West Offaly Power Generating Station
Thermal Plume Abatement

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Table of Contents

1 Introduction

On 28 November 2018, the EPA issued a notice to West Offaly Power (WOP) requiring consideration of cooling options to ensure that discharge from the facility is compliant with IE Licence P0611-02. It was requested that a proposal be submitted to the EPA outlining how the Station will comply with licence requirements and minimise the impact of heated cooling water discharge on receiving waters.

This document has been prepared in response to this request and sets out a number of options to abate the impacts of the cooling water discharge.

The abatement options were described in the ESB International Report "West Offaly Power, Cooling Water Outfall Modification Options, Risk Summary and Cost Estimates" which was issued in February 2018.

In addition, a number of further potential abatement measures are considered.

1.1 Plume Impacts

In February 2018, ESB International and the Aquatic Services Unit issued the report "West Offaly Power Thermal Discharge Synthesis Report". This report drew together and summarised the results of a programme of surveys and studies addressing the impact of cooling water discharges from West Offaly Power on receiving waters.

A number of the conclusions from the report are reproduced below:

- Thermal cooling water discharges have occurred to the Shannon River at Shannonbridge since the late 1950's when electricity generating stations utilising peat as a fuel were first constructed. Shannonbridge Generating Station was decommissioned in 2003 and its associated Integrated Pollution Control Licence (No. P0626-01) was surrendered in 2011.
- West Offaly Power Generating Station was first licenced under Licence No. P0611-01 in 2002. Although the licence contained conditions relating to water temperature outside of the mixing zone no definition of the mixing zone was included until the revised Licence (IEL No. P0611-02) was issued in 2013. On commissioning of West Offaly Power, the thermal load to the receiving waters was reduced significantly from that due to discharges from the previous Shannonbridge station.
- Thermal heat could be considered as a contaminant of concern within the receiving water and as such, the principle of applying a mixing zone as set out in Technical Guidance (Technical Guidelines for the Identification of Mixing Zones pursuant to Art. 4(4) of Directive 2008/105/EC) is appropriate for WOP.
- The Technical Guidance recommends a tiered approach to the assessment of the acceptability of the thermal plume. This was adopted at WOP with significant in-river bathymetric and thermal assessments carried out since 2014 allowing identification of the extent of the thermal plume and actual mixing zone to be determined under varying climatic conditions.
- The current Water Framework Directive (WFD) status of the river water body into which WOP discharges thermal cooling water is "Unassigned".

- An assessment of the ecological impact of the thermal plume discharges in terms of impact on macrophytes, macroinvertebrates and diatoms was carried out in 2014, 2015 and 2016 which identified that diatoms were the most reliable assessment species. The ecological impact assessment identified that an impact does occur but that this is within the thermal plume actual mixing zone with the “status” returning to at least Good within 200-400m of the discharge location. The thermal plume impact does not effect the status of the rest of the water body length and is localised in effect.
- An important issue for the acceptability of a mixing zone is that of potential impact on fish migration and river connectivity for fish which is a key objective of the Draft RBMP for Ireland 2018 – 2021. Fish sampling undertaken by IFI and ESB has identified the key fish species present in the system at WOP. A literature review and risk assessment relating to thermal plume potential impacts as barriers to migratory fish has been completed which concludes that there is no clear evidence that the thermal discharges are having an adverse impact on the resident fish community at WOP.
- WOP operates within the LCP Bref and Industrial Cooling Water Bref and is BAT compliant with respect to cooling technology (once through and nett energy efficiency). Any additional requirement such as mechanical cooling would likely reduce energy efficiency, would entail significant cost and, based on the ecological impact assessment to date, would not significantly enhance the achievement of water quality status requirements under the WFD. The cost would be disproportionate to any environmental benefit that could be achieved.

Following the Technical Guidance approach on mixing zones and ecological and fish assessments undertaken to date in February 2018, it was concluded that no overall significant impact on the receiving water bodies occurs into which the thermal discharges take place.

In Quarter 1 2019, as part of the WOP IE Licence review process and to ensure continued operation until the end of the current planning permission (which ends in December 2020), it is proposed to submit a request to amend Condition 5.5.

2 Abatement Options

In early 2018, ESB International undertook a study to identify, assess and cost the effectiveness of a number of potential cooling water discharge abatement measures at West Offaly Power. The findings of this study were set out in the ESB International Report "West Offaly Power, Cooling Water Outfall Modification Options, Risk Summary and Cost Estimates", issued in February 2018. The options set out are summarised below.

1. Option 1: Extract an additional 5.5m³/s of cooling water from the Shannon adjacent to the current cooling water intake, mix it with the cooling water from the plant and discharge it to the cooling water outfall location. This concept involves additional extraction to dilute the CW outfall in order to cool the discharge to the desired temperatures. It would involve additional pumping using an already existing spare CW inlet pump which would need to be connected to the outlet pipe before it reached the river.
2. Option 2: Increase natural river flow to the cooling water channel by the removal of part of the headland located just above the cooling water discharge point. This would allow additional river water to flow through the channel reducing the thermal discharge temperature though mixing.
3. Option 3: Air Cooled Heat Rejection (ACHR) units, dry systems. This option reviewed the potential use of air cooled heat exchangers to dissipate the cooling water temperature to the atmosphere. It is a typical type of industrial heat exchanger. The Air Cooled Heat Rejection (ACHRs) units are water circulation heat exchangers which has forced air flowing across it to allow the dissipation of heat.
4. Option 4: Forced Draft Cooling Towers (air to water, wet systems). This is a traditional power plant cooling system design found in many older industrial cooling systems and power plants as a direct method of reducing temperatures in heated water. This method uses evaporation to cool water.
5. Option 5: Replace Existing Condenser and CW Systems with New Air Cooled Condensers (ACC). An ACC is a typical modern type of power plant heat exchanger. ACCs, are steam condensing heat exchangers which uses forced air as a cooling medium. These units are very close in design to the ACHR cooling device (see above). The two designs look similar and work in similar fashion, thus they have a lot of the same equipment and footprint sizes and costs can be assumed to be similar.
6. Option 6: Construct cooling ponds for outflow water. In this option the cooling water discharge would be directed to cooling ponds before re-entering the Shannon River. Cooling ponds are a simple way of bringing CW outfall water temperatures back to ambient temperatures. The water comes from an external source such as a river in the WOP scenario, it runs through a plant, rests for a time in a large shallow pond to allow some degree of cooling before being discharged back to the river.
7. Option 7: Cooling pond with spray system. A variation of the cooling pond

solution whereby a smaller footprint of land for water ponds is required, is to spray water into the air within the cooling ponds. The water spray method consists of a pumped fountain of cooling water spraying into the air to force water cooling by using up energy through creating a fine spray of water. This process is called atomization as it creates water droplets as small as individual atoms. Thus the water will exchange heat with air very efficiently through these small droplets.

8. Option 8: Construct a second pass cooling loop in the CW/Condensing system. This would require the abstraction of an additional quantity of cooling water from the Shannon River which would be circulated inside a new installation of additional heat exchange surface area (a second loop), which amounts to more tubes to extract more heat from the depleted steam inside the existing condenser.

The feasibility of these options is discussed in more detail in Section 3 below.

Two additional potential measures to minimise the impacts of cooling water discharges and ensure the continued operation of the plant are set out below.

Option 9: External Alternative Solutions (e.g. District Heating, drying, heated greenhouse.)

This option would require an auxiliary water supply system with associated ancillary plant from the CW outfall piping that could be utilised by a third party industry for either district heating provision, drying of wet biomass for the Renewable Heat Industry or agricultural purposes.

Calculations indicate that the thermal cooling water energy from WOP, if extracted, could potentially provide district heating to over 18,000 homes.

The extracted energy could also be used to dry wet biomass to a dry form suitable for the heating market.

Historically, two alternative partial heat usage projects were developed. One in the form of heated greenhouses for horticultural purposes and one for peat drying.

These two projects used the CW Outfall water as a low level heat source through heat exchange from the water to the air in green houses and in the peat storage silos.

It is technically feasible to provide a connection to the cooling water process to facilitate use of the thermal energy from the station. ESB can make provision for an auxiliary water supply system with associated ancillary plant from the Cooling Water outfall for the use by a third party but the effectiveness of this measure in reducing thermal cooling water load would be dependent on a feasible third party industry use for the resource.

Option 10: Scheduling of Outages.

To accommodate station maintenance, an outage of WOP is required on an annual basis. This outage is typically two/three weeks in duration. It is proposed to schedule such outages for the summer months when River Shannon Flows are typically at their

lowest. The proposed 2019 outage has been scheduled for May subject to grid requirements. (The timing of maintenance outages must be agreed in advance with EirGrid.)

The feasibility of these options is discussed in more detail in Section 3 below.

3 Discussion

3.1 Abatement Options

The feasibility of the measures set out in Section 2 above to minimise the impact of heated cooling water discharge from West Offaly Power on the receiving waters is discussed below.

With respect to Options 1 to 8, this discussion makes reference to the conclusions of the February 2018 ESB International report, "West Offaly Power, Cooling Water Outfall Modification Options, Risk Summary and Cost Estimate". This report concludes that the technical measures proposed were not feasible to meet thermal discharge abatement requirements at Shannonbridge. Given the expiry of the Station planning permission in 2020, the potential measures variously:

- cannot be implemented in time,
- are technically infeasible for the location and/or
- are prohibitively expensive.

Table 3-1 presents a summary of the key findings associated with each measure.

Option	Likely Feasibility	Budget Engineering Cost (Feb 2018 report)
Option 1: Extract an additional 5.5m³/s of cooling water from Shannon, mix with cooling water from plant and discharge to cooling water outfall location	Mathematical modelling of the potential impact of this scenario was undertaken under low (95 percentile) flow conditions and indicated that the thermal plume footprint would be altered. It would quickly impact across the entire river section due to the increased hydraulic load from the increased discharge. The temperature level of the cooling water outfall would decrease but would not be below 1.5°C above ambient and significantly more than 25% of the cross sectional area of the entire river section would be impacted. Irrespective of cost the measure will not achieve the level of plume abatement required to meet the requirements of the existing Condition 5.5 of the IE Licence.	€1,722,964
Option 2: Increase natural flow into cooling water discharge channel by removing headland above discharge point	The impact on the Shannon River ecology is unknown and would take significant time to evaluate. The changes associated with the river main channel at Shannonbridge and the navigation right of ways would require the consent of the relevant competent planning and environmental authorities. Given the configuration of the outfall at WOP, this option is not considered to be feasible.	n/a
Option 3: Install an Air Cooled Heat Rejection (ACHJ) Unit , dry system	The ACHR units would require a large footprint area within or adjacent to the plant with engineering tie in requirements to the plants	€15,573,714

Option	Likely Feasibility	Budget Engineering Cost (Feb 2018 report)
	cooling system and with realignment of existing services and electrical infrastructure. Feedback from ACHR equipment vendors with respect to the application of this technology to WOP concluded that during summer conditions, at the time when abatement is required, the air cooled heat exchangers are unlikely to work to the required level due to "Approach to Dew Point". Note: Dew point is the temperature to which air must be cooled to become saturated with water vapour. The Approach to Dew Point issue for the ACHR heat exchangers is caused by humidity in air preventing heat exchange at air temperatures close to the 27°C temperature of the water and the 20°temperature that the CW water needs to be when it leaves the CW outfall in order to meet the EPA requirements. Primarily this is when the air temperature is higher than 20° and humidity is also high. As a result of the problems caused by "Approach to Dew Point", the ACHR design will not achieve the required temperature reduction in the event that abatement of the thermal plume load is required. The option to install an Air Cooled Heat Rejection Unit will not technically deliver the reduction in temperature in the cooling water required. This option would also entail significant capital investment requirement. The cost of this measure would render the plant economically unviable.	
Option 4: Forced draft cooling towers (air to water, wet systems)	This option has a significant environmental risk as it directly employs Shannon River water inside of the cooling towers; thereby requiring an additional extraction. The use of thermally heated river water in a direct interface with air can also promote Legionaries' disease. In order to eliminate the disease potential, the water has to be inoculated and this chemical additive inoculation would have a significant impact on the river water. The addition of these chemicals may impact negatively of the ecology of the river system. The forced draft cooling system requires the installation of fans in individual cells to produce the forced draft. The resultant parasitic loading of the fans would impact on the overall efficiency of the plant. The Forced Draft Cooling system will achieve the required thermal load reduction and it has a similar footprint as the ACHRs. But, it will require	€15,573,714

Option	Likely Feasibility	Budget Engineering Cost (Feb 2018 report)
	significant engineering works and site alterations. It would require the moving of power lines. It would lose a significant amount of the cooling water to vapour even with an extra vapour capture condensing equipment. The additional vapour capture condenser may use a significant amount of power. Forced draft cooling would require harsh chemical treatment of the cooling water with potentially significant potential impact on the receiving water quality. This option would also entail significant capital investment requirement. The cost of this measure would render the plant economically unviable.	
Option 5: Replace the existing plant condenser system with Air Cooled Condensers (ACCs)	Replacing existing Condensers with ACCs would achieve the required cooling but poses significant risks, as it requires demolition of the existing plant condenser system and rebuilding which will have various unknown risks, plant impacts and costs. ACC systems have the same "Approach to Dew Point" problems as the ACHR equipment have (see 3.2.5 above) and will reduce overall plant efficiency. Changing the condenser system is likely to have a significant impact on the overall plant efficiency. This option would also entail very significant capital investment requirement. The cost of this measure would render the plant economically unviable.	€34,902,109
Option 6: Construct cooling ponds for outflow waters	A Cooling Pond system will require diversion of the cooling water directly to the cooling ponds. This cooling system evaporates water directly to the air in order to cool the water – resulting in a water loss to vapour. Such a solution, considering the WOP cooling load, would require approximately 60 Hectares of land for ponds which is more land than is currently available to ESB. Obtaining 60 Hectares from third parties, rights of way and land leases in order to lay the pipe, getting planning and the cost of these agreements are unknown and are significant risk items. Vaporisation of most of the cooling water is also a high potential risk as it will ultimately reduce the return flow to the Shannon River. This option would also likely result in the creation of a heavily modified water body downstream of the cooling water abstraction point with implications under the EU Water Framework Directive.	€15,971,091

Option	Likely Feasibility	Budget Engineering Cost (Feb 2018 report)
	The cost of this measure would render the plant economically unviable.	
Option 7: Cooling Ponds with Spray System	As with Option 6, this option may require more land than ESB currently owns. ESB owns 10.8 Hectares at WOP that may be available to be used for ponds, although subject to further study it is anticipated that this area may not be sufficient to create the vapour spray ponds. In scenarios of high wind, the water spray may be blown away from the ponds resulting in water loss and ultimately a reduction in volume returned to the river. Significant water loss to the atmosphere may occur reducing the return flow to the Shannon River. This solution employs Shannon River water as the spray, requiring additional extraction. The use of river water in a direct interface with air, may again promote Legionnaires' disease. In order to eliminate the disease potential, the water has to be inoculated and this inoculation is a harsh chemical additive to the river water. The addition of these chemicals may impact negatively of the ecology of the river system. This option has a large potential environmental risk as it can vaporize and eliminate the cooling water in large amounts and at the right conditions it has an even higher risk of vaporizing most, if not all, of the river water. Such concerns compound the problems associated with the normal cooling pond design. This option consumes significant power used to pump the water in the ponds and to create the vapour spray increasing the house load on the plant. Furthermore this option would require planning and environmental consent. It would also likely result in the creation of heavily modified water body downstream of the cooling water abstraction point with implications under the EU Water Framework Directive. The cost of this measure would render the plant economically unviable.	€6,514,823
Option 8: Install second pass cooling loop in the CW system	It may not be possible to retrofit this kind of installation within the existing design of condenser. This would entail significant design calculations to balance the condenser sizing and layouts. From the assessment carried out by ESB this process would not provide any significant improvement in thermal abatement.	€34,902,109

Option	Likely Feasibility	Budget Engineering Cost (Feb 2018 report)
	The solution would not provide any improvement in the total thermal outflow. This option would require a major rebuild and redesign of the existing condenser system, the risks imposed by the rebuild would be very high. Installation of a second pass cooling loop would not achieve the requirement of the existing Condition 5.5 of the IE Licence. This option would also entail significant capital investment requirement. The cost of this measure would render the plant economically unviable.	

Table 3-1: Potential Technical Abatement Measures

Options 1 to 8 above would require consent from the planning and environmental authorities. At a minimum, applying for planning would likely require at least 14 month's duration, followed by the requirement for a licence revision, a significant procurement phase and subsequent construction. Given that the current planning permission expires in 2020 it is unlikely that a feasible solution would be in place before that date.

The identified costs for the potential cooling water plume reduction solutions are high (see Table 3-1). The February 2018 report concludes that scientific studies previously submitted to the EPA and summarised in the WOP Synthesis Report, have demonstrated that no significant negative impact is occurring on the ecology of the Shannon River or on fish migratory species, and therefore these costs would be disproportionate to any environmental benefits achieved.

3.2 Option 9 External Alternative Solutions

As noted in Section 2 above, ESB can make provision for an auxiliary water supply system with associated ancillary plant from the Cooling Water outfall at the WOP site boundary for the use by a third party of the thermal cooling water load from the station.

Due to the size of the adjacent community, minimal industry in the community and lack of an existing installed district heating network, a District Heating scheme is not immediately feasible. The thermal load reduction would also be unlikely to be achieved as the level of utilisation would not be sufficient to reduce the thermal load in the cooling water discharge given that the opposing seasonal requirements of thermal plume abatement and typical third party heating processes such as district heating occur in differing time periods The demand for District Heating is generally at it's lowest during the summer months which is when the flows in the Shannon receiving waters tend be lowest.

The extracted energy could also be used to dry wet biomass for example to a dry form suitable for the renewable heat industry heating market. It would require a separate industry to establish adjacent to WOP to use the extracted heat, entail

very significant transportation requirements of biomass materials and would potentially supply all the heating biomass requirements for the state, an unlikely market scenario.

At the moment, no or insufficient alternate heat uses exist in the vicinity of the plant to utilise thermal cooling water load effectively.

3.3 Option 10 Scheduling of Outages

The timing of annual station maintenance works and associated outages in summer months will ensure that there will be no thermal discharges during a three week period when river flows are typically low. The dates of such outages must be agreed some time in advance with EirGrid. Subject to grid requirements, the proposed outage associated with the scheduled 2019 maintenance programme is set for May 2019. A similar request will be made for 2020.

3.4 Operational Consequences

The feasibility of mitigating the thermal discharge through the reduction of station load was considered.

Based on data obtained from on site measurement devices and surveys, the behaviour of the plume associated with cooling water discharges from West Offaly Power is influenced strongly by the magnitude of flow in the Shannon and the station load.

Whilst consideration could be given to curtailing station load and thereby reduce the thermal discharge in conditions of low flow in the River Shannon when a breach of Condition 5.5 is likely to be imminent, this would result in a number of serious impacts including:

- A threat to the financial viability of the station and as a result
- Significant socio economic impacts on the region

Further detail on these potential impacts is given below.

The form of any load reduction would be based on knowledge of:

- Flow conditions in the Shannon at Shannonbridge. There is no rated hydrometric gauge at Shannonbridge as the site has proved unsuitable for rating.
- Flow values in this reach of the river Shannon are readily available only at Athlone (the outlet of Lough Ree) and Banagher. Generally, there is likely to be a strong correlation between the flow at Athlone and the flow at Shannonbridge.
- Temperature conditions in the Shannon at Shannonbridge. A programme of continuous temperature monitoring has been ongoing since July 2016 at seven fixed locations on the east and west banks of the River Shannon in the vicinity of West Offaly Power at Shannonbridge. At each location, between two and four temperature thermistors with loggers were deployed to measure and record temperatures at 0.3m, 0.8m and 0.5m below the water surface.

  The data is only available retrospectively. For the data to be downloaded, it is necessary for the specialist contractor, Irish Hydrodata (IHD), to visit each temperature logger by boat. The downloaded data is then processed by IHD at

their office and forwarded to ESB in report and spreadsheet formats a week or so later.

From these temperature records, the periods when the station is in breach of Condition 5.5 is inferred when the loggers record temperature increases greater than 1.5 degrees above ambient simultaneously on the east and west banks of the Shannon.

- Relationship between flow and temperature.

  An analysis has been undertaken of the temperature data recorded since July 2016 and the periods when the Station is inferred to be in breach of Condition 5.5 were noted. The analysis considered any potential relationship between the magnitude of the calculated flows at Athlone and the timing of these periods.

  In addition, a mathematical model of the Shannon receiving waters at Shannonbridge has been developed using Telemac software. This model can consider the magnitude of flows in the Shannon below which a breach of Condition 5.5 is more likely.

  Using the information to hand in January 2019, this preliminary analysis indicates that the station is at risk of breaching Condition 5.5 when the flow at Athlone is less than 43.4 m^3/s. This equates to the 75 percentile 1953-2017 flow i.e. the flow that is equalled or exceeded 75% of the time. However, further analysis would be required to develop a more complete understanding of this relationship.

The format of a reduction procedure would be based on the type and quantity of flow and temperature data available. The layout of a possible procedure is set out below.

a) Identify Athlone low flow which triggers reduction.

   The preliminary analysis described above recommends a value of 43.4 m^3/s as the flow below which reduction may be required. Further assessment using the Telemac mathematical model and temperature monitoring results would provide more complete information.

b) Identify degree of station reduction to be adopted when trigger flow reached.

   Using information currently available, the following hypothetical reduction scenario was considered:

   i. WOP operates at Min Gen when flow < Trigger Flow throughout the year.
   "Min Gen" is the minimum feasible level of load at which the station can operate, 59 MW.

The Telemac Shannonbridge plume model could be applied to synthesise plume behaviour for a range of flows and station loads from Min Gen to Full Load. From this a more refined reduction regime could be developed.

A loss of generation capacity of the magnitude arising from the implementation of such a reduction action would have serious implications for the viability of the station and would impact significantly on associated activities, particularly existing peat

supply contracts. The likely consequences of station closure are considered in Section 3.5 below.

Further investigations would be required to refine and clarify the operational details though it is likely that the implications for the station would be similar. In addition, any reduction programme is likely to impact significantly on grid and market obligations.

As noted above, scientific studies with respect to cooling water discharge at WOP previously submitted to the EPA and summarised in the WOP Synthesis Report, have demonstrated that no significant negative impact is occurring on the ecology of the Shannon River or on fish migratory species, and therefore these costs would be disproportionate to any environmental benefits achieved.

3.5 Plant Closure

There would be very significant negative impacts from plant closure. A loss of generation capacity of sufficient magnitude would result in the cessation of electricity generation on the site with the resultant loss of direct and indirect employment and economic activity to the Midlands Region. The closure of the WOP Station and Ash Disposal Facility (ADF) with the associated cessation of peat supply for electricity generation at WOP would ultimately see an immediate termination of all employment at and associated with the site and associated peat harvesting and delivery activities.

This scenario would entail the loss of all 358 jobs (202 full-time and 156 seasonal) directly associated with the WOP Station and ADF aside from security, decommissioning and closure activities which would be mainly short term in nature. This scenario would also lead to the loss of 96 indirect and induced jobs supported by the WOP Station and ADF. There would be immediate significant and long term loss of employment in WOP and in indirectly associated activities such as the fuel supply operations and routine maintenance activities. There would also be a loss of economic contribution to the local authority.

Overall there would be significant socio-economic long term negative impact from the closure of the WOP Station with loss of employment and rates contribution to the Local Authority.

The following sections have been extracted from the West Offaly Power Socio Economic Report prepared by Future Analytics on behalf of ESB to accompany the planning application for the proposed transition of WOP from peat to biomass.

> “WOP currently provides a significant contribution to the local and regional Midlands economy, through the direct provision of employment and economic activity, as well as having an indirect positive impact on economic activity in the area through the on-going acquisition of fuel and services.

The Midland Region forms part of Eastern and Midland Region. The Midland Region consists of the counties of Laois, Longford, Offaly and Westmeath. According to the EU Regional Innovation Monitor[1]:

'The Midlands counties have the lowest disposable incomes in Ireland. Between 2013 and 2016, there has been a decrease in the severe material deprivation rate from 11.4% to 4.9%. However, in the same period, the at-risk-of-poverty rate has increased from 21.3% to 22.4'.

The Midland region has attracted less Foreign Direct Investment than other regions. Of the net additional jobs created by IDA clients in 2016 47% were located in Dublin and the Mid-East, 5% were located in the Border region and just 0.5% in the Midland region.2 The Midland Region Action Plan for Jobs 2015-2017 published by the Department of Business, Enterprise and Innovation in 2015 identified 'Energy & Sustainability' as a strong sectoral activity rooted in the region which has sustainable competitive advantage.[3] According to the report:

'ESB has been synonymous with the Midlands Region for over 60 years, with over 10 peat burning stations since the early 1950s in different counties dotted the country…. Down the years, ESB has had a special relationship with Bord Na Mona, which remains to this day with ESB being their biggest customer. The peat harvesting required to supply the stations is a source of substantial fulltime and seasonal employment through Bord na Mona, as they meet ESB'S significant requirement for milled peat on an ongoing basis'.[4]

The Midland region has a strong history of energy production and transmission and is well placed to relay the history of energy generation and transmission. Bord na Mona has harvested the peatlands of the region for many years and has provided substantial levels of employment. The ESB is also a significant employer in the Midland region.

The region has embraced the renewable sector with the presence of co-fired peat and biomass and wind power, whilst also being home to the

[1] *Regional Innovation Monitor Plus - Internal Market, Industry, Entrepreneurship and SMEs - European Commission. Border, Midland and Western (BMW) Region* (https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/border-midland-and-western-bmw-region)

[2] *Midland Region Action Plan for Jobs 2015-2017* , Department of Business, Enterprise and Innovation, 2015 (https://dbei.gov.ie/en/Publications/Publication-files/Action-Plan-for-Jobs-Midland-Region-2015-2017.pdf)

[3] *Ibid.*

[4] *Ibid*, p. 22

internationally significant Clara Bog and the 2015 National Tourism Award Winner for Environmental Innovation with Lough Boora Discovery Park'.[5]

WOP Station is located next to the town of Shannonbridge in County Offaly. WOP directly employs 41 ESB staff on site. 148 full-time and 156 seasonal Bord Na Móna workers are employed by supplying WOP with peat[6] and 13 full-time transport employees contracted by Bord Na Móna. 55 of these Bord Na Móna employees are located on site at WOP (i.e. 48 located at WOP Station and 7 at ADF). In addition to the direct employment connected with WOP provided by Bord Na Móna and the ESB a significant level of indirect and induced employment is supported by the plant. The existing direct and supported employment for WOP totals 358 jobs (202 of these are full time and 156 are seasonal (part-time).

The importance locally of WOP as an employer is underlined by data relating to employment from the 2016 census. According to the census the total population of Shannonbridge is 267 and the total number of jobs located in the town is 247. While not all Bord na Móna workers employed at Shannonbridge work on site, the fact that it employs 358 people directly shows the relative importance of the station as an employer locally. WOP pays 1.5 million euros annually to Offaly County Council in rates. The net amount of rates levied by the council to 2017 was €16.6 million[7]. WOP rates contribution represents over 9% of the net amount levied by the council on a county basis. Rates paid by WOP is a significant positive impact in terms of contribution to Offaly County Council's annual budget requirements.

A 'significant reduction in the plant operation or a full plant closure scenario would represent the loss of all 358 jobs (202 full-time and 156 seasonal/part-time) directly associated with the WOP Station and ADF aside from security, decommissioning and closure. This scenario would also lead to the loss of 96 indirect and induced jobs supported by the WOP Station and ADF.

It would be expected that skilled engineering and site facility tasks are mobile in nature and these employees are likely to move out of the area. Workers in

[5] *Ibid*, p. 67

[6] Including employees involved in fuel handling at station, rail hauliers based at WOP, employees at WOP ash disposal facility, peat operations and transport employees contracted by Bord na Móna.

[7] Offaly County Council Local Authority Budget, Calculation of Annual Rate on Valuation For The Financial Year 2018, Adopted 2017 Net Expenditure

the peat extraction industry, with a relatively narrow skills base, may seek opportunities to retrain or work in other industries. However, it is notable that employment in the agriculture sector has experienced decline in recent years and may have limited capacity to absorb additional workers. 53% of Bord na Móna's total workforce is aged over 45, 69% of Bord na Móna's workforce have no third level qualifications.

Based on this age and educational profile Bord na Móna workers employed supplying WOP Station would not be well placed to secure alternative employment in the event of the plant ceasing operation in 2020. "

4 Licence Review

The Technical Guidance (Technical Guidelines for the Identification of Mixing Zones pursuant to Art. 4(4) of Directive 2008/105/EC) approach was applied to the findings of the programme of WOP mixing zones and ecological and fish assessments undertaken and was presented in the February 2018 ESB International Report "West Offaly Power Thermal Discharge Synthesis Report". As noted in Section 1.1 above, this report concluded that no overall significant impact on the receiving water bodies occurs into which the thermal discharges take place.

As a result of these findings and to ensure that discharge from the facility is compliant with IE Licence P0610-02, in Quarter 1 2019, as part of the review process for WOP IE Licence P0610-02, it is proposed to submit a request to amend Condition 5.5 to the EPA. For information, in March 2018, a Technical amendment request to alter Condition 5.5 of the existing WOP (and LRP) licences was submitted. On the advice of the EPA, it was decided to withdraw the Technical Amendment request and proceed with a Licence Review.

The proposed amendment is summarised below:

> Condition 5.5 (Current)
>
> Discharges from the installation shall not artificially increase the ambient temperature of the receiving water by more than 1.50C outside the mixing zone. In relation to temperature, the mixing zone shall not exceed 25% of the cross sectional area of the river at any point.
>
> Condition 5.5 (Proposed)
>
> Discharges from the installation shall not artificially increase the ambient temperature of the receiving water by more than 1.5^0C outside the mixing zone. In relation to temperature, the mixing zone shall not exceed 25% of the cross sectional area of the river at any point ***where such exceedances would result in contravention of the EPA Act and in particular cause significant environmental pollution to the receiving waters***

5 Conclusions

Minimise Impacts

A number of options to minimise the impact of cooling water discharge on receiving waters were identified and assessed.

1. Option 1: Extract an additional 5.5 m^3/s of cooling water from the Shannon adjacent to the current cooling water (CW) intake, mix it with the cooling water from the plant and discharge it to the cooling water outfall location.
2. Option 2: Increase natural river flow to the cooling water channel by the removal of part of the headland located just above the cooling water discharge point. This would allow additional river water to flow through the channel reducing the thermal discharge temperature though mixing.
3. Option 3: Air Cooled Heat Rejection (ACHR) units, dry systems.
4. Option 4: Forced Draft Cooling Towers (air to water, wet systems).
5. Option 5: Replace Existing Condenser and CW Systems with New Air Cooled Condensers (ACC) s.
6. Option 6: Construct cooling ponds for outflow water.
7. Option 7: Cooling pond with spray system.
8. Option 8: Construct second pass cooling loop in CW/Condensing system.

Given the expiry of the Station planning permission in 2020, it was concluded that measures 1 to 8 listed above variously:

- cannot be implemented in time,
- are technically infeasible for the location and/or
- are prohibitively expensive.

As a result, none of these measures are feasible to meet thermal discharge abatement requirements at West Offaly Power.

Two additional potential measures to minimise the impacts of cooling water discharges and ensure the continued operation of the plant are set out below

Option 9 related to the export of the cooling water discharge to a third party to meet process heating/drying requirements. Such potential requirements include District Heating, drying of biomass and heated greenhouses. This option would require an auxiliary water supply system with associated ancillary plant from the CW outfall piping that can then be rerouted to third party service pipes.

Due to the size of the adjacent community and minimal industry in the community, there are currently insufficient alternate heat uses available in the vicinity of the plant to utilise thermal cooling water load effectively. The opposing seasonal requirements of thermal plume abatement and typical third party heating processes such as district heating poses additional constraints. The demand for District Heating is generally lowest during the summer months which is when the flows in the Shannon receiving waters tend be lowest

ESB can make provision for an auxiliary water supply system with associated ancillary plant from the Cooling Water outfall for the use by a third party

Option 10. On an ongoing basis, it is proposed to schedule the timing of annual station maintenance works and associated outages (two/three weeks in duration) in summer months to ensure that there will be no thermal discharges when river flows are typically low. Subject to grid requirements, the proposed outage associated with the scheduled 2019 maintenance programme is set for May 2019. A similar request will be made for 2020.

Station Operations

Given the close relationship between thermal plume size and river flow, the possibility of mitigating the thermal discharge through the reduction of station load was considered when river flows were below a trigger threshold (43.4 m^3/s at Athlone). As there is no reliable long-term river Shannon flow data for Shannonbridge, flow records for Athlone were used.

Using information currently available, the following hypothetical reduction scenario was considered:

i. WOP operates at Min Gen when flow < Trigger Value throughout the year.
"Min Gen" is the minimum feasible level of load at which the station can operate, 46 MW

A loss of generation capacity of the magnitude arising from the implementation of this reduction action would have serious implications for the viability of the station and with resultant significant impact on associated activities, particularly peat supply.

In this scenario, electricity generation on the site would cease with the resultant loss of direct and indirect employment and economic activity to the Midlands Region. The closure of the WOP Station and Ash Disposal Facility (ADF) with the associated cessation of peat supply for electricity generation at WOP would ultimately see an immediate termination of all employment at the site and associated peat harvesting and delivery activities.

This scenario would entail the loss of all 358 jobs (202 full-time and 156 seasonal) directly associated with the WOP Station and ADF aside from security, decommissioning and closure activities. This scenario would also lead to the loss of 96 indirect and induced jobs supported by the WOP Station and ADF. There would be immediate significant and long term loss of employment in WOP and in indirectly associated activities such as the fuel supply operations and routine maintenance activities. There would also be a loss of economic contribution to the local authority.

Address Licence Compliance

Following the Technical Guidance approach on mixing zones and ecological and fish assessments undertaken to date in February 2018 and presented in the ESB International Report "West Offaly Power Thermal Discharge Synthesis Report", it was concluded that no overall significant impact on the receiving water bodies occurs into which the thermal discharges take place.

As a result of these findings and to ensure that discharge from the facility is compliant with IE Licence P0610-02, in Quarter One 2019, as part of the WOP IE Licence review process, it is proposed to submit a request to amend Condition 5.5.