| Submission | |
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| Submitter: | Patrick Dwyer |
| Submission Title: | Submission |
| Submission Reference No.: | S006187 |
| Submission Received: | 12 November 2020 |
| **Application** | |
| Applicant: | SSE Generation Ireland Limited |
| Reg. No.: | P0606-04 |
| | |
| See below for Submission details.<br><br>Attachments are displayed on the following page(s). | |

## Reason for Review of Licence

The applicant states that the reason for the review application by SSE is given as the following:

- SSE Generation Ireland Limited (SSE) is making an application to the Environmental Protection Agency to review its existing licence (P0606-03 as amended by Technical Amendments A to C) for the following items:
- Approve the use of emission point SW8;
- The reintroduction of storm water line SW7;
- Update the licence in line with Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions under the Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants;
- Amend the frequency for testing oils on storm waters in line with EPA / SSE agreement from daily to monthly;
- Include SW11 in the licence.
- SW7 and SW8 emission points have always been on the installation licence however were to cease on commencement of the CCGT. The review was requested is to remove the requirement under Schedule B.2 of the licence, page 26, to cease emissions on commencement of the CCGT plant.

Thus the applicant was and **still is operating in breach of licence** by continuing with discharges at SW8 and SW7. Importantly also the applicant has avoided stating another important reason for the application and that is the concern that the EPA had and presumably still have in relation to the scale of Sodium Hypochlorite use at the plant which is in the order of several hundred times that envisaged when licence 606-03 was applied for and granted is a proposed annual usage of 5 tons was envisaged versus 1300 T per annum reality. This the EPA discovered in a chance comment during an inspection and not by an examination of purchase records for sodium hypochlorite. Indeed maybe the EPA would still consider such a retrospective examination of those records and may even in the future look at them more often. The omission of sodium hypochlorite usage as a reason for review is remarkable considering so much of the accompanying documentation (Natura Impact Statement, water quality modelling study and literature survey) for the new application 'attempts' to address that very point *is* the modelling and impact of sodium hypochlorite in the estuary.



It is the very use of such large quantities of sodium hypochlorite, its subsequent fate and the impact of the chlorine produced oxidants (CPO's) on phytoplankton (primary production) that is the most important issue to shellfish producers as oysters and mussels feed on phytoplankton. Secondary to this concern would be direct lethal and sub lethal effects either acute/delayed or chronic on shellfish (mussels and oysters) caused by Chlorine Produced Oxidants (CPO's) and Chlorination by Products (CBP's), the latter formed with compounds present in estuarine suspended solids. These issues are not dealt with in any serious way in the application.

The water quality modelling study does state that it deals with modelling Sodium Hypochlorite in a conservative manner:

> *The modelling approach in the study has been conservative and representative of the worst-case scenarios. It has purposefully: a. excluded natural free chlorine decay*

It is this very decay into toxic product, CPO's and CBP's of longer lifespan in the ecosystem which has been ignored totally in the modelling study that is of concern to us. But it's not just a group of shellfish farmers that have concerns about CPO's. Quite a few countries hold these concerns equally

as strongly as ourselves and have invested time and resources into establishing guideline values for such compounds in the marine environment for the purpose of protecting marine life.

## Guideline Values for Chlorine Produced Oxidants in other Countries

Batley and Simpson 2020 (Short-Term Guideline Values for Chlorine in Marine Waters, G.E. Batley and S.L. Simpson Environmental Toxicology and Chemistry, 2020;39:754–764) discuss the impact of CPO's in the marine environment and the guideline values that have been set by various countries. They propose:

> *Guideline values that were protective of 99, 95, and 90% of species at 2.2, 7.2, and 13 µg CPO/L respectively.*

And furthermore Batley and Simpson 2020 go on to state:-

> *In applying these conservative guideline values in field situations, it would*
> *Need to be demonstrated that concentrations of CPOs would be reduced to below the guideline value within an acceptable mixing zone through both dilution and dissociation.*

**This has not been demonstrated by the applicant**. Zero fieldwork on sampling and testing for CPO's or CBP's has been undertaken by the applicant. If the EPA of Ireland are going to live up to their name they will have to ensure that an objective study into the levels of CPO's in the estuary to determine that they are not elevated above guideline values must take place. This is a Special Area of Conservation and a shellfish designated waterbody and has protection status as such. The health of the ecosystem is also meant to be protected under the Water Framework Directive.



The US, Canada, Australia, New Zealand, South Africa and the UK have all given serious consideration to guideline values for Chlorine Produced oxidants

> *US Environmental Protection Agency (1985), which recommended that "except possibly where a locally important species is very sensitive, saltwater aquatic organisms and their uses should not be affected unacceptably if the 4-day average concentration of CPOs does not exceed 7.5 µg/L more than once every 3 years on the average*
> *And if the one-hour average concentration does not exceed*
> *13 µg/L more than once every 3 years on the average."* Batley and Simpson 2020

The Canadian Council of Ministers of the Environment (1999) derived a guideline value of 0.5 µg/L. This derivation was based on most sensitive species of which phytoplankton were a group.

> A risk assessment report for the UK Environment Agency (Sorokin et al. 2007) yielded a *predicted no-effect concentration (PNEC) in saltwater of 0.05 µgCl/L.*

The above was recommended as a replacement for the existing environmental quality standard (EQS) as part of the European Water Framework Directive. The existing EQS for total residual oxidants (TROs; Lewis et al. 1994) is 10 µg/L. Note that the value of 10 was derived from studies showing acute LC50 value of 28 µg/L for both plaice and sole for TROs.

In the year 2000 Australia and New Zealand set a low reliability environmental concern value of 3 µgCl/L for marine waters and indeed there is such concern over Chlorine produced oxidants that in 2018 the Australian and New Zealand Governments have set about revising the guideline value:

> *A revision of the marine chlorine default guideline value for Australia and New Zealand was identified as a priority as part of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality. -**Australian and New Zealand Governments. 2018. Australian and New***

*Zealand guidelines for fresh and marine water quality. Canberra ACT, Australia. [Cited 2019 September 20]. Available from: www.waterquality.gov.au/anz-guidelines*

In South Africa the recommended guideline value for CPO is 2 µg/L. (Republic of South Africa, Department of Environmental Affairs (2018). South African Water Quality Guidelines for Coastal Marine Waters - Natural Environment and Mariculture Use. Cape Town.) This document is also interesting as they list the guideline values for other jurisdictions e.g. States in the USA etc. There would be no point adding all of these in as it is abundantly clear that numerous countries/jurisdictions have very low guideline values set for CPO's due to the acute and chronic toxicity to marine life. Even the UK interim Total Residual Oxidant (TRO) level of 10 µg/L is proposed to fall to 1 µg/L. These are all at or below the detection limit.

The literature review presented by the applicant is quite poor in this regard. One would expect the EPA of Ireland to be fully aware of the serious negative implications that the use of sodium hypochlorite has for the receiving marine environment. It's bad enough that the EPA were misinformed by a previous application based on a usage of 5 ton hypochlorite per annum which was licensed only to discover (by chance only) a usage of 1300 T/annum on their watch but to now subsequently despite all of that history and in the full knowledge of the negative ecosystem impacts attempt to licence the use of even a 1000tons of hypochlorite per annum defies belief.

In case the EPA are not fully knowledgeable about the negative ecosystem impacts of the use of sodium hypochlorite (the resultant Chlorine Produced Oxidants) in estuarine environments then the following is a selection of some research into this area.



Negative Impact of CPO's on Phytoplankton/Primary production

Carpenter et al. Showed that chlorine concentrations considerably below those required to eliminate fouling organisms might decrease productivity in entrained phytoplankton. (Carpenter, E.J., Peck, B.B. and Anderson, S.J., 1972, Cooling water chlorination and productivity of entrained phytoplankton. Marine Biology, 16(1), 37–40.)

Poornima et al 2005 observed that at a residual oxidant level of 0.1–0.3 mg/L, the reduction in chlorophyll a concentration was in the range 20–80%. Poornima, E.H., Rajadurai, M., Rao, T.S., Anupkumar, B., Rajamohan, R., Narasimhan, S.V., Rao, V.N.R. and Venugopalan, V.P., 2005, Impact of thermal discharge from a tropical coastal power plant on phytoplankton. Journal of Thermal Biology, 30, 307–316.

Eppley et al.] Reported that at a chlorine dose of 1 mg/L, the reduction in productivity was 80%. (Eppley, R.W., Renger, E.H. and Williams, P.M., 1976, Chlorine reaction with seawater constituents and the inhibition of photosynthesis of natural marine phytoplankton. Estuarine Coastal Marine Science, 4, 147–161). This author also went on to state that damage was irreversible.

Ahamed et al. Reported that at residual oxidant level of 0.2 mg/L, the reduction in GPP was 30–70%. (Ahamed. M.S., Suresh. K., Durairaj, G. and Nair, K.V.K., 1993, Effect of cooling water chlorination on Primary productivity of entrained phytoplankton at Kalpakkam, east coast of India. Hydrobiology, 271(3), 165–168.)

A chlorine dose of 1 mg/L (0.1–0.2 mg/L TRO) caused a reduction of 16–35% in gross primary productivity (GPP) in the diatom species studied; at 3 mg/L dose (0.4–0.5 mg/L TRO) the reductions were about 10–80% immediately after chlorination. The reduction in primary productivity was

comparable among the tested species- *(E. Vinitha , P. Veeramani & V.P. Venugopalan (2010) Chlorination for power plant biofouling control: potential impact on entrained phytoplankton, International Journal of Environmental Studies, 67:4, 515-530, DOI: 10.1080/00207233.2010.495214)*

When one considers that the level of phytoplankton in the estuary (upper estuary in particular) is already under pressure from the sediment loading of the water column in part by high frequency dredging opposite Cheekpoint by the Port of Waterford under licence from the EPA, the in-combination effect on phytoplankton levels/primary productivity in the estuary is even more negative. The ecosystem of Waterford Estuary like any other is built upon primary productivity however it is more sensitive as a result of the dredging activities which reduce light reaching phytoplankton. Shellfish in particular will suffer the most as a result even if they are supposedly protected within a Shellfish Designated Waterbody. It is no wonder that it is hard to find a mussel on the shore and that they have disappeared from locations where they used to be.
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The modelling study and Marine Ecological Survey don't refer to or deal with the actual impact on phytoplankton taken into cooling water intake but focus on the discharge waters and their impact. Phytoplankton are subjected to thermal shock, physical shock and biocidal activity when the run through the cooling system.

Yeon-Shik Kang et al calculated the mean fluctuation rate of carbon assimilation number of phytoplankton was 57.6%, and the seasonal variations of FR of carbon assimilation number ranged from 47.5% to 76.8% at a power plant. *(Yeon-Shik Kang et al Fluctuation Rates of Phytoplankton Assemblages by Passage through Power Plant Cooling System Korean J. Environ. Biol.2012*)

The impact of reduction of phytoplankton by power plant activities may have a higher negative impact on shellfish production during warmer summer months when shellfish have higher nutrient requirements due to growth and when water levels in the estuary are lower, warmer and power plant hypochlorite usage is high. Some research has highlighted that dinoflagellates may be even more sensitive to CPO's than diatoms. This is very interesting as this could have greater significance when dinoflagellates are more prevalent in the estuary e.g. in summer time.



The Eco toxicological summary data for Sodium Hypochlorite in Marine environment as per the European Registration Dossier states a Predicted No effect concentration (PNEC) of 0.042 µg/l. https://echa.europa.eu/registration-dossier/-/registered-dossier/15516/6/1 . The water modelling report talks about levels of 0.1mg/l (much higher than the above PNEC) for 2% of the time on certain tides extending 2km down from the discharge point. Again we note will incredulity that the model doesn't like crossing the estuary and prefers to go up and down on the eastern side (maybe it's aware of the 25% width of the estuary licence condition).

## Direct effect on shellfish

Capuzzo (1979) has demonstrated that Crassostrea virginica (Eastern Oyster) an LC50 of 80 µg CPO/L after only a 30-min exposure in seawater in a flow through system. *(Capuzzo JM. 1979. The effect of temperature on the toxicity of chlorinated cooling waters to marine animals—a preliminary review. Mar Pollut Bull*
*10:45–47.)*
However in estuarine water of 20ppt salinity, Roberts and Gleeson (1978) obtained a 48-h LC50 of 26 µg/L, in a flow through system. (*Roberts MH, Gleeson RA. 1978. Acute toxicity of bromo chlorinated seawater to selected estuarine species with a comparison to chlorinated*

*Seawater toxicity. Mar Environ Res 1:19–30.)* A very pertinent finding considering the lower salinity levels in the upper estuary. Also the decay rate of CPO's is slower in cooler receiving waters and may even be incomplete in winter time.

Note flow through experiments normally don't extend beyond 96hrs. So in reality because the power station is continuously generating a supply of CPO to the Waterford Estuary it is possible that marine life are being exposed on a much longer term to chlorine produced oxidants. The applicant admits to this scenario for mussels close to the discharge point based on modelling of sodium hypochlorite but as stated before it's the distribution of CPO's which travel further and last for longer that hypochlorite that is the major concern. The applicant has not determined the impact of CPO's in the seawater.

Rosenberg et al 1980 showed that straight hinged larvae of the eastern oyster had LC50 values of 0.3 ppm CPO at 48 h, 0.08 ppm at 72 h, and 0.06 ppm at 96 h. They also clearly demonstrated that the higher the concentration and/or the longer the exposure time resulted in higher mortalities. (*Effects of Chlorine-Produced Oxidants on Survival of Larvae of the Oyster Crassostrea virginica* Mar Ecol. Prog. Ser.Vol 3: 93-96, 1980).* Hence some jurisdictions set even more stringent guideline values for chronic exposure. The exposure to CPO's doesn't get any more chronic that in Waterford Estuary.

Scott, G. et al 1980 studied the physiological effects of chlorine-produced oxidants and uptake of chlorination by-products in the American oyster, Crassostrea virginica (gmelin) and results of the study indicated that oysters may be stressed in areas adjacent to chlorinated effluent outfalls. Summer exposure of oysters to high concentrations of CPO (0.66 to 1.23 mg/1) proved very toxic, while exposures to lower concentrations (0.11 to 0.21 mg/1) were only slightly toxic. Exposure to CPO severely inhibited feeding, growth and re productive potential, while significantly increasing tissue respiration. (*Scott, G. et al pp 501 516 of Water chlorination: environmental impact and health effects. Volume 3. Jolley, R.L.; Brungs, W.A.; Cumming, R.B. (Eds.). Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1980). From 3. Conference on chlorination: environmental impact and health effects; Colorado Springs, CO, USA (28 Oct 1979).* This study would of course not looked at the loss of phytoplankton food also that oysters would be subjected to as a result of constant destruction of phytoplankton in intakes waters and mixing zones. So the impact in reality is worse than in the lab.
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Mussel (Mytilus edulis) have reported 100% mortality rates with exposures to 1mg/l chlorine for 15 days, 100% mortality rate with exposure to 2.5mg/l for 5 days and mussel larvae wont attach at 0.02-0.05mg/l and attached mussels will move (Assessment of the effects of Chlorinated Seawater from Power Plants on Aquatic Organisms Inter Agency Energy/Environment R&D Programme Report, US EPA, Nov 1978). The applicant does refer to toxicity data on mussels in the application and there is no point repeating them in this section.



## Issues with the Application and Associated Documents

In the application form for this licence the applicant states that the current surface water usage is 201993000 cubic metres per year and a future usage per annum if the licence is granted of 2890800000 Cubic metres per year. So that is a 14.3 times increase in surface water abstraction from the estuary from current usage and 10 times the maximum limit allowed for under the current licence per annum. (The current licence limit for discharge is 33000 m3/hr, 792000 m3/day and 289080000 m3 per annum.) So is this a typographical error or not? If it is a typo and an extra zero has been erroneously added then the proposed usage will be 1.43 times the current usage which in itself then begs the question will the proposed sodium hypochlorite usage be 1.43 times that currently used? Given that recent sodium hypochlorite usage figures per annum have gone up towards 1300 tons

one could logically assume that maybe in the future 1.43 times this value will have to be used which would bring us to 1859 tons/annum. If this is not correct then could you explain why it isn't correct?

Of course it will depend on the concentration of the sodium hypochlorite used. Will the company be sticking with a 14-15% concentration solution (as stated in the raw materials and intermediates document) or will the licence allow for flexibility to use a more concentrated solution of sodium hypochlorite e.g. 1000 tons of an even stronger solution of sodium hypochlorite whereby the proposed 1000 tons/annum licence limit is not breached as there is no licence limit on the strength of the solution of sodium hypochlorite? Will the EPA be including a concentration limit on the sodium hypochlorite also? If it is not a typo then one could assume that the current usage rate of sodium hypochlorite would need to be increased by a factor of 14.3 to match the proposed future water intake. Could the applicant/EPA clarify which is correct? Will the EPA be setting a maximum daily/weekly/monthly/annual usage rate (tons/litres per time period) of sodium hypochlorite at a set concentration of solution e.g. it is currently used at 14-15% solution. A situation cannot exist again whereby the licensee was able to use sodium hypochlorite at a level 230 times beyond what was originally conceived for many years and even after this was discovered by chance the licensee is still not in breach of licence for this as it wasn't a stated licence condition. This cannot ever be allowed to happen again.

Not much is revealed in the application regarding the mode of use of sodium hypochlorite e.g. continuous feed into the intake water at what volume/weight per hour? What is the target biocidal concentration of free chlorine in the coolant water that the applicant is aiming for? What is the residual concentration of chlorine being aimed for in the cooling water? It also states in the application that usage rate is dependent on river water temperature. So if there is a cut-off point in river temperature below which it is not used e.g. industry norm is don't use biocide below 10 degrees intake water temperature then how many months of the year would that be? May to November? The effect of this would then be to concentrate the use of sodium hypochlorite in the remainder of the year its impact presumably into the important growing period within the ecosystem March-October.



Also are higher 'booster' dose of sodium hypochlorite given on top of the continuous feed (again another industry practice that is employed) and if so what would the booster dose be? Does testing at the SW2 discharge point happen after booster dosing if booster dosing is a used or does it happen before booster dosing? The weekly test of discharge water for chlorine is not only almost pointless the chlorine has already reacted but it could miss peaks in chlorine usage.

Marine Ecological Survey provided by applicant:

In relation to the Marine Ecological Survey I would like to point out several issues of concern which I believe render the report useless:

- There are no benthic, intertidal transects, and phytoplankton sampling locations on the western side of the estuary from Cheekpoint Southwards. This is remarkable considering the bathymetry of the estuary where the main flow of water hugs the western side of the estuary south of Cheekpoint. Therefore the sampling stations are not representative with the main flow of water and hence the movement of chlorine produced oxidants and Chlorinated by products.

- The study does not actually quantify phytoplankton data but rather uses a qualitative scale and thus we cannot determine if phytoplankton quantities are suppressed below what one would expect from an estuary on the south coast. A quick look at the phytoplankton data from the Marine Institute weekly samples across oyster production areas in the southeast

shows that phytoplankton levels in Waterford Estuary are many times lower than in Youghal, Dungarvan and Bannow Bays) and this is exacerbated in the summers months.

- The special range of phytoplankton samples is so narrow (clustered close to the discharge location) and as such does not rule out that all the samples are very similar in that they all have been impacted.
- To say that the thermal plume prevents impact on benthic habitats may not be correct as particulates present in the water column can react with Free Chlorine/Chlorine produced oxidants to produce Chlorination by Products attached to particulate matter which can settle out to the benthic layer. The upper estuary has elevated suspended solids in part due to the high frequency dredging at Cheekpoint undertaken by the Port.
- What was the level of use of sodium hypochlorite use in the months preceding the Marine Ecology sampling dates?
- The report is based on a snapshot one-to day study and does not reflect seasonal impact. The profile of phytoplankton will change throughout the year and science has already demonstrated that different species of phytoplankton e.g. dinoflagellates are more sensitive to CPO's. Also species like oysters are more sensitive during the summer to additional stresses.

Water Modelling Report

- .Condition 5.7 in the existing licence dealing with emissions states that the mixing zone shall not exceed 25% of the estuarine cross-sectional area at any point. Figure 5.5 of the Water Modelling report submitted with this application showing the modelled Maximum chlorine concentrations (mg/l) throughout neap tides would appear to show a mixing zone greater than 25%. Indeed it should be a prerequisite that sampling and testing for CPO's and CBP's should be undertaken across the full width of the estuary north and south of Cheekpoint. In addition a dye release study from the discharge location SW2 should be undertaken to verify discharged water movement throughout the estuary. It would be our contention that water does move across the width of the estuary from east west following the main channel on an ebb tide and also from west to east following the main channel on flooding tides. Furthermore weather could exacerbate the spread of discharged water across the estuary thus we also contend that it is impossible to meet condition 5.7 requiring the mixing zone to be less than 25%. Thus fish passing up and down the estuary will at times have to pass through a curtain of CPO's or be prevented from passage as a result of avoidance of such chemicals. Also at high and low water movement is slack and we would contend also that discharged water from the power plant will traverse across the estuary from east to west in the line of the discharge and with its force. A full dye and drogue study would be required across and full neap and a full spring tidal cycle to verify the movement of discharged waters in the upper estuary and indeed to determine levels of the dye that making it to other locations in the estuary. We would advocate that dosing with hypochlorite not take place during the course of those recommended studies in case the hypochlorite has any impact on the dye.



**Alternatives that could be considered to reduce the impact of the applicant's activities on the marine environment:**

Under the Natura Directive Stage 3 requires that Alternative Solutions. Has the applicant done this and explained why the alternatives are not appropriate? Other power stations/researchers are looking at alternatives for example chlorine dioxide.

Chlorine dioxide as antifouling biocide results in reduced Trihalomethanes in condenser effluents at a coastal power station. Indian Journal of Geo Marine Sciences. Volume 45 (12), December 2106, pp, 1638-1644. Rajamohan, R. et al

The Environment Agency for England and Wales in their evidence document looking at cooling water options for the next generation of nuclear power plants discuss the use of ablating hydrophilic polymer films and low free surface-energy polymer films the former requiring fast intake flows and the latter not as dependant on flow. Silicone-based coatings have been used in Japan with intake pipes being repainted every two to 4 years Trials in the US and Denmark silicone coatings continued to be protective in the fourth year after application. Imagine 4 years with no CPO's impacts. Cupro-nickel coating system (paint) CuprotectTM. Cupro-nickel paint this has minute (50 to 100 µm) cupro-nickel spheres is claimed to have a 20-year service life.
Other studies have been done on low level voltage applied to intake piping and cooling water pipes to reduce biofouling.

In summing I object to this application on the basis of the scientifically known negative environmental consequences of the use of sodium hypochlorite in the marine/estuarine environment and the lack of

- a dye and drogue study to validate water movement across a full spring and neap tide
- a lack of a sampling programme for CPO's and CBP's,
- a lack of wider and inclusive sampling points for phytoplankton (quantification of), sediment and transects,
- the lack of looking at alternatives such as those mentioned, in my reply
- the lack of accounting for in combination effects particularly with dredging activities in the port
- Waterford County Council should be consulted too given the fact that the estuary is a shared waterbody



The above and the unknowns that I have asked questions about would surely invoke the precautionary principle. I would like answers to the questions posed. All of the signs are pointing to the fact that something isn't well in the ecosystem in Waterford Estuary e.g. the disappearance of mussels on rocks and structures, the lack of mussel bed recruitment within the estuary, the very low phytoplankton levels, the abnormally high oyster mortalities compared to neighbouring bays in the southeast and the concerns of inshore fishermen. The Environmental Protection Agency must surely ask the applicant to commission objective further studies into the above and also must put this application to the public for consultation.

Yours sincerely,
Patrick Dwyer

William Dwyer

Stake holders Involved in oyster farming, harvesting of mussels, cockles and claims in Waterford harbour