

Fortum Carlisle Limited

## Kingmoor ERF

### Assessment of Dioxins and Dioxin-Like PCBs Against Tolerable Weekly Intake

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## 1 Introduction

Fortum Carlisle Limited has submitted an Environmental Permit (EP) application to the Environment Agency (EA) for the Kingmoor Energy Recovery Facility (the Facility) in Carlisle. Fichtner Consulting Engineers Limited (Fichtner) prepared the Human Health Risk Assessment<sup>1</sup> (HHRA) which was submitted to support the EP application for the Facility. This Technical Note should be read in conjunction with the HHRA.

The HHRA assessed the intake of dioxins and dioxin-like PCBs against the Tolerable Daily Intake (TDI) of 2 pg WHO-TEQ/kg bw/day. As part of the duly-making process, the EA has requested that an assessment be undertaken against a new Tolerable Weekly Intake (TWI) of 2 pg WHO-TEQ/kg bw/week, which is equivalent to 0.286 pg WHO-TEQ/kg bw/day.

This technical note details the background and applicability of the TWI, and includes an assessment of the impact of dioxin and dioxin-like PCB emissions from the Facility using the TWI.

## 2 Background

The HHRA submitted as part of the EP application was undertaken against a TDI for dioxins and dioxin-like PCBs of 2 pg WHO-TEQ/kg bw/day. This value was set by the Committee on Toxicity (CoT) and has been taken from the 2009 EA Science Report "Human health toxicological assessment of contaminants in soil"<sup>2</sup>. The TDI of 2 pg WHO-TEQ/kg bw/day has subsequently been used as the assessment criteria in HHRAs in the UK.

### 2.1 Derivation of new TWI

The European Food Standards Agency (EFSA)'s expert panel on Contaminants in the Food Chain (CONTAM) carried out a review of the risk to human and animal health from dioxins and furans in food and feed, publishing a Scientific Opinion in June 2018 which was published in the European Journal on 18 November 2018. CONTAM recommended a tolerable weekly intake of 2 pg TEQ/kg bw/week.

The justification for the new TWI is that this is protective against effects on semen quality, based on a single scientific study – the Russian Children's Study<sup>3</sup>. This study enrolled 516 boys aged 8-9

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<sup>1</sup> Fichtner ref S2856-0320-0010SMN

<sup>2</sup> Human health toxicological assessment of contaminants in soil - dioxins, Science Report - Final SC050021/SR2, Environment Agency, 2009

<sup>3</sup> A Longitudinal Study of Peripubertal Serum Organochlorine Concentrations and Semen Parameters in Young Men: The Russian Children's Study, Minguéz-Alarcon et al, 2017, Environmental Health Perspectives

years. Ten years later, when the participants were aged 18-19, semen samples were obtained and analysed. A total of 133 of the 516 boys originally enrolled completed the study. The study concluded that “Higher peripubertal serum TCDD concentrations and PCDD TEQs were associated with poorer semen parameters”, but that “Serum PCBs, furans, and total TEQs were not associated with semen parameters.” Based on the study, the EFSA concluded that exposure to dioxins at the levels found in the study can affect reproductive development. The EFSA derived the new TWI from the critical level in this study by modelling the build-up and decline of dioxins in children through their life, assuming (amongst other assumptions) 12 months of breastfeeding and an intake of 800 ml per day of breast milk.

## 2.2 Applicability of new TWI

The Scientific Opinion recommending the new TWI was discussed at an Information Session on 13 November 2018. UK representatives participated in this session and submitted comments in advance which had been prepared by the CoT following a meeting on 23 October 2018. The CoT made a number of criticisms of the EFSA approach, including:

- the study did not contain a discussion on the possible explanation for the observed effect;
- while human data should be used to establish an HBGV (health-based guidance value), the CoT was unable to conclude that basing the HBGV on a single study was robust; and
- the applicability of the TWI to the whole population was questioned by the CoT.

Furthermore, the commentary on the Russian Children’s Study from German representatives at the Information Session stated that the study was undertaken “in the vicinity of a chemical manufacturing plant which has led to an extensive contamination of the environment with special pattern of dioxins, but also with organochlorine pesticides, lead and probably other compounds with shorter half-lives not detected in the study.” This has implications for the validity of applying the results of the study to the wider population.

The CoT discussed the Opinion again in its meeting on 17 September 2019. The discussion paper for the meeting stated “A significant reduction in the TWI for dioxins and dioxin-like PCB’s would mean that a significant portion of the population would exceed the safe exposure levels and some may therefore be experiencing adverse effects related to these compounds. Significant efforts would be required in order to reduce current exposures.” The CoT was asked “Do the Committee agree that the TWI established by EFSA is justified given the available data?” The minutes of the meeting state that Committee neither endorses or dismissed the Opinion.

The EFSA’s statement on the Opinion concludes “The European Commission and EU Member States will discuss risk management measures following EFSA’s scientific advice to ensure a high level of consumer protection.” Fichtner are not aware of any records which confirm that these discussions have taken place. Furthermore, the UK government has not published guidance on whether this standard should be applied.

Based on the above, the new TWI remains a recommendation by the EFSA’s CONTAM and has not been adopted as an assessment criterion for the protection of human health by either the EU or the UK government. As such, the most recent published guidance on the tolerable intake of dioxins and dioxin-like PCBs remains the EA Science Report published in 2009.

However, an assessment of the impact of the Facility against the new TWI has been undertaken, as requested by the EA.

## 3 Assessment Against TWI

### 3.1 Assessment methodology

As the new TWI is the same as the current TDI, assessing the results of the HHRA against the TWI will increase the predicted impacts sevenfold as a % of the assessment criterion.

The HHRA considered the impact of emissions from the Facility at 15 sensitive receptor locations which were categorised as either 'residential' or 'agricultural'. Residential receptors represent a known place of residence. Agricultural receptors represent an operational farm within the study area. In addition, a receptor has been assessed at the point of maximum impact to assess the theoretical maximum impact of the Facility. This point lies within the Kingstown Industrial Estate and is neither inhabited nor used as farmland.

As a conservative measure agricultural receptors consider the ingestion of dioxins and dioxin-like PCBs from home-grown produce, eggs, poultry, pork, beef, and milk, regardless of whether the farm is arable, pastoral or mixed.

The assessment added the contribution from the Facility to the Mean Daily Intake (MDI). If the overall intake is below the TDI or TWI (as applicable), then no significant health effects are expected and the impact of emissions from the Facility is not significant.

### 3.2 Results – at the point of maximum impact

The results of the assessment at the point of maximum impact using the TDI and the TWI are presented in Table 1. Any exceedances of the TDI/TWI are highlighted.

Table 1: Intake of Dioxins and Dioxin-Like PCBs – Point of Maximum Impact

Receptor Type	MDI		Process Contribution		Overall	
	% of TDI	% of TWI	% of TDI	% of TWI	% of TDI	% of TWI
<b>Adult</b>						
Agricultural	35.00%	<b>245.00%</b>	6.66%	46.59%	41.66%	<b>291.59%</b>
Residential	35.00%	<b>245.00%</b>	0.15%	1.06%	35.15%	<b>246.06%</b>
<b>Child</b>						
Agricultural	90.65%	<b>634.55%</b>	9.40%	65.79%	<b>100.05%</b>	<b>700.34%</b>
Residential	90.65%	<b>634.55%</b>	0.47%	3.31%	91.12%	<b>637.86%</b>

As shown, the MDI (i.e. existing intake) is significantly in excess of the TWI for both adult and child receptors. In all cases, the contribution from the Facility is below the TWI, so the exceedance of the TWI is due to the existing intake of dioxins and dioxin-like PCBs in typical diets.

In addition to the above, the ingestion of dioxins and dioxin-like PCBs by an infant resulting from emissions from the Facility, considering the breast milk pathway and based on an adult agricultural receptor at the point of maximum impact of emissions from the Facility feeding an infant, is 1.13 pg WHO-TEQ / kg-bw / day which is 56.5% of the TDI and 395.7% of the TWI. For a residential type receptor this is only 1.07% of the TDI and 7.5% of the TWI.

As shown, the intake by an infant resulting from emissions from the Facility would exceed the TWI, based on an adult agricultural receptor at the point of maximum impact feeding an infant. This is a

very worst-case assessment. To assess the likely impact of emissions from the Facility, consideration has also been given to the maximum impact at an identified receptor location.

### 3.3 Results – maximum impact at a receptor

The following table outlines the impact of emissions from the Facility at the most affected receptor (i.e. the receptor with the greatest impact from ingestion and inhalation of emissions from the Proposed Development) (R2 – Gearshill Farm). This receptor has been classified as an agricultural receptor, which is conservative as it assumes that a significant proportion of the diet of the receptor is sourced from the receptor point assessed, including meat and milk products. In reality, people in the UK tend to source their diet from a wide geographical area.

Table 2: Intake of Dioxins and Dioxin-Like PCBs – Maximum Impacted Receptor

Receptor Type	MDI		Process Contribution		Overall	
	% of TDI	% of TWI	% of TDI	% of TWI	% of TDI	% of TWI
<b>Adult</b>						
Agricultural	35.00%	<b>245.00%</b>	0.74%	5.19%	35.74%	<b>250.19%</b>
<b>Child</b>						
Agricultural	90.65%	<b>634.55%</b>	1.05%	7.33%	91.70%	<b>641.88%</b>

As shown, the contribution from the Facility at the maximum impacted Facility is much lower than at the theoretical maximum impacted receptor presented in Section 3.2. In addition, the intake resulting from emissions from the Facility is a small percentage of the existing intake, being 2.1% of the MDI for adult receptors and 1.2% of the MDI for child receptors.

The ingestion of dioxins and dioxin-like PCBs by an infant resulting from emissions from the Facility, considering the breast milk pathway and based on an adult agricultural receptor at the maximum impacted receptor feeding an infant, is 0.126 pg WHO-TEQ / kg-bw / day which is 6.30% of the TDI and 44.1% of the TWI.

While the intake of dioxins and dioxin-like PCBs by an infant at the maximum impacted receptor is below the TWI, it is an order of magnitude higher than the intake for adult and child receptors. The breast milk intake is based on the following conservative assumptions:

- The Facility continually operates at the maximum permitted emission limit for dioxins and dioxin-like PCBs;
- Exposure duration of infant to breast milk is one year;
- The adult agricultural receptor sources a large proportion of their food from the affected land (i.e. from Gearshill Farm), including milk and meat products.

A review of satellite imagery of the land surrounding Gearshill Farm indicates that the farming undertaken is predominantly arable. Therefore, this assessment is highly conservative and the intake is likely to be much lower. Table 3 presents the effect of excluding locally-sourced pork, beef and cows' milk from the assessment of the impact at Gearshill Farm.

Table 3: Breast Milk Intake of Dioxins and Dioxin-Like PCBs – Maximum Impacted Receptor

Scenario	Infant breast milk intake of dioxins and dioxins-like PCBs	
	As % of TDI	As % of TWI
Fully agricultural	6.30%	44.1%
Excluding pork	6.11%	42.8%
Excluding beef	4.85%	34.0%
Excluding cows' milk	1.81%	12.6%
Excluding milk, beef and pork	0.17%	1.17%

As shown, the exclusion of the cows' milk ingestion pathway has by far the largest effect on the intake of dioxins and dioxin-like PCBs by a breastmilk-fed infant receptor. When milk, beef and pork sourced from the receptor point are excluded, the contribution from the Facility is just 1.17% of the TWI at Grearshill Farm. This is much more likely to be representative of the actual impact of the Facility, but still retains the conservative assumption that the Facility continually operates at the maximum permitted emission limit for dioxins and dioxin-like PCBs.

Furthermore, the intake of dioxins and dioxin-like PCBs in infants is elevated due to the low bodyweight and relatively high concentrations in breast milk. However, the duration of exposure is short and does not significantly affect average lifetime exposure.

## 4 Conclusions

Fichtner has reviewed the background and applicability of the new TWI and concluded that the evidence underpinning the TWI is not conclusive, and neither the EU nor the UK government has adopted the TWI as an assessment criterion. Nonetheless, Fichtner has undertaken an assessment of the likely maximum impact of emissions of dioxins and dioxin-like PCBs from the Facility against the new TWI. This has shown that, at the maximum impacted receptor, the contribution from the Facility to the intake of dioxins and dioxin-like PCBs is small for child and adult receptors, at 7.33% and 5.19% of the TWI respectively. The reported exceedance of the TWI is due to the existing intake exceeding the TWI.

The contribution from the Facility to the intake of dioxins by an infant being fed by an agricultural receptor at the maximum impacted receptor is 44.1% of the TWI. However, the maximum impacted receptor is not a dairy or pastoral farm. When cows' milk, beef and pork sourced from the receptor point are excluded, the intake is only 1.17% of the TWI.

In conclusion, the results of the assessment against the new TWI show that the Facility will not have a significant effect on human health due to the intake of dioxins and dioxin-like PCBs.

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