Note:
This is a translation of the document entitled “Frageliste der ESK für den Stresstest für die Anlagenkategorien 1, 3 und 6”. In case of discrepancies between the English translation and the German original, the original shall prevail.

ESK list of questions regarding the stress test for facilities of categories 1, 3 and 6

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Introduction

By advisory request, the ESK was asked by the BMU to carry out the stress test for the nuclear fuel supply and waste management facilities. More details can be found in the advisory request itself and the answers provided to the corresponding questions posed in parliament (see annexes). Together with the BMU, the ESK has specified the facilities and installations to be examined in this stress test. There are marked differences between the facilities and installations with regard to their inventories, technical situation and licensing procedures. These differences have to be taken into account in the stress test procedure as well as in the assessment. The ESK has therefore applied an internal classification of the facilities and installations into facility categories.

The following list of questions serves as a basis for the performance of the stress tests by the ESK for the following facility categories:

- **Nuclear fuel supply facilities**: URENCO uranium enrichment plant at Gronau, ANF fuel element production at Lingen, (facility category 1 of the ESK-internal classification),

- **dry storage facilities for irradiated fuel assemblies and/or vitrified waste in storage casks**: twelve on-site interim storage facilities, Interim Storage Facility North (ZLN), Gorleben interim storage facility, Ahaus interim storage facility and Jülich interim storage facility (facility category 3 of the ESK-internal classification), and

- **other large nuclear waste management installations**: PKA, WAK, VEK, (facility category 6 of the ESK-internal classification).

Answers to the questions need to be provided for all the facilities mentioned.

General notes

- What is important for an understanding of the following questions – irrespective of the fact that all requisite safety demonstrations have been provided as part of the licensing procedures carried out for these facilities – is that the object of a stress test is to examine how the facilities will behave when

subjected to ***beyond-design-basis loads***. These are loads that are greater than those that were assessed for the design within the framework of the licensing procedure. Hence there are questions arising regarding the behaviour of the facilities when subjected to loads greater than the design basis loads postulated in the licensing procedure.

- Part of the stress test deals with the question of ***"cliff edge effects".*** A "cliff edge effect" occurs if a sudden rise in the radiological effects outside the facility is registered that is due to the failure of components or measures caused by a load that exceeds the design basis load.

- ***Precautionary measures or their failure*** are also the subject of questions. By analogy to the technical terms used in connection with nuclear power plants, precautionary measures are to be understood as those measures that prevent a certain failure event from occurring, e.g. because the failure is excluded due to special quality-assuring measures. In a stress test, on the other hand, it also has to be examined how the situation might develop should such a precautionary measure fail after all.

- ***Accident management measures*** are also the subject of questions. By analogy to the technical terms used in connection with nuclear power plants, accident management measures are to be understood as those measures that following the occurrence of a beyond-design-basis event sequence can still limit the consequences, either by mitigating intervention in the further sequence of events or by partial limitation of the release. Only those measures can be subsumed under accident management measures that have explicitly been planned in advance and which are laid down in corresponding instructions or can immediately be realised. Note: external disaster response measures are not to be understood as accident management measures.

- At the end of each complex of questions, information is provided as to what ***stress levels*** the ESK will apply for its assessment. Concerning the complexes of questions regarding "aircraft crash" and "gas cloud explosion", ***degrees of protection*** are indicated as a measure of assessment in correspondence with the stress test performed by the RSK.

- ***Assessment criteria*** of the ESK will be for all questions: a) Will the vital functions be maintained in connection with the different stress levels? b) What maximum effects are realistically conceivable in connection with the stress levels? c) Are cliff edge effects foreseeable and have they been considered? d) On which basis has the assessment been made and is it plausible and comprehensible?

- One important question is the reliability of the statements. Here, there will at any rate be ***different qualities of the bases on which statements are made***. It may be that verified documents from the licensing procedure are available that will also yield information about the situation with regard to the stress level. On the other hand, there is the possibility that the operator may be the only one who possesses detailed documents which have, however, not been examined by the authority. Possibly, there will be no elaborate documents at all but merely the possibility to make assessments on the basis of the expert knowledge available. Hence, for the ESK to be able to assess how reliable the statements that have been used for the answers are, it is necessary that information be provided in connection with the answers to the individual questions about the documents or considerations on which the answer is

based.

- Questions of physical protection are not considered in the ESK stress test.

Questions

A On earthquakes:

1 Was a seismic design considered in the licensing procedure?
What earthquake intensity was the facility designed to withstand?
Was the design according to DIN or KTA?
Have any earthquake-related expert opinions been prepared (seismological, structural); if so, what was the essential result?

2 Does the seismic design also rest on precautionary measures? If so, on which ones? What will happen if the precautionary measures fail?

3 How does the plant behave in the event of a beyond-design-basis earthquake (stress level)?
Are there any related studies? Are there any qualitative considerations on how the facility will behave in connection with this level or what damage mechanisms may occur? To what extent may precautionary measures fail or become ineffective in such a case?

4 Are there any considerations for the possible damage mechanisms in connection with the stress level that may be applied from other load cases? If so, what do they take into account?

5 Does the stress level include any interdependent combinations with other load cases that may occur as a consequential effect and have to be taken into account? (e.g. consequential fire)?

6 Are there any accident management measures provided? Can these still be carried out in the event of an earthquake according to the stress level? In what way is the feasibility at the stress levels influenced?

7 Are there any studies available that deal with the question of soil liquefaction in an earthquake at the site?

Basic level: the design earthquake or otherwise the seismic zonation according to DIN 4149.

Stress level: increase of the intensity of the earthquake by 1 compared with the basic level.

B On flooding

1 Against what high-tide levels (principle of annuality) has the facility been designed? Which measures are provided in this respect?
What conditions will there be in the event of a design flood within the grounds of the facility and on its access road?

2 Is the design against flooding also based on precautionary measures? If so, what are they? What will happen if the precautionary measures fail?

3 How does the plant behave in connection with the stress level for flooding (in excess of the design basis)? Are there any related studies? Are there any qualitative considerations on how the facility will behave in connection with this level or what damage mechanisms may occur (here, the failure of precautionary measures also has to be considered)?

4 Are there any accident management measures provided? Can these still be carried out in the event of a flooding according to the stress level? In what way is the feasibility at the stress levels influenced?

Basic level: the design basis flood.

Stress level 1: For sites located on rivers: a run-off that is higher by a factor of 1.5 compared with the design flood. For sites located near tidal waters: a flood that is one metre higher compared with the design flood.
In this context, consequential effects on the stability of dikes and other protective measures also have to be considered.

Stress level 2: For sites located on rivers: a run-off that is higher by a factor of 2 compared with the design flood. For sites located near tidal waters: a flood that is two metres higher compared with the design flood.
In this context, consequential effects on the stability of dikes and other protective measures also have to be considered.

Stress level 3: Risk has been/has to be excluded site-specifically.

C On heavy rain:

1 What heavy-rain events were considered in the design? What consequences ensue in this context for the facility? What measures are provided for such a case?

2 Is the design against heavy rain also based on precautionary measures? If so, what are they? What will happen if the precautionary measures fail?

3 How does the plant behave in connection with the stress level for heavy rain?
Are there any related studies? Are there any qualitative considerations on how the facility will behave

in connection with this level or what damage mechanisms may occur?

4 Are there any accident management measures provided? Can these still be carried out in the event of heavy rain according to the stress level? In what way is the feasibility at the stress level influenced?

Basic level: The design of the facility/installation against heavy rain corresponds to the rain yield $r_{5,5}$ according to DIN.

Stress level: The safety of the facility/installation will not be impaired even by heavy rain with a rain yield of $r_{5,100}$ according to DIN.

D On other weather-related events:

The other weather-related events have to be considered each for itself for the respective facility in question. What has to be considered on any account is:

- storms – also including hurricanes,
- hail,
- snow loads,
- sleet and
- lightning stroke.

It may be that due to local conditions there will be additional weather-related events that have to be considered.

(*Note: answers to be provided separately for each individual kind of weather-related event*):

1 Which of these events was the plant designed to withstand? What corresponding measures are provided?
What will the conditions within the plant grounds and the access road be like in these events?

2 Which weather-related events have to be additionally considered due to local conditions?

3 Is the design against other weather-related events also based on precautionary measures? If so, what are they? What will happen if the precautionary measures fail?

4 How does the plant behave in connection with the stress level, i.e. beyond the corresponding design provisions?
Are there any related studies? Are there any qualitative considerations on how the facility will behave in connection with this level or what damage mechanisms may occur?

5 Are there any accident management measures provided? Can these still be carried out in the event of

weather-related events according to the stress level? In what way is the feasibility at the stress level influenced?

Basic level: Corresponding design according to DIN.

Stress level: Load cases clearly beyond the corresponding design.
(qualitative consideration taking into account the corresponding possible damage mechanisms).

E On the loss of electrical power:

1 What safety functions or other important functions and systems are reliant on a supply of electrical power? *(Please provide full list.)*

2 How is the electrical power supply and, if any, the emergency/substitute power supply for these systems structured? (Explanation by the basic circuit diagrams or verbally; what is important is above all the clear presentation of which supplies are multiply or diversely available and which exist only once.)

3 *For facilities with emergency/substitute power supply:* For what operating times is the emergency/substitute power supply designed, including the supply with fuels and auxiliary supplies? What operator actions are necessary at what time to start up and maintain the emergency/substitute power supply? Are there any provisions for operation of the emergency/substitute power supply beyond the design duration?

4 *For facilities without emergency/substitute power supply:* Are there any plans or provisions for the re-establishment of the electrical power supply?

5 How will the plant behave in a longer-lasting total loss of offsite power and emergency/substitute power supply?

6 Are there any accident management measures provided? Can these still be carried out according to the stress level? In what way is their feasibility at the stress levels influenced?

Basic level: Design of the facility.

Stress level 1: Loss of the regular electrical power supply for three days.

Stress level 2: Loss of the regular electrical power supply for one week.

Stress level 3: Additional to stress level 2 loss of the emergency power supply for one day.

F On internal fires:

1 What internal fires were considered in the design? What consequences ensue for the facility? What measures are provided?

2 Is the design against internal fires also based on precautionary measures? If so, what are they? What will happen if the respective precautionary measures fail?

3 How will the plant behave in connection with stress level 1 for internal fires?
Are there any related studies? Are there any qualitative considerations on how the facility will behave in connection with this level or what damage mechanisms may occur?

4 Are there any accident management measures provided to limit the consequences? Are they still feasible in the event of an internal fire at stress level 1? In what way is their feasibility at stress level 1 influenced?

Basic level: Design of the facility.

Stress level 1: Fire lasting an hour longer than provided by the facility design.

Stress level 2: Due to the limited fire loads, fires lasting longer than provided by the facility design are generally not possible.

G On external fires:

1 Does the facility border on woodland areas and/or on built-up areas where increased fire loads exist and/or on transport routes along which larger fire loads (which ones?) are regularly transported?

2 What external fires were considered in the design? What consequences ensue for the facility? What measures are provided?

3 Is the design against external fires also based on precautionary measures? If so, what are they? What will happen if the respective precautionary measures fail?

4 How will the plant behave in connection with stress level 1?
Are there any related studies? Are there any qualitative considerations on how the facility will behave in connection with this level or what damage mechanisms may occur?

5 Are there any accident management measures provided to limit the consequences? Are they still feasible in the event of an internal fire at stress level 1? In what way is their feasibility at stress level 1 influenced?

Basic level: Design of the facility.

Stress level 1: Fire in the area bordering on the facility lasting an hour longer than provided by the facility design.

Stress level 2: Due to the limited fire loads in the area bordering on the facility, any fires or fires lasting longer than provided by the facility design are generally not possible.

H On aircraft crashes:

1 Have the effects of an aircraft crash on the facility been taken into account? If so, what aircraft crashes were assumed in the consideration or in the design? What consequences will ensue from the mechanical as well as the thermal loading ensuing from the events considered?

2 Does the facility lie in the approach path of an airport?

The assessment criteria for a postulated aircraft crash are divided into three degrees of protection. Here, a distinction is made between the mechanical (impact of the aircraft) and the thermal (kerosene fire) degree of protection in connection with a crash of an aircraft comparable to a Starfighter (degree of protection 1), load-time diagram according to the RSK Guidelines (Phantom) or a medium-sized commercial airliner (degree of protection 2) and additionally a large commercial airliner (degree of protection 3).

Mechanical degree of protection 1:
Maintenance of the vital functions upon the crash of a military aircraft of the Starfighter type.

Thermal degree of protection 1:
Maintenance of the vital functions at the postulated spillage and fire of fuels upon the crash of a military aircraft of at least the Starfighter type.

Mechanical degree of protection 2:
Maintenance of the vital functions at the load-time function according to the RSK Guidelines or a load-time function of a medium-sized commercial airliner.

Thermal degree of protection 2:
Maintenance of the vital functions at the postulated spillage and fire of fuels upon the crash of a Phantom or a medium-sized commercial airliner.

Mechanical degree of protection 3:
Design with the load-time function according to the RSK Guidelines as well as maintenance of the vital functions at or a load-time function of a large commercial airliner.

Thermal degree of protection 3:
Maintenance of the vital functions at the postulated spillage and fire of fuels upon the crash of a large commercial airliner.

I On blast waves

1 Has the facility been designed to withstand a blast wave? On what boundary conditions was the design based?

2 What effects have to be expected if a much stronger blast wave than one of the intensity provided for in the design occurs?

3 What amounts of explosive gases have to be expected in the surroundings of the facility or installation (gas cargo vessels, lorries or freight trains with gas freight)? At what distance?

4 For facilities with no special design: What damage may occur due to a blast wave if this cannot be excluded?

The assessment criteria for a postulated blast wave are divided into three degrees of protection.

Degree of protection 1:
It is ensured under the aspect of robustness that vital functions are maintained in the case of impacts according to requirements of the BMI Guideline on blast waves, even including any possible consequential damage and the possible loss of personnel as a consequence of the impact.

Degree of protection 2:
If a blast wave occurs that is more intense by 20% (pressure distribution curve) compared with degree of protection 1, the vital functions are ensured, even including any possible consequential damage and the possible loss of personnel as a consequence of the impact. Infrastructure destructions are taken into account here, also taking possible consequential damage into account. Accident management measures may be considered if these are designed against such impacts or can be obtained from outside the facility in time.

Degree of protection 3:
In the closer surroundings and at the site, stationary as well as temporary sources of explosible gases that have a release potential that poses a risk to vital functions are practically excluded.