BRADWELL SITE

DETAILS OF PROPOSED VARIATION TO EPR PERMIT EPR/ZP3493SQ TO MODIFY AQUEOUS DISCHARGE LINE TO OUTFALL

BRAD/EN/REP/099

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SUMMARY

Radioactive discharges at the Site are permitted under the Environmental Permitting Regulations 2010 under Permit Number EPR/ZP3493SQ. The discharges occur via two named routes: 'System for Discharging Radioactive Waste from the Final Monitoring and Delay Tanks (FMDT) to the Blackwater Estuary via the east cooling water outfall' and 'System for discharging treated sewage effluent and storm water to the Blackwater Estuary via the east cooling water outfall'. Following the Care & Maintenance Preparations (C&M Preps) phase of the Site, it is intended to leave all systems in a passively safe state to minimise the need for personnel to attend for maintenance activities. As part of this work, new pipelines have been installed which will take effluent directly from the FMDT and the Main Drains Pit to the estuary without utilising the East Cooling Water Outfall, thus allowing for removal of the Alternative Effluent Pumping System (AEPS) pumps.

This document details the changes to the permitted routes that are requested to enable ongoing discharges of Aqueous Effluent and the removal of redundant plant.

The change requested is the addition of two aqueous waste disposal outlets to be referenced in schedule 3 as:

- 'System Provided for Discharging Radioactive Waste from the Final Monitoring and Delay Tanks directly to the Blackwater Estuary' and;
- 'System for discharging treated sewage effluent and storm water directly to the Blackwater Estuary'

This document sets out the:

- technical descriptions of the activities;
- operating techniques to protect the environment and optimise the protection of people;
- monitoring of discharges and disposals of radioactive waste;
- environmental monitoring;
- Impact on people of discharges and on-site disposals;
- Impact on non-human species of discharges and on-site disposals.

1. Technical Description of the Activities

The Site is currently permitted to discharge aqueous waste, to the Blackwater Estuary via the East Cooling Water Outfall via two named routes; 'System for Discharging Radioactive Waste from the Final Monitoring and Delay Tanks to the Blackwater Estuary via the east cooling water outfall' and 'System for discharging treated sewage effluent and storm water to the Blackwater Estuary via the east cooling water outfall'.

When radioactive aqueous waste is pumped from the FMDT into the outfall the Alternative Effluent Pumping System (AEPS) provides a flow of 3,200m^3/h to ensure that the effluent is flushed through the discharge pipe and therefore discharged during the optimum time for natural dispersion due to tidal flows. This system provides an 8,550:1 dilution of the effluent at 100m and has been assessed as the Best Available Technique for minimising the radiological effects on the environment and members of the public.

Storm water and treated sewage effluent is pumped automatically from the Main Drains Pit (MDP) into the east cooling water outfall when the level reaches a pre-set point. It then discharges passively to the estuary over the natural tidal cycles with discharge mainly occurring at low tide.

Throughout the C&M Preps phase of the Site, work shall be undertaken to remove hazards and leave all remaining systems in a passively safe state. This work includes minimising active liquid effluents requiring disposal. As part of the aim to minimise the need for personnel to attend Site for maintenance activities during Care and Maintenance (C&M), new pipelines have been installed through the outlet culvert which, once connected, will take effluent directly from the FMDT and the Main Drains Pit to the estuary without utilising the East Cooling Water Outfall thus allowing for removal of the AEPS pumps. It is intended to change over to this new system after the FED dissolution programme has completed, however, both the inlet and outlet culverts which allow the flow of dispersion water, are being impacted by movement of silt within the estuary and there is the potential that one or both will become blocked prior to the completion of the FED dissolution programme.

A project has carried out removal of silt from the inlet and outlet culverts both to allow installation of the new discharge pipeline and to maintain a flow of dispersion water. However, surveys suggest that silting is reoccurring and it is likely that one or both of the culverts will become blocked again prior to entry into C&M. Consideration has been given to a continuous programme of de-silting, however, due to the presence of oyster beds in relative close proximity to the culverts, there are limitations on when this work can be carried out to minimise the impact (i.e not during oyster spawning periods). These limitations mean that de-silting can only occur during the winter when experience has shown weather conditions can cause significant delays and interruptions to the programme. In addition, the installation of the new pipelines has resulted in access to the outlet culvert being restricted by the 'guide chute'. Although there is the potential to carry out de-silting of the inlet culvert, mapping of the silt movement in the river in the location of the outfall, suggest that it is the outlet that is at greatest risk from blockage due to siltation and as such the time, cost and hazard associated with de-silting the inlet culvert would not be of benefit in maintaining the current discharge route.

This permit variation is requested to add two new discharge routes to the current permit. 'System Provided for Discharging Radioactive Waste from the Final Monitoring and Delay Tanks directly to the Blackwater Estuary' and 'System for discharging treated sewage effluent and storm water directly to the Blackwater Estuary'. The intent will remain that the current system is used until the Site enters C&M, unless the AEPS becomes unavailable due to siltation.

2. Operating Techniques to Protect the Environment and Optimise the Protection of People

This application requests a variation to the route for aqueous discharges; it does not alter any of the other systems or operating techniques currently in place to ensure that each discharge meets the requirements of Permit EPR/ZP3493SQ. For each project where creation of an aqueous effluent is produced, an assessment identifies how it should be treated to minimise the activity to be discharged.

For discharges from the MDP, the effluent will continue to be pumped automatically when the level reaches a pre-determined set point. The new pipeline will carry the effluent directly to the Estuary and therefore discharges will occur at all stages of the tide cycle. As this effluent will no longer mix with sea water within the east cooling outfall, there will not be the same initial dilution (nominal 10:1) of the discharge, however, this effluent contains only trace levels of activity and as such the impact from this variation is insignificant.

When an FMDT is ready for discharge, it is isolated to prevent any further input of effluent, recirculated to ensure homogenisation and sampled. Analysis of the pre-discharge sample is reviewed and if all parameters are within expected and permitted limits, the discharge is authorised. An interlock system prevents discharge prior to the approval of the discharge by an Appointed Suitably Qualified and Experienced Person (ASQEP) for liquid discharges.

Discharge time and method are optimised to minimise the radiological effects on the environment and members of the public. Active Effluent discharges currently take place between high tide plus one hour and high tide plus two hours which is identified as the optimum time for dispersion of the effluent (Note: FED effluent discharges are discharged between high tide plus one hour and high tide plus one and a half hours for compliance with Environmental Permit DP3127XB). The discharge utilises a flow of abstracted estuary water to ensure effluent is flushed from the discharge pipe and to maximise dispersion. The current system achieves an 8,550:1 dilution of the effluent within 100m of the discharge point.

For the new discharge line, modelling studies have been carried out to inform the design of the outlet and timing of discharge to ensure it achieves the maximum dispersion possible. This modelling covers both near field and far field dispersion and considers both instantaneous and annual averaged impacts.

There are two factors affecting the choice of discharge window; instantaneous dilution and minimising return of effluent on the following rising tide.

The results of the far field modelling (Ref: 1) show that a discharge time closer to high water reduces the retention within the Estuary, however, this also reduces the initial dilution factor due to the low current speeds. A discharge window of high tide plus one hour and high tide plus two and a half hours has therefore been identified as the optimum, taking both near and far field dispersion into account (Ref: 2). This slightly larger window also allows for operational flexibility. Calculations of the time taken for the effluent to reach the discharge point will need to be carried out to determine changes to the operating instructions regarding authorised discharge times, prior to use of the new line.

The general arisings of aqueous active effluent (AE) and the FED dissolution effluent which may be discharged via the new line have different densities and compositions. Modelling was therefore carried out for each effluent stream to identify the optimum design of the discharge point (Ref: 3) to achieve the maximum dispersion. The modelling identified different heights for the discharge port for each of the two streams, however, due to the design of the active effluent and FED discharge systems, both effluents will be discharged via the same line. The option to utilise a branched configuration to allow different streams to be discharged at different heights would involve significant design changes together with the risks of the incorrect head to be used during operation and as such this was not considered a credible option. The outlet design which is optimised for FED has been chosen as this is optimised for the higher hazard effluent (FED effluent is a solution of magnesium nitrate containing trace levels of heavy metals together with low levels of radioactivity). Modelling of the dispersion of the active effluent from the FED port has been completed to confirm that it will not have a significant detriment to the overall impact of discharges from Bradwell Site (Ref. 4). The original modelling studies have shown that the near field dispersion of AE via the FED optimised discharge port would achieve a dilution of 500:1 or better at 100m for greater than 60% of tides compared to 500:1 at all times from its optimum discharge point (during current discharge window). This demonstrates that there is not a significant detriment to AE discharges by utilising the design to optimise FED discharges.

The AE outlet will, however, be reconfigured once FED dissolution discharges are complete to ensure discharges remain optimised during the C&M phases of the Site's lifecyle.

Taking the discharge window and outlet design into account, the modelling studies have shown (Ref: 2) that the near field dispersion of the FED effluent will achieve an average of 1,000:1 and a minimum of 240:1 within 100m of the outfall. For the AE, the near field dispersion will achieve an average of 650:1 and a minimum of 250:1 within 100m of the outfall. While both are lower than the dilution achieved by the current discharge system, the far field dispersion is not affected by the change. The reduced near field dispersion is the reason that the current system will be utilised as long as it is available to comply with the permit condition to use BAT to minimise the radiological effects of our discharges on the environment and members of the public.

3. Environmental Monitoring

There will be no additional environmental monitoring associated with the discharges of storm water and treated sewage effluent.

In the event that we need to changeover to the new pipeline prior to the completion of FED dissolution, the Environmental Monitoring Programme will be revised to confirm no accumulation is occurring, as predicted by the dispersion modelling. The changes to the programme will be documented and remain in place for the duration of the FED programme, but will consist of increased frequency of near field silt samples as a minimum (as the far field dispersion remains unaffected by this change).

4. Impact on People of Discharges and On-Site Disposals

There are no impacts from the discharges of storm water and treated sewage effluent.

HR Wallingford has carried out modelling studies to ascertain the initial dilution of both types of effluent and the far field dilution of the FED effluent.

The new design of discharge system will result in a reduced initial dilution of effluent within the Estuary.

The far field study is primarily looking at the impact of nitrate concentrations within the discharge, however, references to dilution of the effluent will apply equally to the radionuclides in solution. This modelling shows the predicted concentrations at various monitoring points and their variation over time. The maximum concentration corresponds to a dilution of 15,000:1 and shows that the concentrations drop dramatically once the discharge is complete. In addition to the above, additional consideration was given to the oyster beds located in the Blackwater Estuary which are designated shellfish waters. Modelling of the concentrations at the closest oyster bed predicts that the effluent achieves a 150,000:1 dilution relative to the initial concentration and that the plume does not reach the other bed at quantifiable concentrations.

Public doses for FED discharges have been estimated utilising the PC Cream software and are still bounded by the original dose estimates of <1μSv for an individual. As this model does not account for optimised dispersion or dilution and the general active effluent arisings will contain lower levels of activity than the FED effluent this estimate remains valid for both effluent streams. This estimate will be validated through the district survey programme.

5. Impact on Non-Human Species of Discharges and On-Site Disposals

There are no impacts from discharges of storm water and treated sewage effluent.

The area local to Bradwell Site is classified as a 'Site of Special Scientific Interest' (SSSI) and a 'Special Area of Conservation' (SAC) due to the presence of salt marsh. It is also classified as a 'Special Protected Area' (SPA) for the overwintering birds, including brent geese. The area has also recently been classified as a Marine Conservation Area.

The Environment Agency tool, the IRAT spreadsheet, was used to calculate the dose to Estuary Wildlife and gives a dose of $<1 \mu Gy\ h^{-1}$.

This value is below the guidance screening level of $1 \mu Gy\ h^{-1}$ however, as the area is classified as SSSI, SAC and SPA further detailed assessment of the potentially affected habitats was undertaken. The affected habitats are the wintering birds i.e. Brent geese and the salt marsh and therefore the calculated dose rate was compared to the values specified in ICRP (2008) for the protection of populations for the 'reference duck' and 'reference brown seaweed'. $<1 \mu Gy\ h^{-1}$ is below the lower value specified for both the reference duck and the reference brown seaweed and as such it is considered that there is no adverse impact of the discharge on the designated sites.

6. References

1. BRAD/EN/REP/114 - FED Discharge Arrangements: Far Field Dispersion (Including HR Wallingford Report EBR4908-RT010-R04-00)

2. BRAD/EN/REP/138 - HR Wallingford Report - RT012 - Annual Average Concentration - Dedicated Discharge

3. BRAD/EN/REP/142 - Effluent Discharge Arrangements: Initial Dilution (Including HR Wallingford Report EBR4908-RT009-R02-00)

4. BRAD/EN/REP/113 - Effluent Discharge Arrangements: Initial Dilution (Including HR Wallingford Report EBR4908-RT009-R04-00)