

RSK STATEMENT

Definition of component failure postulates

08 September 2005 (386th meeting)

Within the framework of the update of the rules and regulations, the RSK set itself the task to review, assess and, where required, redefine the component failure postulates to be considered for analyses, as they are defined in the RSK guidelines, regarding the state of the art in science and technology.

Definition of terms, principles

Break

Integrity loss with an opening area equivalent to the cross section of the component. The prerequisite for such a failure is to reach the critical crack length.

Leak

Integrity loss of the component without reaching the critical crack length.

Postulate

In nuclear technology, the task of a postulate is to specify design requirements and, where required, requirements for safety analysis methods which are defined as enveloping for the scope to be considered. The postulates may indeed be very different, depending on the safety requirements to be fulfilled and the expected occurrence frequency of the event postulated.

Distinction is to be made between the terms “postulate” and “assumption” which can be referred to by those involved in the procedure in many ways for demonstrating that the respective requirements have been fulfilled, e. g. for the assessment by means of parameter studies.

The establishment of postulates may be required due to:

- the specification of an enveloping design requirement for complex technical processes or for reducing the diversity of individual safety demonstrations, or
- creation of design margins independent of the capability to determine the required boundary conditions transparent analyses.

The band width of type and content of the postulate is between parameters and events to be expected during the operating lives of plants and those not to be referred to for the design due to their expected low occurrence probability. Regarding the issue of appropriateness, the hazard potential also has to be considered, in addition to the probabilistic aspect, for the event postulated (violation of protection goals).

It is also characteristic for a postulate that it does not have to be physically consistent with other approaches or cause/effect relations. For postulates, attention has to be paid that the character of the postulate is not changed by interpretation at a physical/technical level.

The RSK states that for determining appropriateness it is required to list the existing postulates, to retrace their justification and to reformulate them, if necessary. In this context, it shall also be checked whether new postulates have to be defined or existing postulates can be dismissed (check for completeness).

Applicability of postulates

The validity of postulates and the reliability of their application often involve defined prerequisites. Only if these prerequisites are fulfilled, the postulate can be applied in the respective procedure. Accordingly, a postulate cannot be applied if the parameters or events to be expected during the plant lifetime establish requirements that go beyond the postulate.

Defined postulates have to be changed if

- the known prerequisites/assumptions applicable when the postulates were defined are no longer valid, or
- the assessment of potential effects on the protection goals change.

Failure postulates on pipes of the pressure boundary of the reactor coolant system

The RSK confirms the applicable specifications in the RSK guideline, Chapter 21.1 (1) and (2) with the addendum that it regards a limitation of the design requirements to leak cross-sections smaller than the double-ended break only as admissible if the components fulfil the requirements of the general specification “basic safety of pressure-retaining components” and, in particular, if the following prerequisites are given:

- Exclusion of conditions leading to failures due to corrosion mechanisms, as e. g. stress-corrosion cracking, flow-assisted corrosion and erosive corrosion.
- Exclusion of conditions leading to vibration-induced failures.
- Determination and knowledge of operational and specified loads and the actual component condition.
- Exclusion of conditions leading to failures due to not specified dynamic loads (e. g. water hammer, hydrogen explosion).

If these prerequisites are given it would be possible to determine the leak sizes to be considered for the design in each individual case by means of fracture-mechanical analyses under consideration of the possibilities to identify damages.

In terms of the “definition of an enveloping design requirement for complex technical processes or for reducing the diversity of individual safety demonstrations” (see chapter “Definition of terms, principles”), the RSK is of the opinion that for the design requirements, the postulate of a 0.1 A leak (longitudinal/transverse direction) represents an enveloping requirement.

Since regarding the issue of appropriateness of type and content, the hazard potential also has to be considered, in addition to the probabilistic aspect, for the event postulated (violation of protection goals), the postulates of Chapter 21.1 of the RSK guideline that go beyond it remain justifiably applicable.

Leak postulates for the detachment of insulation material

At the 320th meeting of the RSK on 16.09.1998, the Commission stipulated that the 0.1 A leak postulate may be applied for jet forces regarding the detachment of insulation material if the prerequisites for a break limitation are given.

The RSK confirms that the 0.1 A leak postulate may generally be applied if the prerequisites defined above for the admissibility of the limitation of leak cross-sections to be postulated are fulfilled, since the prerequisite of a postulate beyond it (2A) is not given due to the potential damage extent (violation of protection goals) for the following main reasons.

- For the reduction of the loads of the strainers and the requirement on the necessary suction head for the pumps, the measures stipulated in the instruction manual can be initiated in the short term so that the protection goals continue to be met.
- For determining the amount of insulation material detached, that special leak location was chosen which produces the most unfavourable consequences regarding strainer loading and effectiveness of emergency cooling. The major part of potential leak locations leads to a considerably smaller amount of insulation material.