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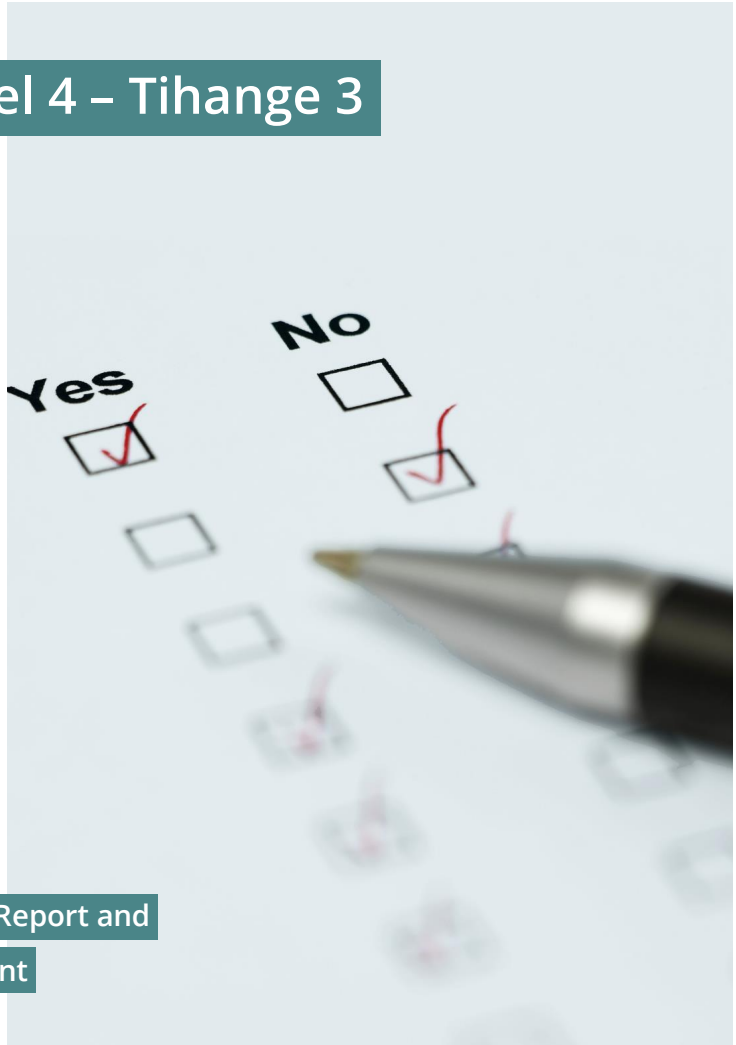
UVP Doel 4 – Tihange 3



Consultation Report and Final Statement

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Bojan Tomic
Franz Meister
Robert Muner

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

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Project Manager Franz Meister (Umweltbundesamt GmbH)

Author Franz Meister (Umweltbundesamt GmbH)

Robert Muner (Federal Ministry Climate Action, Environment, Energy, Mobility, Innovation and Technology)

Bojan Tomic (Enconet Consulting Ges.m.b.H.)

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CONSULTATION REPORT AND FINAL STATEMENT

This report present the findings and final recommendations gained, after a bilateral consultation took place at Brussels on 13 November 2023.

This consultation allowed to discuss remaining open questions, which arose after the first exchange of questions and answers in written form.

In light of the recent challenges regarding the energy supply, the government of Belgium reversed its earlier decision to proceed with a shutdown of reactors Doel 4 and Tihange 3 (D4T3) in 2025 and instead decided to proceed with the lifetime extension for a period of 10 years.

An agreement between the Belgian government and the operator ENGIE has been reached in principle, though not yet fully formalised (a change of a law is still outstanding). In order to authorise both plants to operate beyond the expiry of their current operating licenses (1st July 2025 and 1st September 2025 for D4 and T3, respectively), the periodic safety review (PSR) and related safety improvements as well as the Long Term Operation (LTO) assessments and related ageing management need to be implemented. An important element of the whole process is the development of the Environmental Impact Assessment (EIA) for the D4T3 life extension, which is needed in accordance with EU Directives and the Belgian law. Of particular relevance for the performance of the EIA is the decision of the European Court of Justice on Case C-411/17 related with the extension of the lifetime for the units 1 and 2 at Doel NPP in Belgium.

The EIA report for the lifetime extension for D4T3 for a period of 10 years has been developed in line with the requirements of the Espoo convention and applicable EU directives. It covers radiological and non-radiological impacts on the population and the environment, including on water, air, climate as well as human and non-human biota. The EIA report has been provided to all interested parties, Austria being among them, because the impact on the Austrian territory in case of a radioactive release from D4T3 in the period of extended lifetime cannot be excluded. Upon receiving the EIA report in Spring 2023, the Austrian expert team reviewed the EIA and documented the findings in the report (UBA report REP-0860, Wien, 2023) covering 5 topical areas, including severe accidents and transboundary impact. For each of those 5 thematic areas, a set of questions was raised, both to obtain additional information and to get clarification of issues that were not sufficiently clear. 28 questions were raised and delivered to the Belgian government. Austria received Belgian answers on 28th August 2023. Those were evaluated by the Austrian expert team, who found that useful additional information and clarification were provided, clarifying the situation on several important issues.

Nevertheless, some of the questions (more precisely 13), covering most topical areas but in particular relevant for the assessment of severe accidents and dispersion modelling/ impact on the environment were not answered in sufficient detail and/or some elements of were missing. In order to have full clarity on all

of the issues, including methods and approaches used in the preparatory analyses and in the EIA itself as well as in the conclusions reached in the EIA, the Belgian government organised the bilateral consultations meeting between the Belgian and Austrian experts that took place on 13th November 2023 in Brussels.

For the consultations, the Belgian government prepared a presentation that summarised the status on all of the 13 remaining questions. Moreover, the presentation was supported with additional information and clarification presented by the experts. Further, all clarifying questions raised by the Austrian delegation were thoroughly answered.

This bilateral consultations greatly helped in improving Austrian experts' understanding of how the EIA was developed, the methodology and underlying assumptions were used. The clarifications and additional information provided allowed a comprehensive (or even full) understanding of the course of action that Belgium intends to pursue in the lifetime extension of D4T3. In this, very important are the regulatory requirement and FANC focus on assuring safety during the LTO up to the final shutdown that is now expected to occur after 2035. The concept of the safety analysis is to be undertaken within the PSR and the implementation of resulting safety improvements (even though the full list of safety measures is not yet available – as the analysis would need to be completed first) was explained. Similarly, the LTO assessments and ageing management focused on required inspections, modifications of replacements were described including some details on the concepts and expected activities.

The severe accident sequences that were used for determining the source term(s), the dispersion analysis as well as the possible impact on Austria were all explained. On the dispersion analysis, the details on both the approach used (i.e. hourly weather and 6 hours release "window") as well as the calculated impact on the most affected area in Austria (Voralpengebiet, where the deposition due to rain is dominant) were shown. The consultation provided the necessary maps and clarifications, enabling a conclusion on the possible impact.

This report summarises the conduct and the conclusion of the bilateral consultation process on each of the areas of interest, focusing on the items and questions that were discussed. However, for a encompassing assessment for the Austrian review of the EIA for the lifetime expression of D4T3, this report should be considered together with the experts option as in the UBA report REP-0860, Wien, 2023.

PROCEDURE AND ALTERNATIVES

The EIA is developed to fulfil the legal requirements in the EU, as specified in the Espoo Convention and in the Environmental Impact Assessment Directive 2011/92/EU). The EIA as presented, including the clarifications provided, fulfils

the requirements. Nevertheless, the LTO for D4T3 is in a way a special case because unlike in other NPP lifetime extension EIAs, the LTO/PSR activities and other actions were not known at the time of the development of the EIA. Consequently, the "final" status of D4T3 as operated post PSR/LTO which (should has been) the basis for the EIA assessment is actually not known. Therefore, for the EIA, the status as of 31st January 2023 is the one modelled.

This situation has an impact on the EIA. In case that the extent of activities to be implemented is such that the facility changes significantly, the current EIA might not cover this new situation. In this respect, the Austrian expert team raised the question whether the conditions in the EIA procedure would have a binding effect on the subsequent procedures. The answer was that in accordance with Belgian law, the EIA is a non-binding procedure. What has been modelled/predicted in the EIA is not binding for any future activities or conditions. Furthermore, given that the final status of the PSR/LTO analysis and subsequent changes on D4T3 is not yet known, a clarification of the course of actions was provided. It was clarified that if there would be major changes to the D4T3 as compared to the situation on 31st January 2023, which was the cut-off date for the EIA (the modelling date), the Belgian law would require that a new (or updated) EIA has to be conducted. This was confirmed by the representative of FANC, who quoted a previous case when the EIA was updated (or redone) following a major change in a facility. These explanations gave comfort to the Austrian experts that, although not legally binding, if the facility were subject to extensive changes, a new EIA would be developed.

Another issue of concern in this area was related to the investigation of alternatives and availability of the electricity supply in case that there is a delay in D4T3 coming back on line. While the assessment of possible alternatives in the EIA is brief and is not supported by deeper analysis (the EIA report refers to various other studies that analysed the alternatives), the conclusion is that without the lifetime extension of D4T3, there will be a high risk to the security of supply in Belgium. This has been confirmed in the consultation meeting, where the eventual non-availability of the D4T3 units as of November 2025 (and even more for winter periods in future years) was termed "unimaginable". Nevertheless, as there was no (clear) timeline of the LTO activities presented in the EIA, Austrian experts understood that the D4T3 will be shut down in 2025, checked and modified and then restarted in 2027. As it was explained during the consultation meeting, the fact of the matter is that D4T3 will be shut down (for a few months) in 2025, then again during the summer of 2026, 2027 and 2028, to allow for all the work on the LTO to be completed. D4T3 will already restart on 1st November 2023, and then restart for a winter operation after each of the LTO outages. After 2028, a normal operation with standard refuelling outage schedules will commence. This is a plausible schedule. Although the details or the scope of neither the LTO related activities nor PSR related safety enhancements are known, a schedule where the work on necessary inspection and modification would be spread over 4 focused outages is considered reasonable.

The information obtained during the consultation also clarified the whole concept of the development and then implementation of the safety and other

measures during the PSR and LTO processes. When the explanation is combined with the timeline of planned activities as presented during the consultation, those were considered plausible.

LONG-TERM OPERATION

The EIA assesses the impact on the environment from the extension of the lifetime of the D4T3 units for a period of 10 years. The status of those two plants as of 31st January 2023 was used as a basis for the EIA. This cut-off date was needed because the actual extent of the LTO activities and the PSR are not known. The Austrian experts were interested to understand how the process of the LTO and PSR and implementation of safety and other modification requirements would be considered to assure comprehensiveness. The Belgian experts first presented the timeline of the performance of the PSR and LTO activities and then explained what the (general) concept of those are. The Austrian experts concluded that those are following international practices and regardless of the short time for the preparation and gradual implementation, there is no specific reasons to believe that those might have a negative impact on the safety of the D4T3 units. All of the activities, those required by the LTO analysis as well as those required from the 4th PSR are now to be completed by July 1st 2028 for D4 and by September 1st 2028 for the T3 unit.

Further discussion clarified that the concept of the 4th PSR for the D4T3 units is in compliance with the applicable Belgian regulations, in particular the Royal Decree of 30th November 2021, specifically its Article 14. This Decree makes it absolutely clear that unless there is a PSR, the result of which the regulator needs to agree with, there will be no operation beyond the current end-of operation date (1st July and 1st September 2023 for D4 and T3 respectively). Accordingly, the PSR is already being worked on, with the target for its submittal to FANC in January 2025, and expected approval by FANC in June 2025, which is still within the currently licensed operating time.

Austrian experts also inquired whether Belgium will invite a SALTO mission in order to independently verify the appropriateness of the LTO, against international standards and experience of the LTO. The answer was that while the IAEA missions have been invited in the past, there are no plans to invite a SALTO for the D4T3 LTO.

Planned design and safety improvements are described rather vaguely in the EIA. The EIA lists 3 modifications as important ones, those being the emergency centre, SNF pools and general improvements to cope with weather extremes including high temperatures. Upon Austrian experts' question during the consultation process, it was clarified that there were multiple improvements in the past and that there might be more resulting from e.g. verification against WENRA RL 2020. All of this was known, the fact of the matter is that D4T3 within their design basis included advanced safety features like bunkered system and

more recently added Filtered containment (FCV). Still no new information on planned new safety measures and their implementation was provided. It is understood that given that the PSR is under development and the LTO is being planned, no specific measures are yet available. Nevertheless, the Austrian experts believed that some of the "ideas" as what would need to be addressed to assure safe operation for the next decade must be circulated between the plants' operator and the regulator. While those are now likely to be preliminary and therefore difficult to share at the moment, sharing the list of improvements at a later date would be appreciated.

The Austrian experts wanted to know the status in relation with the activities that were expected to be implemented as per the Belgian action plan for the TPR, but due to the expected shutdown in 2025 were not. The clarification provided by the Belgian experts indicated that there were two actions, both related with the containment structure and their inspection including the instrumentation and methodology for inspection. With the planned lifetime extension for an additional 10 years, those actions will now be taken on board in the PSR and evaluated accordingly. In the view of the Austrian experts, this is reasonable and will lead to the safety improvements.

ACCIDENT ANALYSIS

The accident analysis and the transboundary impact assessment are, for the countries that are more distant from the NPP units, the most important element of an EIA. This is the case for the D4T3 and its impact on Austria. Therefore, special scrutiny was placed on the review and understanding of severe accidents that were used as the basis for the transboundary impact assessment within the EIA. In this area of interest were the selection of (enveloping) severe accident sequence, the steps and elements within a sequence and the results in terms of effects/source term(s) obtained of importance. In the D4T3 EIA three different accident sequences were used to assess the impact on the environment. Two of those are the design basis accidents (DBA), the LOCA event as well as a fuel handling accident (FHA). Then a long term station blackout with extremely limited operability of equipment, leading to a complete damage of the core and radioactive release from the containment and through the CFV was selected as a representative of the Design Extension Condition (DEC) category B (core damage, DEC-B). From the perspective of a country that is not in the vicinity of D4T3, the FHA scenario is of no interest. The LOCA scenario, which is a design-basis accident and the complete station blackout, which is the DEC-B scenario, are both of relevance. Somewhat unexpectedly, the LOCA scenario leads to a higher impact on Austria than the DEC B scenario.

For the DEC B accident sequence a complete station blackout accident (CSBO) was postulated. It would last for a long time (no restoration was envisaged within the 10 days window covered by the analysis, which is more conservative

than the Post Fukushima Stress Test analysis) with almost no equipment available, leading to the core meltdown and release through two pathways: the containment design leakage (0.25% of the containment volume per day) and the containment's filtered vent (FCVS). Both the DEC B and the LOCA scenario have been previously calculated i.e., not specifically developed with the EIA. In the case of LOCA, the scenario was assessed as a part of the preparation for the operation of the D4T3, as a part of the submittal needed under the EURATOM Article 37. This is relevant because the release estimates from that sequence were based on the deterministic and conservative (design bases) analysis, and represent the status of the plant as it was at the time of the original design. The DEC B scenario was evaluated in the frame of assessments needed to determine the compliance with WENRA RL 2014. Unlike the LOCA scenario, the DEC-B sequence was evaluated using the modern tools and approaches, and its results are the best estimate (rather than conservative, as in the design bases accident). Furthermore, the releases were estimated with the D4T3 being "as -is" now, meaning that new safety measures and equipment were not taken into account. The results indicate a dominant impact on the source term from the operation of the containment filtered vent as well as alternative containment sprays, plus the direct cavity injection for the T3.

During the consultations, Belgian experts explained in more detail both sequences of interest including specific steps and their timing, but also the way the calculations were undertaken. Austrian experts concluded that the sequences were well selected to estimate the impact of the environment. In a case of DEC B sequence, some more details were asked for and provided only verbally, because those were considered confidential. Nevertheless, Austrian experts could understand the main steps as well as the timing of each of those, including the operation of the CFV, which is of high importance for estimating the release source term.

The results of the analysis indicated that the LOCA release, which is a design-basis accident, is a significantly higher source term that the DEC B accident, which is an accident beyond the design basis. This is an unusual result. In case of DEC B, there is a damage/melt of the core leading to the releases from the fuel pellets. The LOCA sequence, in accordance with the applicable guides (RG 1.195), basically limits the release to the content of the gap release, which is also released in the DEC B sequence. The lower release to the environment in the DEC B sequence seems be driven by the functioning of CFV, which reduced unfiltered releases from the containment (during consultations, it was stated "both unfiltered release and CFV release are jointly limited to 0.25% of the containment volume"). The fact that some of the releases are filtered through CFV (in specific DEC B sequence, there are 3 openings of CFV each with ca 4-6 hrs duration) are not, in the view of Austrian experts, enough to explain significantly higher release in the LOCA sequence. Nevertheless, from the perspective of impact on Austria, it is not that relevant because even in the most conservative case (which in this case is the LOCA sequence) the dispersion model shows low impact.

TRANSBOUNDARY IMPACTS

In the terms of the outcome of the EIA, the transboundary impact of a radiological release is the most interesting parameter for Austria. While the EIA report provides good assessment of impact in immediate vicinity, which is particularly relevant for D4 as the border of the Netherlands is nearby, for locations further afield very little information has been provided. There are maximum doses and predictions for depositions for affected locations in the Netherlands, Luxembourg, and Germany, but not for e.g., Austria or other places that are more distant. The transboundary impact was assessed for the normal operations (effluents) and for all three selected accident sequences, two DBA sequences (LOCA and FHA) as well as for the DEC B sequence CSBO.

The transboundary impact was assessed using a detailed numerical step/sequence for each hour of the year 2020 and the estimation of the impacts from a release. It needs to be stressed that the release was summarised/truncated to a duration of 6 hrs, making it conservative. In a case of DEC B sequence, the sequence has been calculated for 10 days and there was a release on-going for the most of that time. While taking weather data over a year is generally expect to be a reasonable averaging of the variability of the weather, it is not necessarily providing the most conservative results. It is nevertheless recognised that other EIAs estimating the transboundary effect has used the same principles.

Apart from the immediate neighbourhood, the transboundary impact is calculated for rectangular area up to 1000 km distance, which includes parts of Austria. The dispersion was estimated using the LaGrange Ches Partikelmodell, with the actual historical numerical weather data provided by ECMWF, for every hour in 2020. The estimates for the Time integrated concentration (TIC) and for the integrated deposition were prepared. The EIA itself did not provide any graphical nor numerical representation as to how it would the expected impact on Austria be.

During the consultations, Belgian experts provided much more detailed results from the impact assessment, including specific values for most affected areas of Austria. With the extensive explanations by Belgian experts, it all became much clearer as to how the analysis was done, how the estimates are to be understood and finally what is the highest impact on Austria in case of a release from D4T3. An example of T3 release of aerosols was provided, where more than 50% of the simulated meteorological conditions are such that there is no impact on Austria. Detailed deposition maps were provided for a 1TBq releases (which allow for scaling up, as the releases in all sequences is at least 100 TBq). The maps that were shared with the Austrian delegation clearly show that the impact on any part of the Austrian territory is low. In addition to graphical presentation, the actual disposition on the territory of Austria has been provided. Related to the 6 hours-duration release of Iodine, the maximum deposition value is 753 Bq/m^2 and 276 Bq/m^2 in a case of a release from D4 and T3 respectively. As Iodine is a short-lived isotope, this deposition is somewhat theoretical, as it

would quickly disappear due to radioactive decay. Respective values for aerosols are 2.16 and 20.7 Bq/m^2, meaning that the values for deposited Cs 137 are well under the lower limit for the introduction of emergency protection measures (the initial monitoring per Austrian emergency plan is triggered with the radioactive deposition being over 750 Bq/m^2). From the figures presented and explanations offered by Belgian experts, it could be concluded that the effect on the Austrian territory due to a DEC-B release (the CSBO sequence selected) at D4T3 is low.

CONCLUSIONS

This leads to the final conclusion that no significant effect for Austria is expected as a consequence of the 10 years lifetime extension for D4T3 units.

It is further recommended to gain information on the results of the PRS and the LTO and the assessment to be performed by FANC. Special attention is given, if this would lead to additional measures, which were not presented as a prerequisite of the EIA assessment. In case that further measures are needed, which could be interpreted as major changes, the Austrian side would like to get informed if such measures would stipulate a further EIA procedure.

As presented during the bilateral consultation a final agreement between the Belgian government and ENGIE had not been reached yet. The Belgian side stated, that this agreement should cover pure financial arrangements related to the LTO of D4T3. If this arrangement would cover additional technical measures – not being presented in the EIA – the Austrian side would like to be informed about them.

ABBREVIATIONS

CFV	Containment Filtered Venting
D4T3	Doel 4 and Tihange 3
DEC-A/B	Design Extension Condition
DBA	Design Basis Accidents
ECMWF	European Centre for Medium-Range Weather Forecasts
EIA	Environmental Impact Assessment
FANC	Federal Agency for Nuclear Control
FCV	Filtered containment venting
LOCA	Loss of Coolant Accident
LTO	Long Term Operation
NPP	Nuclear Power Plant
PSR	Periodic Safety Review
SALTO	Safety Aspects of Long Term Operation of NPPs
TIC	Time integrated concentration
WENRA	Western European Nuclear Regulators' Association

umweltbundesamt

Umweltbundesamt GmbH
Spittelauer Laende 5
1090 Vienna/Austria

Tel.: +43-(0)1-313 04

office@umweltbundesamt.at
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