
Note:
This is a translation of the RSK statement entitled
“Monitoring von Know-how- und Motivationsverlust und geeignete Maßnahmen zur Stärkung von Motivation und
Know-how-Erhalt in der deutschen Kernenergiebranche”
In case of discrepancies between the English translation and the German original, the original shall prevail.

RSK statement
(488th meeting of the Reactor Safety Commission (RSK) on 03.11.2016)

Monitoring of know-how and motivation loss and suitable measures for strengthening motivation and maintaining know-how in the German nuclear energy industry

1 Background

On 11 March 2011, the east coast of Japan was hit by a seaquake with a magnitude of 9 followed by a catastrophic tsunami. In particular, the impacts of the tsunami led to one of the most severe nuclear disasters in the history of civilian use of nuclear energy in the Fukushima Daiichi nuclear power plant. On 14 March 2011, the Federal Government and the Prime Ministers decided to impose a moratorium of three months during which all 17 nuclear power plants had to be subjected to a safety review, and the seven oldest facilities and the Krümmel plant were taken off the grid for three months.

At the latest since then, the use of nuclear energy for electricity generation has been declared undesirable in Germany in politics and society for the long term. The 13th amendment of the Atomic Energy Act entered into force in August 2011. This regulated the final shutdown for eight nuclear power plants and the phase-out of nuclear energy by 2022.

This decision to phase out nuclear technology almost abruptly changed the professional perspective of those working in the nuclear sector, in particular for the younger employees having lost their long-term professional perspective in the nuclear sector in Germany.

Against the background of this situation, the RSK adopted a memorandum at its 449th meeting on 12.07.2012, addressing the management staff of companies and organisations involved in the nuclear sector, but also policy makers and the media, and pointing to a “potential threat to nuclear safety by loss of know-how and motivation”. The purpose of the memorandum was to point out that the decision to phase out the use of nuclear energy may cause a loss of motivation of the staff in nuclear facilities and that, as a result of staff turnover, this may lead to a relevant loss of know-how and know-why both for the plant operators as well as for important manufacturers and authorised experts. In order to counteract such developments, additional efforts are needed to maintain the contribution of staff working in the nuclear sector – in particular in nuclear facilities – to nuclear safety. As essential features and prerequisites for the maintenance of nuclear safety, the memorandum mentions:

- *the deep sense of responsibility and the commitment of the persons working in the nuclear sector*
- *competent and motivated personnel*
- *recognition and appreciation of their work and respect for the employees*
- *development opportunities for professional careers*
- *fair and appropriate presentation to the public*

Since the publication of the RSK memorandum in 2012, further changes have taken place in the field of energy supply besides the phase-out decision, which are the reason for pursuing the aspects mentioned in the memorandum. These are, in particular, the economic situation of the electric power utilities, which is significantly worsening due to market conditions and the resulting changes in corporate structures. This, in turn, leads to impacts on companies and organisations working in the nuclear sector. According to empirical evidence, such changes require a professional change management in the companies and organisations concerned to avoid any adverse effects on the efficiency and reliability of a company.

2 Consultations

With request for advice of 23.10.2012, the BMU asked the RSK in response to the RSK memorandum to develop proposals for measures against a potential loss of know-how and motivation. At its 452nd meeting on 22.11.2012, the RSK commissioned the RSK Committee on REACTOR OPERATION (RB) to provide advice on this topic.

For the purpose of determining the actual state, the Committee RB decided to ask manufacturers, plant operators, authorised experts and supervisory authorities to describe in presentations their measures taken to prevent a loss of know-how and to maintain staff motivation. Following this, key organisations in the nuclear energy sector were invited by letter of 18.03.2013 to present to the Committee the respective strategy of their institutions to ensure sufficient know-how and motivation of their staff for the safe operation of the German nuclear power plants in the coming years within the framework of a presentation. From the 218th (04.04.2013) to the 223rd meeting (05.12.2013) of the RSK Committee RB, the following companies and organisations held presentations on the topic:

- AREVA GmbH,
- Gesellschaft für Simulatorschulung (GfS),
- Westinghouse Electric GmbH,
- VdTÜV e. V. (TÜV SÜD and TÜV NORD in a joint presentation),
- Ministry of the Environment, Climate Protection and the Energy Sector Baden-Württemberg (UM BW),
- Gesellschaft für Anlagen- und Reaktorsicherheit mbH (GRS), and
- VGB PowerTech e.V.

At its 224th meeting on 21.03.2014, the Committee RB held concluding consultations on the results of the hearings and adopted a first draft report to inform the RSK at its 225th meeting on 16.04.2014. After reporting on the results of the hearings at the 465th RSK meeting on 24.04.2014, the RSK asked the Committee RB to draw up an initial draft statement on the basis of the report to the RSK. From the 226th meeting on 15.05.2014 to the 239th meeting on 08.12.2015, the Committee RB prepared a draft statement. During this period, supplementary hearings were held in the Committee on the following issues:

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- ENSI presentation on safety culture from the authority's point of view in Switzerland (226th meeting, 15.05.2014),
 - GRS presentation on the development of a safety culture guide (*SiKu-Leitfaden*) (227th meeting on 24.07.2014),
 - report by the University of Duisburg-Essen on the loss of motivation and know-how from the perspective of work and organisational psychology (228th meeting on 19.09.2014),
 - VGB presentation on the results of the VGB safety assessment system (SBS) reviews since 2011 (230th meeting on 12.12.2014),
 - presentation of the results of a literature review by members of the Committee on appropriate measures and indicators in safety-critical business areas (231st meeting on 29.01.2015), and
 - exemplary presentation of a plant operator's indicator system by a member of the Committee (233rd meeting on 24.03.2015).

The Committee RB adopted the draft opinion at its 239th meeting on 08.12.2015. Subsequently, the RSK discussed and adopted the draft statement at its 488th meeting on 03.11.2016.

3 Outcome of the hearings

In order to assess the measures taken to maintain know-how and motivation, hearings and presentations were held by the organisations mentioned in which they presented the measures they had taken or planned against the loss of know-how and motivation.

According to the RSK's understanding, the term know-how includes both the knowledge of the construction and operation of the nuclear facilities and the handling of these facilities for all plant states ("know-how") as well as the knowledge of the respective design bases of the technical installations and the safety-relevant rules for operation ("know-why").

All presentations reflected a management perspective. The staff's perspective, e.g. in the form of staff surveys, was not presented.

Overall, the presentations were very heterogeneous. Thus, it was not possible to compare the contents presented or to bring them down to a common denominator. Therefore, the contents of the hearings were summarised in tabular form for the respective measures presented in order to provide an overview on a higher abstraction level.

It turned out that all eight organisations had addressed the loss of know-how, but only four explicitly dealt with the loss of motivation.

3.1 Measures to maintain know-how

The information provided by the organisations can be assigned to the following clusters:

- **Strategic personnel management**, this means e.g. qualitative personnel/qualification planning, continuous maintenance and updating of competence profiles, strategic personnel marketing¹ and recruiting, strategic personnel development,
- **Classical methods of knowledge management**, e.g. triad conversations², experience evaluations/incident analyses, refresher training/technical qualification, near-the-job training³
- **Informal measures**, e.g. on-the-job learning⁴, job enlargement⁵/job enrichment⁶
- **Strategic corporate and organisational planning**, i.e., above all, broadening of the range of services

In their presentations, six of the eight organisations intend to counter a potential loss of know-how through broadening of the organisational performance spectrum (see Figure 1), e.g. by acquiring orders from abroad. This is also seen as a measure to maintain motivation.

¹ The task of personnel marketing is to identify, in the context of the objectives of strategic planning and personnel planning, potentially suitable workers, to draw their attention to the organisation and the available jobs, to encourage them to apply for a job, as well as to retain those persons in the organisation in the long term who have been recruited by the organisation and proved to be suitable. Nerdinger, F.W., Blickle, G. & Schaper, N. (2011). *Arbeits- und Organisationspsychologie*. Heidelberg: Springer

² The triad conversation is a spatially and temporally limited conversation on a previously agreed topic in which three persons participate in specific roles voluntarily with the objective of passing on experience-based knowledge. From Dick, M. Triadengespräche als Methode der Wissenstransformation in Organisationen, <http://www.fhnw.ch/aps/ifk/projekte/abgeschlossene-projekte/Triadengespraech/triadengespraech>, downloaded on 23.08.2015

³ Near-the-job: Measures that take place in close proximity to the position in terms of space, time and contents, such as a learning at the workshop level or development workstations.

⁴ On-the-job: Measures that take place directly at the workplace during the execution of work, this means e.g. learning on-the-job as well as gradual changes in the work tasks, which lead to a change in the qualification.

⁵ Job enlargement: expansion of work activities by horizontal work steps and by combining partial work

⁶ Job enrichment: expansion of work activities by vertical work steps, such as planning and/or control

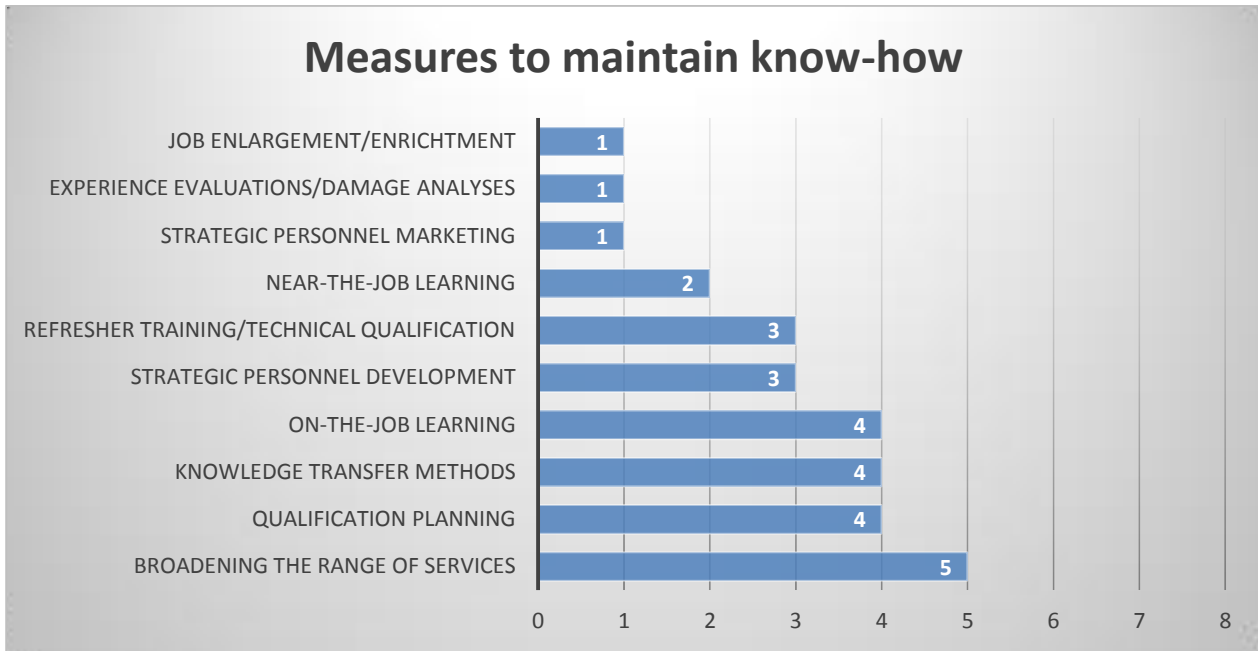


Figure 1: Number of measures mentioned to maintain know-how

Half (4) of the organisations mainly use informal methods, such as on-the-job learning and knowledge transfer methods, or qualification planning.

3.2 Measures against loss of motivation

The following clusters were obtained as measures against a loss of motivation:

- **measures related to extrinsic incentives** (offering job security, conducting events),
- **measures aimed at intrinsic incentives** (stressing importance of the task, workplace design),
- measures to maintain motivation in the **longer term** (more challenging tasks and new tasks),
- measures to maintain motivation in the **short term** (creating transparency and communicating importance), and
- use of **surveys** to assess the motivation.

The measures against motivation loss presented are shown in Figure 2. Three organisations assume that job security is sufficient to maintain motivation. Two organisations use creation of transparency as a measure for short-term maintenance and measures for long-term maintenance, such as assigning new challenging tasks.

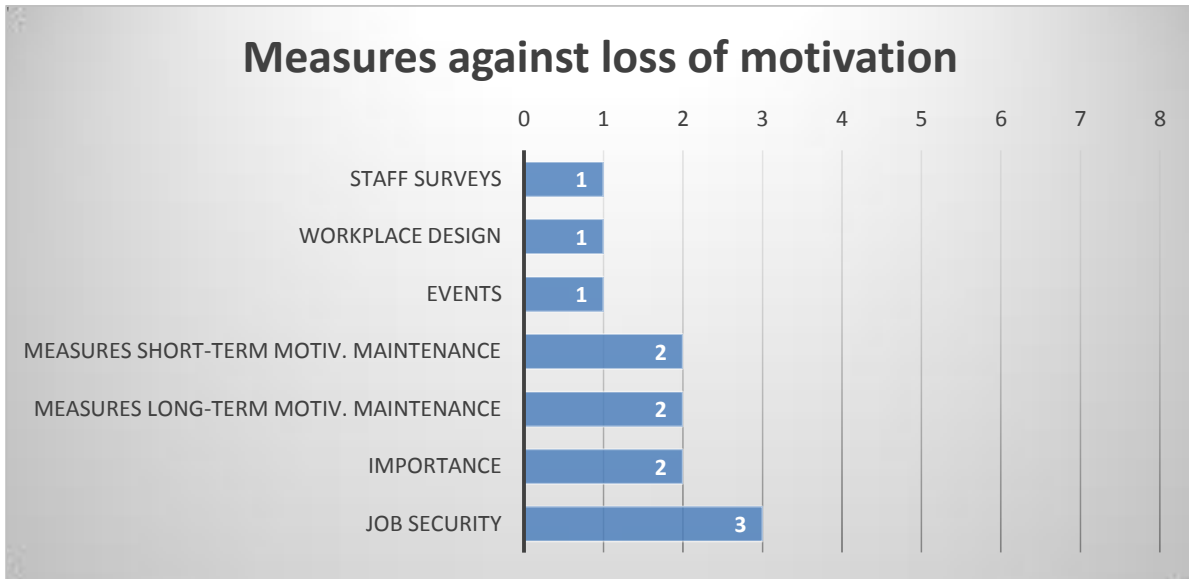


Figure 2: Number of measures mentioned against loss of motivation

3.3 Evaluation of the presentations

All organisations have expressed their views on the questions posed by the RSK and responded according to their understanding. During the evaluation of the presentations, however, it was found that some aspects which are important from an organisational psychology point of view have not been addressed.

In their presentations, none of the organisations dealt in detail with the availability or implementation of a strategic competence management to ensure the necessary know-how transfer, e.g. by continuously updating the competence profiles of the employees taking into account the changed boundary conditions. Competence management is an effective basis for the transfer and maintenance of know-how to show which know-how is at risk of being lost and by which concrete measures this is counteracted. The implementation and the effectiveness of measures taken can also be supported by using organisational statistics (e.g. development of staff turnover rates, duration of training for new staff, expenditure on know-how transfer and maintenance of know-how).

During the hearings, none of the organisations presented its management of the upcoming change processes.

The process theories of motivation relevant in terms of work and organisational psychology according to the state of the art in science and technology (S&T), theories of motivation, theories on commitment, on work satisfaction and further constructs relevant for change management, such as the “psychological contract⁷”, suggest that the phase-out decision and the other changes in the sector environment and in the established

⁷ Psychological contract = psychological construct that encompasses the implicit and not “written” expectations of employees regarding the relationship between employees and the organisation and which goes beyond what is legally regulated in the employment contract (Schalk & Roe, 2007), such as e.g. “diligence and commitment (or also loyalty to the organisation) will be rewarded” or “If I show flexibility, the organisation will also show flexibility to me” or the like.

electric power utilities would have to lead to a motivational change in response to the (unilateral) termination of the psychological contract (by the organisation as a result of a political decision) and consequently in terms of commitment and work satisfaction.

On the basis of the presentations given to the Committee, no conclusions can be drawn as to the extent to which the measures described include the fields of action described below in Chapter 4, which have proved to be effective in the field of work and organisational psychology.

In summary, it is therefore to be stated that it is the RSK's conclusion that the presentations of the organisations do not allow any reliable statements as to the extent to which the RSK's concerns expressed in the memorandum are countered with effective measures and as to the current situation in the organisations in this respect.

Since the knowledge and information available to the RSK indicates that in individual cases situation-specific "change management" processes are implemented but robust data regarding the effectiveness of such processes are not available, it was decided to refrain from more presentations for the time being.

Taking into account the state of information presented, in the following proposals, the RSK presents suitable measures against a potential loss of know-how and motivation in line with the BMUB's request for advice of 23.10.2012. These measures concern the two main fields of action – the maintenance of know-how and the maintenance of staff motivation as elements of the safety culture.

In the following, the RSK points out appropriate instruments which can support maintenance of motivation of the management and staff and the necessary transfer of know-how, thus ensuring the technical qualification of the personnel. These include, above all, an efficient "strategic personnel management" and professional management of change processes through a planned programme and project management as well as instruments to validate the effectiveness of the measures taken.

4 Measures to maintain know-how and motivation

4.1 Strategic personnel management

Strategic personnel management involves the implementation of quantitative and qualitative personnel planning and the further development or establishment of a strategic competence management. Strategic competence management is considered as a continuous process relating to the corporate and organisational planning process on the one hand and the strategy/planning process in terms of human resources on the other hand⁸. These processes must be adapted, above all, to such significant changes in the environment of an organisation as described above (e.g. higher staff turnover rates than in the past, changes in the economic conditions, etc.).

Strategic competence management includes the following:

- The description of competencies (knowledge, skills and attitudes) which are critical for success or, in the present case, for safety, i.e. a strategic requirements analysis based on quantitative and qualitative human resources planning. At the staff level, these are, in the present case, professional and methodological competencies as well as attitudes to safety. At the management level, additional competencies are required for the active support and implementation of a safety culture.
- Drafting of a competence development and competence maintenance catalogue based on the defined safety-critical competencies.
- Review of existing programmes and development of corporate-/organisational- and/or activity-related safety-critical competence maintenance measures.
- Regular and valid measurement of safety-critical competencies as a basis for personnel development activities and planning of strategically derived year-based qualification and maintenance measures, as well as communication to the participants.
- The systematic internal use of competence information for strategic corporate and organisational decisions, implementation, evaluation and transfer control of the measures.
- Control of the achievement of development and maintenance goals, control of the achievement of corporate and organisational goals, communication of one's own abilities as a company or organisation to the outside.
- Development of measures for internal and external personnel marketing (i.e., in the present case, measures to ensure staff loyalty and to prevent staff from leaving the company who is to be retained).
- Adaptation or new development of management tools such as employee interviews, interviewing tools, feedback processes.

⁸ Wottawa, H. (2004). Expertise im Kompetenzmanagement. In: L. von Rosenstiel, D. Pieler & P. Glas (ed.): Strategisches Kompetenzmanagement. Wiesbaden: Gabler.

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- Development of appropriate personnel development measures and trainings (based on the “systematic approach to training” (SAT)).
 - Needs analyses (based on quantitative and qualitative human resources planning) and determination of training needs (also in terms of time) in order to maintain appropriate skills and qualification of staff in the long term.
 - Taking into account the objectives and contents of the change in personnel management (adaptation of personnel selection criteria, assessments, incentive systems, training objectives).
 - Establishment of multipliers on site as a contact in case of problems.
 - Systematic and organised “mentoring” for workplace-specific knowledge transfer.
 - Review of the structural and procedural organisation (changed tasks, responsibilities, processes in the management system, etc.) and updating of the documentation.

4.2 Professional management of change processes

Change management through planned programme & project management:

- Planning and development of schedules for the orchestration of change management methods, short-, medium- and long-term sequencing of work packages, resource planning, budgets and milestones for communication, and interventions within the context of change management.
- Initialisation of learning processes and establishment of feedback in the organisation on the effects of change management processes.

Management of information & communication and integration of internal communication

- Short-, medium- and long-term planning of work packages, schedules, resources, budgets and milestones for the communication measures within the scope of the upcoming changes.
- Development of measures for downward, upward and horizontal communication.
- Planning of the measures on the basis of quality criteria such as relevance, precision, timeliness, and providing a vision.
- Adaptation of each communication measure according to sender, receiver/target group, channel/medium, message/content, desired effect and point in time.

Implementation of organisational diagnosis systems to support strategic personnel management and corporate and organisational development management

- Development and performance of a situation-based organisational diagnosis on the staff's perception and behaviour regarding the changes, e.g. with regard to safety culture, working atmosphere, trust, motivation loss, commitment and intention to leave (also as possible indicators of loss of know-how due to staff turnover), with the involvement of the staff.
- Adaptation of leadership models and leadership principles, development of new leadership roles.

4.3 Considerations on indicator systems

In the course of the consultations on the topic it was discussed which indicators could be suitable to identify a loss of know-how and motivation of staff in the various organisations of the nuclear industry and how the effectiveness of countermeasures can be verified.

With regard to indicators, a general distinction is drawn between so-called lagging indicators and leading indicators⁹. In the classic safety management approaches, there are lagging indicators, i.e. indicators that point to an event that has already happened. With a lagging indicator it could be possible to determine in retrospect whether there has been a loss of know-how or motivation. As possible already existing indicators which could act as lagging indicators, the database of the reportable events was discussed. However, on the basis of the data available in the database and on aspects according to the AtSMV (*Nuclear Safety Officer and Reporting Ordinance*) reporting form – in particular also due to the limited statistical data basis – at present, there is no evidence of a decrease in know-how and/or motivation or a positive change.

However, the RSK holds the view that there are lagging indicators which, due to a better data basis, are indeed suitable for recognising such changes. These are, for example, the development of the number of near-misses (minor events), of unsuccessful maintenance measures (rework), of licensing and expert opinion conditions not complied with yet, as well as turnover and sickness absence rates, etc. Further suitable and proven indicators can be found, for example, in IAEA documents [1, 2, 3] and in EU documents [4].

A so-called leading indicator, i.e. an indicator that precedes an event, is intended to anticipate and recognise changes (here: loss of know-how and motivation). Leading indicators are considered as part of the risk management. In the case of the leading indicators, a further distinction is again drawn between so-called monitor indicators (which are intended to represent the organisation's potential to operate safely) and drive indicators (which are intended as a measure of fulfilment of effective safety-related management activities). For assessing the loss of know-how and motivation in organisations in the nuclear sector, both drive indicators and monitor indicators could be suitable.

⁹ Reiman & Pietikäinen, 2012. Leading indicators of system safety – Monitoring and driving the organizational safety potential. *Safety science*, 50 (10), 1993-2000

Examples which could be applicable for the present problem are “competence management”, “work process management” and “contractor management” for drive indicators, as well as “work and safety motivation”, “understanding of safety” und “culture for safety” for monitor indicators.

Such leading indicators can also be used to carry out a supplementary staff survey. Examples of leading indicators for nuclear facilities can be found in EPRI documents [5, 6].

From the point of view of the RSK, leading indicators of motivation and know-how development are also the resources (temporal and financial) provided by the companies for personnel measures since empirical evidence shows that significant reductions in the expenses for replacing staff leaving the company and initial training and/or for maintaining technical qualification of the established personnel are early indicators of a potential loss of competence.

As a result of the discussions on indicator systems, the RSK summarises that there are indicators available – being also quite common in the field of nuclear technology – which allow identifying changes in staff motivation and know-how. From the presentations, however, it was not clear whether, and if so, which indicators are used in the companies to accompany the upcoming change processes and to assess the effectiveness of measures to maintain staff motivation and know-how.

5 Conclusions

The political framework and boundary conditions in Germany with regard to the further use of nuclear energy have not changed significantly since 2012. However, market-economic reasons have forced further changes to corporate structures in all the organisations involved (especially for manufacturers, plant operators and authorised experts). These are reasons to continue closely examining the measures to ensure the necessary motivation and to ensure the necessary know-how of the staff. The high-level know-how will still be required for operation until 2022, residual operation and the post-operational phase as well as for the dismantling of the nuclear power plants also in the long term. The concerns set out in the RSK memorandum of 12.07.2012 continue to exist since the shutdown of all nuclear power plants and other structural changes in the energy industry in Germany have led and will continue to lead to organisational adjustments for most of the organisations involved (manufacturers, plant operators, authorised experts and supervisory authorities).

With regard to the development of proposals for measures against a potential loss of know-how and motivation, as requested by the BMUB, the RSK draws the following conclusions:

The RSK holds the view that, further to the measures already in place, a specific action plan should be developed and implemented in the companies and organisations concerned for managing the changes associated with the phase-out decision and the changed economic conditions (i.e. a change management). The extent to which such a plan already exists or is being developed at the organisations concerned could not be assessed on the basis of the reports presented to the Committee. The RSK has therefore presented appropriate instruments which have been empirically validated in comparable situations and can be applied by the organisations. The effectiveness of change management measures introduced should be monitored by means of lagging and leading indicators. Recommendations on their application are given in Chapter 6.

These should include, inter alia, the implementation of the requirement stated in KTA 1402, Chapter 5.5, according to which organisational changes “shall be carefully planned and implemented by a systematic and comprehensible procedure in order to avoid any negative repercussions”.

From the point of view of the RSK, this also requires informing the staff about the changes and their necessity at an early stage regarding future perspectives, i.e. providing comprehensive information and conducting integrated corporate and organisational communication of the planned change measures with the staff affected.

Under the given conditions, the maintenance of staff know-how through strategic personnel management and specific measures in the facilities is an important aspect to ensure the safe operation of the facilities. A transparent and organised transfer of the required know-how in the facilities is an essential prerequisite for it. It should also be taken into account that the availability of qualified staff in external organisations is decreasing.

6 Recommendations

Recommendation 1:

The RSK recommends – if not already done – developing and implementing a specific action plan for the management of the changes associated with the phase-out decision and the changed economic conditions (i.e. a change management), taking into account the possibilities presented in Chapter 4. In doing so, it should be ensured that the opinions of the staff are also taken into account.

The situation in the facilities and the effectiveness of the measures taken by the organisations to maintain motivation and to ensure the availability of know-how required for the safety of the facilities are to be monitored. For this purpose, suitable analysis instruments (indicators) are to be implemented as described in Chapter 4.3.

Recommendation 2:

The RSK recommends establishing suitable instruments for systematically recording the necessary safety-relevant know-how in the organisation. This includes traceable documentation and continuous updating of the competence profiles of the employees adapted to the changed boundary conditions, and the provision of the necessary financial and temporal resources. The competencies (technical departments, experts for personnel development, etc.) available in the companies and organisations should be integrated into these processes. Given the changing framework conditions, a change to be expected in the availability of required specialist competencies in external companies and organisations (availability of expert support) is also to be taken into account.

7 References

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