN 2016/12 [1], recommendations were derived in the areas of quality assurance measures for surveillance tests, monitoring the activities of external personnel, prevention of faulty measures including deliberate wrong actions, and falsification of documents.

4.1 Quality assurance measures for surveillance tests

Some of the above-mentioned events were due to similar deficiencies in the performance of surveillance tests and in the evaluation of test results.

The surveillance tests are generally subject to the specifications in the testing manuals and in the quality management of the plants. KTA 1202 [6] contains regulations on the contents, structure, layout and preparation of testing schedules and test instructions. Nevertheless, the RSK identified optimisation potentials in connection with the events with respect to the verification of the test result (test certificate) by the operator.

In connection with the increasing digitisation of systems/components, the stored internal fault alarms should be assessed when testing these devices to determine whether their evaluation within the scope of the test is useful for achieving the test objective and, if required, this test aspect should be specified within the scope of the test (see GRS WLN 2016/12 recommendation 2).

In addition to the above-mentioned recommendation of GRS WLN 2016/12 focusing specifically on the surveillance tests of radiation protection instrumentation (readout and logging and resetting of internal system messages as part of the testing), the RSK considers it necessary to analyse this aspect for all test instructions and, if applicable, to implement it for all test instructions (recommendation 1).

In order to implement the four-eyes principle, the person responsible for testing defined in the operator organisation, or a competent person appointed by him, shall satisfy himself and confirm the proper performance of the test and the assessment of the test result independently of the person carrying out the test (own or external personnel) .

In recommendation 5 from [1], GRS formulated requirements for a quick check whether the test has been performed correctly by means of the accompanying demonstrable test documentation (records etc.).

In addition to this GRS recommendation, the RSK considers it necessary that, for the confirmation by the responsible person regarding test performance and assessment of the results, as required according to KTA 1202 [6] Section 3.5 (2), those documents shall be attached to the inspection protocol which enable those assessing the results to make a reliable assessment regarding the achievement of the test objective. This includes, for example, dimensional records, measurement records, process computer messages, recorder copies (photos), etc. The required documents should be specified in the test instruction according to the safety significance of the respective surveillance test.

Where it is not possible to carry out an assessment based on the documentation (e.g. where such documentation cannot be produced during the test), appropriate provisions shall be made to allow effective assessment. Possibilities for this are, for example, the evaluation of test-specific process computer queries, monitoring/surveillance during the performance of the test or a structured debriefing right after the test with the person that had performed the test. Such regulations should be defined test-specifically (recommendation 2).

4.2 Monitoring the activities of external personnel

The personnel involved in the events concerned were partly external personnel. A considerable number of external personnel are working in nuclear power plants, also equivalent to own personnel (in terms of task, function and responsibility). Ensuring that the external personnel also have the necessary qualifications for the commissioned activities and that the performed activities comply with the safety requirements is the non-delegable responsibility of the plant operator [11] and requires efficient management processes [4], [7], [9], [12].

Requirements for the qualification of external personnel are to be found in the nuclear safety standards, e.g. in the guideline relating to the assurance of the necessary knowledge of persons otherwise engaged in the operation of nuclear power plants [9] and in KTA 1402 [7] Section 5.9 (15): *"The requirements regarding qualification, knowledge and training of external personnel shall be in conformance with the task-specific requirements of comparable activities by plant personnel."*

Aspects to be considered in particular with regard to external staff can also be found in French studies [13]. Above all, the communication of experience feedback to external personnel and the assurance of a sufficient control density for checking the activities of external personnel before, during and after maintenance measures are aspects which were also identified as contributing factors for some of the events in the context of the events in German plants discussed at the beginning (cf. e.g. [1]).

To ensure that the qualification of external personnel intended for the respective work corresponds to the requirements of the regulations, it is necessary that their qualification can be verified (e.g. on the basis of documentation), that any existing gaps with regard to qualification and experience are identified and that these – where necessary – are compensated for by appropriate measures, e.g. supplementary training measures prior to deployment or by other measures such as monitoring and control by plant personnel.

In addition to the necessary technical competence, the behavioural competence of employees also contributes to a high level of safety culture. The HPO (**h**uman **p**erformance **o**ptimisation) training courses held in German-speaking countries focus on the work behaviour of the individual, teamwork, communication, pre-work briefing and debriefing, decision making as well as on-site monitoring and work inspection activities in order to avoid errors, thus supporting safety-oriented behaviour.

From the point of view of the RSK, the operators of nuclear installations should practice specific training measures to ensure safety-oriented behaviour (e.g. HPO training) not only for their own personnel but also for external personnel in addition to the requirements of the guideline relating to the assurance of the necessary knowledge of persons otherwise engaged in the operation of nuclear power plants [9]. In particular, the external personnel working as AvO[1] or VDA[2] should be integrated into the measures of the plant operator in the same way as the own personnel (recommendation 3).

[1] AvO - Aufsichtsführender vor Ort (on-site supervisor)
[2] VDA - Verantwortlicher für die Durchführung der Arbeiten (person responsible for the execution of the work)

4.3 Prevention of faulty measures including deliberate wrong actions

An essential element of the recommendations for reducing the probability of events occurring as a result of human errors is, in addition to the implementation of corresponding processes within the framework of the management system, that compliance with the processes and the quality of the actions of the personnel are ensured by an adequate control density.

This can only be ensured if the necessary resources are provided by the operator and if the superiors at all levels fulfil their duties of control within their scope of duties and responsibilities to the extent required.

IAEA GSR part 2 [5] states the following:

Managers at all levels in the organization, taking into account their duties, shall ensure that their leadership includes:

(a) Setting goals for safety that are consistent with the organization's policy for safety, actively seeking information on safety performance within their area of responsibility and demonstrating commitment to improving safety performance;
(b) Development of individual and institutional values and expectations for safety throughout the organization by means of their decisions, statements and actions;
(c) Ensuring that their actions serve to encourage the reporting of safety related problems, to develop questioning and learning attitudes, and to correct acts or conditions that are adverse to safety.

KTA 1402 [7], Section 6.2.1.3 "Process monitoring" contains further requirements for managers:

(1) All processes shall be monitored in order to enable an early detection of deviations from a) the specified procedural sequences, and b) the specified procedural results.
(2) Process monitoring shall comprise observing the procedural sequences as well as the activities undertaken in this context. Process monitoring shall be performed by the process supervisor, by the persons involved in the process and by executives at all hierarchal levels.

Insufficient process monitoring and inadequate monitoring of the activity or its results by managers has been a contributing factor in the events under consideration and it is therefore recommended that this aspect be given due importance in day-to-day work. Managers should be enabled accordingly. The corresponding time and personnel resources are to be provided (recommendation 4).

From RSK´s point of view, the efficient control of activities in the plant, in particular during maintenance and surveillance testing, is also an important contribution to the detection and prevention of deliberate wrong actions. In this context, it also appears necessary to sensitise the management personnel in the plants with regard to the aspects of fraud and counterfeit situations. Management personnel in the plants must be able to understand under which conditions people deliberately commit actions that are not in accordance with the rules. In addition, training should depict how deliberate wrong actions can be counteracted by appropriate management behaviour (recommendation 5).

4.4 Quality assurance of cross-plant document exchange

In connection with the deliberate falsification of documents confirming the trustworthiness of external company employees in a nuclear installation, it had to be clarified whether there are further processes in which safety-relevant certificates are exchanged across plants. According to RSK investigations, this is practiced, for example, within the framework of training courses for external personnel. Further details on this or other procedures and on measures against the potential misuse of such procedures are not known to the RSK. In the case of procedures concerning more than one plant or plant operator and involving an exchange of safety-relevant documentation, the RSK recommends ensuring that suitable procedures and measures against erroneous or deliberate manipulation of documents are specified in the management system of the plant operator (recommendation 6).

5 Summary

Based on a retrospective overall assessment of the surveillance process specific events with reference to GRS WLN 2016/12 [1] as well as events in other German plants, it can be stated that many of these events occurred in connection with surveillance tests and with maintenance activities or their preparation and performance. Against the background that in some cases also aspects of deliberate wrong actions or the falsification of documents occurred [1] [2] [3], these were also considered in this statement.

The RSK regards the insufficient control of operating and maintenance personnel activities as the dominant contributing factor to the event categories mentioned. Therefore, the RSK considers it necessary that the plant operators attach high priority to this aspect and ensure that the necessary control steps are implemented in the management system, that the necessary resources for technical and management personnel are available and that they are qualified accordingly. A high control density also reduces the probability of deliberate wrong actions or the omission of prescribed measures. In view of the events occurred at own plants and those observed in other countries, management personnel should be trained with regard to conditions favouring such behaviour and its recognisability.

The RSK has formulated recommendations for the improvement of test instructions and for the verification of personnel qualification as well as for the adequate control of personnel by the responsible technical and management personnel.

6 Recommendations

Quality assurance measures for surveillance tests

Recommendation 1:

In addition to the above-mentioned recommendation of GRS WLN 2016/12 focusing specifically on the surveillance tests of radiation protection instrumentation (readout and logging and resetting of internal system messages as part of the testing), the RSK considers it necessary to check this aspect for all test instructions and, if applicable, to implement it for all test instructions.

Recommendation 2:

In order to implement the four-eyes principle, the person responsible for testing defined in the operator organisation, or a competent person appointed by him, shall satisfy himself and confirm the proper performance of the test and the assessment of the test result independently of the person carrying out the test (own or external personnel).

In addition to GRS recommendation 5 from WLN 2016/12 [1], the RSK considers it necessary that for the confirmation of the execution and the evaluation of the test result by the responsible persons required according to KTA 1202 [6] Chapter 3.5 (2), those documents shall be attached to the test record which enable the assessor to make a reliable assessment of the achievement of the test objective. This includes, for example, dimensional records, measurement records, process computer messages, recorder copies (photos), etc. The required documents should be specified in the test instruction according to the safety significance of the respective surveillance test.

Where it is not possible to carry out an assessment based on the documentation (e.g. where such documentation cannot be produced during the test), appropriate provisions shall be made to allow effective assessment. Possibilities for this are, for example, the evaluation of test-specific process computer queries, monitoring/surveillance during the performance of the test or a structured debriefing right after the test with the person that had performed the test. Such regulations should be defined test-specifically.

Monitoring the activities of external personnel

Recommendation 3:

The operators of nuclear installations should practice specific training measures to ensure safety-oriented behaviour (e.g. HPO training) not only for their own personnel but also for external personnel in addition to the requirements of the guideline relating to the assurance of the necessary knowledge of persons otherwise

engaged in the operation of nuclear power plants [9]. In particular, the external personnel working as AvO or VDA should be integrated into the measures of the plant operator in the same way as the own personnel.

Prevention of faulty measures including deliberate wrong actions

Recommendation 4:

Insufficient process monitoring and inadequate monitoring of the activity or its results by managers has been a contributing factor in the events under consideration and it is therefore recommended that this aspect be given due importance in day-to-day work. Managers should be enabled accordingly. The corresponding time and personnel resources are to be provided.

Recommendation 5:

From RSK´s point of view, the efficient control of activities in the plant, in particular during maintenance and surveillance tests, is also an important contribution to the detection and prevention of deliberate wrong actions. In this context, it also appears necessary to sensitise the management personnel in the plants with regard to the aspects of fraud and counterfeit situations. Management personnel in the plants must be able to understand under which conditions people deliberately commit actions that are not in accordance with the rules. In addition, training should depict how deliberate wrong actions can be counteracted by appropriate management behaviour.

Quality assurance of cross-plant document exchange

Recommendation 6:

In the case of procedures concerning more than one plant or plant operator and involving an exchange of safety-relevant documentation, the RSK recommends ensuring that suitable procedures and measures against erroneous or deliberate manipulation of documents are specified in the management system of the plant operator.

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