Answers to questions raised in the report by Umweltbundesambt GmbH, Austria

In the context of the cross-border consultation on the postponement of the deactivation of the Doel 4 and Tihange 3 nuclear power plants

On behalf of the Federal Public Service Economy, SMEs, Self-employed and Energy

Under reference 2022/77251/E2/EIE (Ref. SCK CEN: CO-90-22-6049-00)

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1 Introduction

This document answers the questions raised in the Technical Opinion Report on the Environmental Impact Assessment (EIA) on postponing the deactivation of the Doel 4 and Tihange 3 nuclear power plants introduced by the Umweltbundesambt GmbH, Austria in the context of the cross-border consultation on this EIA (report: Fachstellungnahme Umweltverträglichkeitserklärung).

This document follows the numbering of questions as provided in the report and is only available in English.

Information on the EIA on postponing the deactivation of the Doel 4 and Tihange 3 nuclear power plants, the EIA full reports, the non-technical summaries and the consultation process can be found via following links (different languages):

https://economie.fgov.be/nl/themas/energie/energiebronnen/kernenergie/openbare-raadpleging-over-de

https://economie.fgov.be/fr/themes/energie/sources-denergie/nucleaire/consultation-du-public-sur-la

https://economie.fgov.be/de/themen/energie/oeffentliche-konsultation-zur

https://economie.fgov.be/en/themes/energy/public-consultation-life

2 Answers to questions

Questions related to *Procedure and Alternatives* (Chapter 3)

1) Do the conditions imposed in the EIA procedure have a binding effect on the subsequent procedures, in particular the nuclear procedure?

As described in the Environmental Impact Assessment (EIA) report (Paragrpah 1.3. Procedure) the EIA is carried out within the framework of the European EIA Directive, the Habitats Directive and the Birds Directive. After the public consultation and the other consultations as described in the EIA report (including the cross-border consultation) a report with an analyses of the responses will be issued and a bill (a written suggestion for a new law) will be *submitted to the parliament. The EIA report includes some non-binding, both radiological and non-radiological, recommendations to further follow-up and/or further reduce the environmental impact.*

In addition to the EIA and fully related to the nuclear procedure, also the Long Term Operation (LTO) strategy has to be followed according to the legally binding process of the Periodic Safety Assessment. In this context we can add that on 29 June 2023, the federal government and ENGIE Electrabel concluded a concrete agreement on the extension of the operating period of nuclear reactors Doel 4 and Tihange 3. Subsequently, on 20 July 2023, the Belgian nuclear safety authorities (FANC) submitted its expectations regarding nuclear safety to ENGIE Electrabel. The detailed expectations can be found on the website of the nuclear safety authorities (FANC): https://fanc.fgov.be/nl/dossiers/kerncentrales-belgie/langetermijnuitbating-lto-van-doel-4-en-tihange-3-tot-2035. It is now up to ENGIE Electrabel to carry out the necessary preparatory studies and to submit them to the nuclear safety authorities (FANC) for approval, together with an extensive action plan. The necessary safety improvements may be spread over time and must all be implemented by 2028. The FANC will ensure that priority is given to the work most important for nuclear safety.

2) In the unlikely event that D4/T3 are not restarted for an extended period of time (e.g. until 2029), what would be the impact of such a scenario on the power supply/security and stability of the grid in Belgium?

The answer to this question in terms of security of power supply is to be found in § 1.2.2 and § 1.2.3 of the EIA, mainly based on the findings of the Adequacy and Flexibility Study 2022-2032, published by Elia (the operator of the Belgian electricity transmission network) in 2021. This study does not consider the extension of the operations of Doel 4 and Tihange 3 as a given, and thus provides an answer to the question what the impact would be if all Belgian nuclear power plants would be closed (at the latest) in 2025, in line with the original Law of January 31, 2003.

According to the 2021 Elia report, an additional flexible production capacity of about 3,6 GW would be needed after 2025 in order for the system to be able to comply with the requirements in terms of adequacy and flexibility; by 2032 the capacity need would probably have increased to 4,6 GW. Those figures are based on the so called 'EU-SAFE-scenario', which takes into account, among other developments, an increased unavailibility of the French nuclear fleet.

As stated in the report, developments in neighbouring countries mean that import of electricity alone (which would be needed in any case) could not be counted on to fill the gap. Instead, Elia estimated that, given a number of assumptions, implementation of the Capacity Remuneration Mechanism could provide the necessary generation capacity. In the longer term, growth in renewable energy capacity would provide additional power. The winters of 2025-2026 and 2026-2027 would however still be critical.

Evidently, a lot has happened since publication of the Adequacy and Flexibility Study 2022-2032 in 2021. The war in Ukraïne and the continued problems with the French nuclear fleet created an uncertain context in which the Belgian government would not rely solely on the CRM-mechnism and the development of renewables.

Very recently (in June 2023), Elia published its Adequacy and Flexibility Study 2024-2034. This study does consider the lifetime extension of Doel 4 and Tihange 3 as a given, and as such does not describe what would happen if this extension would not occur. The 2023 Elia study does however list the changes that occurred in both supply and demand (at EU and Belgian level) since the publication of the 2021 study. On the supply side, the additional capacity contracted through the CRM-mechanism, the increased offshore wind ambitions (but slower implementation) in the Belgian part of the North Sea and the development of new interconnectors (to the UK and Denmark) are mentioned. On the demand side, it is noted that the electrification of society happens faster and earlier than expected. The result is a considerably higher additional demand, that, according to Elia, could however be covered (given a number of assumptions and conditions) by the combination of nuclear generation, CRM, renawables and increased import capacity. It is obvious that, should nuclear (expected to be able to provide up to 27% of the increase in capacity needs) not be part of the equation, the task of filling this gap would have been notably more difficult.

We understand the question on the stability of the grid to be related to the way the electricity system can cope with variations in demand and generation. Among other things, the variability and uncertainty of renewable and distributed generation is a potential source of uncertainty that increases the need for balancing tools and measures. The Elia (2021) study confirms that flexibility needs will increase in th run-up to 2032, as a result of the integration of variable renewable capacity (mainly wind power) into the system. Periods of 'over generation' (to be managed by storage and export) are expected to be mitigated with the nuclear phase-out. The analysis shows that over the period 2022 to 2032, there will be sufficient capacity installed in the system to cover the identified flexibility needs. This is expected to be the case under every scenario and sensitivity where the installed capacity mix fulfils the adequacy needs of the system. In other words, the nuclear phase-out by 2025 would, as assessed by Elia in 2021, not result in unacceptable imbalances to the system.

3) There are further nuclear power plant units at both sites that will be dismantled during the period of the planned LTE. What conditions laid down in the decisions apply to the plants being dismantled at both sites, against the background of the intended extension of operating life? Can it be ruled out, and if so how, that the dismantling of plants will not affect the intended lifetime extension of D4/T3?

As decribed in the EIA report (§1.2.1.4), the decommissioning process includes different phases: during the post-operational phase (the phase directly after the final shutdown of a reactor for industrial generation of electricity) the operations are still covered by the exploitation license because they consist of activities, such as the removal of nuclear fuel and industrial waste and the flushing and emptying of pipes, which already take place during the operational phase of the reactor. This phase is currently estimated for the Doel 3 and Tihange 2 nuclear reactors to last for 5 to 6 years and no dismantling activities are foreseen in this phase (only preparation for dismantling). This phase will consequently have no impact on the Life Time Extension of Doel 4 and Tihange 3. The next phase is the real dismantling phase. For the dismantling of any nuclear buildings (reactors, …) a specific exploitation license has to be obtained and published as a Royal Decree. Also an Environmental Impact Assessment has to be executed for the dismantling activities. Because the processes of obtaining dismantling licenses and EIAs for dismantling have just started, specific conditions related to the dismantling of the units in final shutdown in context of the intended extension of Doel 4 and Tihange 3 are not yet known in detail. Some common nuclear infrastructure on both sites (e.g., the radioactive effluent processing facilities) is of course essential during the extended operation of Doel 4 and Tihange 3.

4) In the absence of a firm agreement with the government, is it correct that a detailed plan for activities to support LTE for D4/T3 has not yet been developed? Since the list of required retrofits is not known at this time, it is difficult to determine the risks associated with a life extension or to assess the project in detail. Is it planned to carry out an EIA procedure again once the retrofits have been bindingly defined - in which the results of the required PSRs must also be included - so that the public concerned can assess the risks associated with an LTE?

In the course of 2022, when negotiations between the operator of the nuclear power plants, Engie Electrabel, and the Belgian government had started, in parallel, discussions were held with the nuclear safety authorities on the potential design upgrades, modifications and projects to be performed in order to be compliant with evolving nuclear safety requirements applicable in Belgium. These discussions resulted in a detailed and exhaustive view on potential design upgrades and other potential projects. This set of potential design upgrades and other potential projects formed, together with other information, such as works to be performed in the non-nuclear part of the unit, the umbrella scope of works considered to be performed to prepare for another 10 years of operation. This umbrella scope of works, as described in the EIA in section 1.2.1.1 is to be regarded to be bounding with regards to environmental effects and risks. As mentioned in the answer to question 1), on 29 June 2023, the federal government and ENGIE Electrabel concluded a concrete agreement on the extension of the operating period of nuclear reactors Doel 4 and Tihange 3. Subsequently, on 20 July 2023, the nuclear safety authorities FANC submitted its expectations regarding nuclear safety to ENGIE Electrabel. The detailed expectations can be found on the website of the nuclear safety authorities (FANC): https://fanc.fgov.be/nl/dossiers/kerncentrales-belgie/langetermijnuitbating-lto-van-doel-4-en-tihange-3-tot-2035

5) A time chart describing the EIA process, the PSR process, the determination of safety improvements based on current safety requirements, and the timeline for implementation of necessary improvements would be welcome - all in the context of the proposed LTE and associated administrative procedures.

Timeline EIA and PSR.pptx

Attached timeline gives indicative planning in line with the requirements from FANC and Royal Decree on safety regulations for nuclear installations of 30 november 2021 (also called KBVVKI / ARPSIN) for implementation of the actions within a timeframe of anniversary date of the unit + 3 years.

Questions related to *Spent Fuel and Radioactive Waste* (Chapter 4)

6) The EIA report states, "The permit application for the surface storage of category A waste in Dessel is in progress." What is the current status of the licensing procedures and the timetable for completion of the surface disposal site?

The Minister decided on 23 April 2023 to grant the permit to construct and operate a surface disposal facility for low- and intermediate-level, short-lived waste at the Dessel site in Belgium. This decision was published as a Royal Decree in the Belgian Official Gazette on 16 May 2023.

All documents relating to the license application for a surface disposal facility for category A waste in Dessel, can be found on the website of the Belgian Nuclear Regulatory Body FANC:

https://fanc.fgov.be/nl/dossiers/vergunningsdossiers/afgeleverde-vergunningen/oppervlakteberging-dessel

Construction of the first modules is scheduled to start in 2024. The disposal facility is expected to be operational in 2027.

7) The EIA indicated that the Dessel facility will be limited "not only in volume but also in radiological capacity of the repository," with limits set for specific radionuclides. Please provide the limit values for the facility in terms of total activity and per radionuclide (for critical radionuclides only).

The category A waste inventory and the long-term safety assessment results allow to establish a preliminary source term for the Dessel near surface repository. The activity content of any critical radionuclide in the preliminary source term corresponds to this radionuclide's theoretical radiological capacity ('operational limit' or OLI) of the repository as a whole. In the license application, a range is proposed within which the theoretical OLI of a critical radionuclide may vary (§6.4.5.3 of chapter 6 of the Safety Report[1]). The lower limit of this range is 0, the upper limit is called the 'disposal limit' ('bergingslimiet' or BLI) and is set by applying a multiplication factor of 3 to the activity levels of the source term. This multiplication factor allows to take into account uncertainties on the radiological characteristics of the waste yet to be characterised and the future waste. The BLI's for the 28 critical radionuclides are listed in Table 1.

Modifying the OLI of one or several critical radionuclides within the proposed range (0 to BLI) constitutes a non-important amendment. Should ONDRAF/NIRAS wish to set the OLI higher than the current BLI for one or several critical radionuclides, this necessarily also sets a new BLI and constitutes an important amendment, i.e. an amendment of the license as such. In both cases, the evaluation criteria used for the various scenarios considered in the long-term safety assessment must be respected for the full set of OLI's.

[1] https://www.niras.be/hoofdstuk-6-uit-het-veiligheidsrapport-voor-de-oppervlaktebergingsinrichting-van-categorie-afval

Table 1: Disposal limits (BLI's) of the 28 critical radionuclides.

Radio-nuclide	BLI [Bq]	Radio-nuclide	BLI [Bq]
^{108m}Ag	6.90×10^{10}	^{237}Np	2.55×10^{9}
^{241}Am	1.63×10^{12}	^{238}Pu	9.57×10^{11}
^{243}Am	4.92×10^{10}	^{239}Pu	2.81×10^{11}
^{14}C	2.19×10^{13}	^{240}Pu	2.96×10^{11}
^{41}Ca	6.93×10^{12}	^{241}Pu	3.18×10^{13}
^{36}Cl	6.06×10^{10}	^{79}Se	2.70×10^{9}
^{244}Cm	5.70×10^{11}	^{126}Sn	3.75×10^{9}
^{135}Cs	1.12×10^{9}	^{90}Sr	9.57×10^{12}
^{137}Cs	2.42×10^{14}	^{99}Tc	2.24×10^{11}
^{129}I	4.23×10^{9}	^{234}U	2.31×10^{11}
^{93}Mo	6.09×10^{10}	^{235}U	1.13×10^{10}
^{94}Nb	1.20×10^{12}	^{236}U	1.74×10^{11}
^{59}Ni	1.50×10^{13}	^{238}U	6.63×10^{10}
^{63}Ni	1.63×10^{15}	^{93}Zr	4.89×10^{9}

8) The projected radioactive waste generation does not appear to take into account any effects of the activities that will be required at D4/T3 to extend its operating life. It is known that there will be some specific LTE activities, but also specific activities related to safety improvements, including inspections, that could result in additional waste generation. Have you estimated how much additional waste could be generated in this process?

Reference to section 4.3.3 of the EIA Doel 4/Tihange 3. The indicated amount of estimated additional waste due to the LTO is given as 460 m³. This takes into account the preparation works for the LTO, the LTO projects and the operational activities.

9) When will the decision regarding reprocessing or direct final disposal be made?

There is no policy yet regarding spent fuel management on the long term. The reference scenario currently considered by Synatom (spent fuel owner) and the waste management organisation ONDRAF/NIRAS is direct disposal of all the Belgian spent fuel. This scenario serves to determine the provisions that are needed to cover the long term management of the nuclear fuel, including final geological disposal.

10) The EIA report states that "SNF will be stored underwater for at least 2 years." What is the average time that SNF is stored under water, i.e. in the SNF pool, at each site? What is the capacity of the individual pools at Doel 4, Tihange 3 and the common pool at Tihange?

As the pools of Doel 4 and Tihange 3 are quite large, for these units the average cooling time is between 5 to 10 years under water storage in the pools of the units. The pools themselves have a total capacity of fuel assemblies equivalent to +/15 years of production.

Questions related to *Long-Term Operation* (Chapter 5)

11) According to Belgian legislation, another PSR has to be carried out before the commissioning of the plants can be authorized. What is the planned schedule for the PRÜ? Has FANC already defined and/or approved the content of the required PSR?

The LTO will be carried out as part of the 4th PSR, in line with the recommendations / requirements from the Safety Authority. As such the PSR LTO program has been built around several subprograms, including Ageing, Preconditions, Design, Test & Inspections, Knowledge Competence & Behaviour and PSR. The PSR subprogram will use the different outputs from the other subprograms as input for a comprehensive PSR review which will conclude in a PSR Summary Report to be submitted to the Safety Authority not later then 1st July 2025 for Doel 4 and 1st September 2025 for Tihange 3, in line with the Belgian regulations for Periodic Safety Reviews.

12) Does Belgium intend to carry out analyses addressing problems of corrosive cracking of safety-related components as recently identified in French nuclear power plants? How is it ensured that the regulatory authority, on the basis of a timely available assessment of the PSR results and further analyses related to the intended LTO, will issue the necessary authorizations that would allow the intended start of the LTO to be met? 13) Will the Aging Management Program (AMP) be reviewed during its implementation (i.e., prior to commissioning of D4/T3 and after completion of the required measures), e.g., by IAEA SALTO?

Electrabel follows the recent problems regarding cracking in the French nuclear powerplants closely. Actions have already been taken to analyse and investigate possible issues. The results of the performed analyses and inspections so far, lead to the conclusion that the Electrabel NPPs are not confronted with the same problems.

We continue to follow the EDF operating experience and complementary analyses. Further investigations or inspections may follow if new information becomes available.

The analyses and inspection results have been discussed at different stages with the Belgian authorities.

The Belgian NPPs have a "Living Ageing Management Program" that ensures effective ageing management of the Systems, Structures and Components (SSCs) throughout their entire service life.

Therefore, it relies on a systematic approach for coordinating the following plant programs relating to the understanding, control, monitoring and mitigation of ageing effects of the SSCs: Maintenance, Monitoring and Surveillance, In Service Inspections, Chemistry, Equipment Qualification and Obsolescence Management.

The scope and implementation of this ageing management program is yearly assessed by the Belgian Safety Authorities.

In preparation for the Long Term Operation of Doel 4 and Tihange 3 a specific detailed ageing analysis is performed, which is also being presented for approval to the Belgian Nuclear Authorities.

14) It was reported that "Doel 4 and Tihange 3 largely meet the new FANC safety requirements that would apply after 2025, but a number of safety improvements are still required." Could you please provide a list of these safety improvements? Have these been considered in the analysis of the confining accident sequences for the EIA radiological impacts?

See EIA section 1.2.1.1. for the list of design upgrades considered.

These design upgrades have not yet been taken into account for the radiological consequence studies; the studies have been done based on the current design.

15) The EIA report does not include a description of the safety status of both plants, including the completion of the post-Fukushima safety improvements. Were all activities originally described in the NAcP for Belgium already implemented for Doel 4 and Tihange 3, or were there changes to the NAcP due to the fact that the units were scheduled to be shut down in 2025?

All the actions in the NAcP (National Action Plan post Fukushima) have been performed for Doel 4 and Tihange 3. There were no actions of the NAcP removed because of the decision to stop the units in 2025 (decision end 2020) and The Belgian regulatory body (FANC and its technical support onrganisation Bel V) confirms the closure of the stress-tests action plan. See link : https://afcn.fgov.be/fr/system/files/best-2020.pdf and link : https://fanc.fgov.be/nl/dossiers/kerncentrales-belgie/nucleaire-stresstests/verslagen

16) It was reported that several actions due from the 1st TPR "were not followed because the plants were scheduled to shut down in 2025." If D4/T3 do not extend their life, are these due? What are they and when are they to be implemented?

On page 160 of the TPR report 2017 from FANC (https://fanc.fgov.be/nl/system/files/tpr-nar-belgium.pdf), it is indicated that :

"In the framework of this TPR, no additional action or improvement has been identified by the Safety Authority for the overall ageing management program. The Safety Authority considers that on this topic the ongoing action plans set up in the framework of the last PSRs (2012-2015) or of the LTO for the first units, in addition to the actions already performed in 2017 by the Licensee arising from its self-assessment in the frame of the TPR, are sufficient to achieve a complete ageing management program."

In case D4/T3 lifetime is not extended, no additional action is required.

In case D4/T3 lifetime is extended for 10 years starting from 2025, the systematic and comprehensive ageing management approach implemented in the units that already benefited from an LTO (that is to say Tihange 1 and Doel 1&2) will be implemented in Doel 4 and Tihange 3. Such extension of this ageing management program of Tihange 3 and Doel 4 will be implemented following the studies that will be performed for the anniversary date of these units in 2025.

17) Given the difficulties in the availability of qualified nuclear personnel across the EU, how will the operator ensure the availability of resources for a) necessary remediation measures at Doel 4 and Thiange 3, and b) safe operation of the facilities for the period of 10 years thereafter?

- *Competence management is within Electrabel's Nuclear Generation Management System a systemized process. A periodic multidisciplinary evaluation of the status of critical competences is being carried out and the necessary mitigating actions are being taken in order to ensure the availability of critical competences, keeping evolutions in the operating context into account.*
- *The topic 'Knowledge, Competence and Behavior' is a separate and complete chapter integrated in the PSR process for the life time extension of D4 and T3 and is challenged by the safety authorities. Focus is being put on a clear employability action plan in order to retain and retrain the competences of internal staff and further reinforcing the organization with new recruits.*
- *In the scenario of a life extension of T3 and D4, 5 reactors will be shut down in the period 2022 and 2025 (two have already been shut down). This means qualified staff becomes available and can be redeployed on the 2 reactors that have a life time extension.*

Questions related to *Accident Analysis* (Chapter 6)

18) The DEC-B event (the CSBO sequence), which was used as the comprehensive sequence in the analysis of a radioactive material release, was not described in detail, so the description of the accident timing is missing, which is important because the Source Term is highly dependent on the actual timing of the release. Please describe the sequence of events in detail, including the timing and assumptions on which the analysis was based.

The radioactive releases to the atmosphere associated with the CSBO accident scenario for Doel 4 and Tihange 3 are calculated using MELCOR (mass of group of radionuclides during the Severe Accident sequences) and ASTEC (mass of radionuclides linked to iodine behaviour during the severe accident sequences). Releases are calculated for 10 days and consist of two pathways: one continuous relaese originating from a containment leak rate and discontinous releases via the contaiment filtered venting system (CFVS) when pressure builds up in the containment (several ventings are considered in the 10-day release period). For the calculation of the cross border impact (referred to as the Flexpart methodology) the release quantities are summed and assumed to be released conservatevily in one single period of 6 hours.

19) Within the CSBO accident sequence, especially depending on the triggering event , other SSCs in a plant may be affected, making it possible for an unfiltered release to occur simultaneously with a filtered release, e.g., due to contaminated intrusion or damage to an SG pipe.

As mentioned in the answer to question 18, apart from releases through the Containment Filtered Venting System (CFVS) also a continuous release is assumed due to a containment design leak (release during the whole accident scenario). For completeness we can add that the use of the CFVS is mandatory according to the exploitation license of Doel 4 and Tihange 3.

20) The CSBO was selected as the most critical (comprehensive) accident to use as the baseline for estimating transboundary impacts. What plant status was considered in the analysis of this sequence, the current status of the plants or a future safety updated status? Please provide information in this regard.

Current status of the plant is considered. The future design upgrades have not been integrated in the calculations.

Future design upgrades will ensure that the current state of the plant will not degrade, on the contrary the objective of design upgrades is to improve the safety performance of the plant.

21) Why is the CSBO sequence also a "comprehensive" event, even for the airplane crash, which by its nature (due to a jet fuel fire) is expected to have a very different impact on the facility than a CSBO event caused by extreme weather, for example?

Safety systems (including containment) are designed to withstand the effect of the impact of an airplane crash, induced fire and vibration induced by the airplane crash.

At the commissioning of Tihange 3 and Doel 4, the following USNRC Regulatory Guides applied: R.G. 1.70.8, R.G. 1.70. It is mentioned in the Safety Analysis Report that the bunkered structures are designed to withstand an airplance crash and, therefore, if they were to occur, the integrity of the emergency systems and systems containing significant quantities of radioactive products would be maintained, as these systems are protected by the bunkered structures.

In conclusion, the "design basis" events are not likely to lead to unacceptable radiological consequences.

22) The filtered venting system of the containment, which is one of the most important factors for limiting the effects of a release, is not described. The question is how effective it is for the retention of relevant radionuclides and how this effectiveness is proven (the EIA report states "it has a high effectiveness", but nothing more)?

The filtered containment venting system features a filtering solution (scrubber) and different filtration stages. It allows to reduce the aerosols and iodine releases. Guaranteed minimum decontamination factor for aerosols is 10 000 and guaranteed minimum decontamination factor for iodine (molecular and organic) is 1000.

23) What could be the source term of the most critical accident sequence in the event of a malfunction (e.g., bypass) of the filtered venting system?

Malfunction of the filtered venting system is not considered as the system is qualified for severe accident conditions, for the use after an earthquake, is not impacted by flooding as sufficiently high, can be operated during a CSBO event thanks to batteries and manual actions, is qualified for extreme winds, lightning, rainfall and snowfall. Furthermore, operation of the CFVS can be done from the main control room, from the filter control room or locally.

Questions related to *Accidents Involving Third Parties* (Chapter 7)

24) Can you confirm that all actions identified as necessary have been included in the NAcP and have now been fully implemented?

Regarding the National Action plan post Fukushima (also called BEST action plan), all required actions have been performed for Doel 4 and Tihange 3.

Questions related to *Cross-Border Effects* (Chapter 8)

25) The source term used in the dispersion modeling is not provided in the EIA report. Please provide the source term for the LOCA, the FHA, and for the envelope sequence (CSBO) in terms of

a) the release into the containment and

b) the release into the environment.

As discussed in the EIA report, Article 37 is the original document that provides the source terms used for the initial dispersion modeling of the releases and which remains globally applicable. In this document, conservative source terms were considered for the FHA and the LOCA scenarios. Original radiological results obtained considering these source terms remain bounding for any other design base accidents and remain bounding of any more recent internal re-analyses due to the original strong conservatisms taken in the evaluation of the original radiological impact that were more easy to execute at that time.

Although these source terms were slightly increased following the Steam Generator (SG) replacement and the introduction of 18 month-cycles, it was verified that the reassessed radiological impact, using the same methodology but with more refined values for parameters such as the atmospheric dispersion coefficients, did not jeopardize the compliance with the Article 37 conclusions.

The LOCA, FHA and CSBO total source terms to the environment (most important radionuclide groups) can be found in the EIA report, in table 64 for Doel 4 and in table 99 for Tihange 3. Detailed source terms are calculated using MELCOR (mass of group of radionuclides during the Severe Accident sequences) and ASTEC (mass of radionuclides linked to iodine behaviour during the severe accident sequences).

26) For dispersion modeling, the methodology is to use the exact weather data for each hour in 2020, which means that a total of 8784 calculations were performed. It is not clear how the integration was performed to obtain the values for the 48-hour discharge, for example.

The methodology used for the assessment of the transboundary impact is described in the EIA report in section 2.3.4.3. Radioactive releases have been always (for all transboundary scenario's/calculations) conservatively limited to 6 hours or less, even for scenario's with release durations of for example 10 days. However, the radioactive releases (consisting of up to six release periods of one hour) are always followed (transport, dispersion and deposition of released quantities) for 48 hours, using the meteorological data (ECMWF) corresponding to this 48-hour period. The 48-hour corresponds consequently to the calculation period, not to the discharge or release period. In summary: for every hour of 2020 a one hour release is considered followed for 48 hours transport, dispersion and deposition (=8784 calculations). Based on this, for scenario's in which –always conservatively- a six hour release was assumed, six consecutive one hour periods (always followed for 48 hours) are aggregated into a total of 8779 six hour periods to assess maximum dose and deposition values (see footnote 30 in the EIA) in the neighboring countries.

27) The impact assessment will be conducted for a period of 48 hours after the release (starting at the end of the release, which per se is expected to last 6 hours) and will be determined for the areas shown in Fig. 19. While this is obviously the most affected area, it is entirely possible that areas beyond Fig. 19, i.e., up to 1000 km, could be affected. Other recent EIAs on NPP life extension provided information on impacts in areas up to 1000 km from the source and included much more detail on estimated impacts, including deposition of e.g. Cs 137. Other similar EIAs also considered deposition over a longer period of time, for example.

The calculations are performed using two grid resolutions (see detailed explanation EIA 2.3.4.3) corresponding to the two areas shown in Figure 19 (inner box around Belgium, and full domain of Figure 19). The larger domain spans a distance from both reactors depending on the direction from around 600 km up to 1000 km (see as example the plume in left part of figure 20). Indeed, the plume - diluted and depleted (due to deposition)- will be transported outside this domain. It is also possible that the plume has not reached the boundaries of the large calculation domain in the 48 hours the plume is followed or it re-enters the domain after 48 hours. To guarantee that in all situations every location within for example a 1000 km distance is fully covered, both the calculation area and time should be increased significantly having an important impact on the total calculation time (or the calculation resolution, number of calculations, …). For this reason we have opted to report very conservative (highest potential impact over more than 8000 simulations) dose and deposition values. In addition, we have limited in the EIA the results to the neighboring countries of Belgium. From the calculations performed, it is in principle possible to give also results for the other countries (or part of countries) in the large calculation domain (full area of Figure 19), but results in the neighboring countries of Belgium can serve as an (again conservative) estimate of dose values and deposition values in these countries. For example, the values reported for Germany or Luxembourg can be considered as conservative for Austria.

28) Impairments as a result of severe accidents affect not only the population, but also the agricultural sector. In this respect, the depositions determined by analyses - also at a greater distance from the sites - would have to be considered with regard to the values applicable in neighboring countries, as well as in Austria. In Austria, for example, it is stipulated that environmental control measures are to be taken if the deposition exceeds 750 Bq, so that a negative impact above this deposition value is to be regarded as given.

Deposition levels are calculated for every location in the full area of Figure 19 (so up to 600 to around 1000 km distance from Doel 4/Tihange 3 depending on the direction). As discussed in the answer to question 27) we conservatively opted for reporting results of the maximum values over more than 8000 simulations for the neighboring countries. For example, the deposition values reported for Germany or Luxembourg can be considered as conservative for Austria (see Table 65 for Doel 4 and Table 100 for Tihange 3).

The reference to 750 Bq in the question is not fully clear to us. As shown in Table 18 of the EIA different levels apply to the free trade of food and feed products in the EU, expressed in Bq/kg (750 Bq/kg is a value for strontium isotopes in general food products). Table 17 of the EIA gives derived levels for ground contamination in Bq/m^2 used in Belgian context in which countermeasures for the food chain are possible. If the 750 Bq refers to 750 Bq/m^2 ground contamination of certain specific radionuclides in Austrian context the values reported for Germany or Luxembourg in Bq/m^2 (Table 65 for Doel 4 and Table 100 for Tihange 3) can be used to very conservatively estimate the potential impact of the different accident scenarios.