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Memorandum

Subject	**Secondary Containment – Firefighting Water**
To	DCC/NRW
From	Shital Nivle **Checked** Giri Sankar **Approved -** Thomas McNiven
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Notes	Memorandum drafted in response to Question Number 1 in Welsh Water Schedule 5 document:

1) **A detailed estimate of the anticipated volumes of firefighting water that could be used on-site in the event of a fire.**
2) **A robust justification for excluding firefighting water from your containment capacity calculations, supported by relevant assumptions or mitigation measures.**

NOTE:

To be read in conjunction with:

Figure 1 Modelling Output map showing the sludge depth within the secondary containment area after 1 hour.

Anticipated Volumes of Firefighting Water Used On-Site in the Event of a Fire

The Environment Agency's Fire Prevention Plan (FPP) guidance states that, in the absence of fire mitigation measures, a 300 m³ pile of combustible material requires access to a water supply of at least 2,000 L/min for a minimum of 3 hours. This guidance is primarily intended for sites storing combustible waste such as wood, paper, or plastics.

While anaerobic digestion (AD) facilities are explicitly excluded from this guidance, the benchmark can still serve as a useful reference when assessing fire safety provisions.

At Afan WwTW, the biogas holder has a capacity of 2,000 m³ (approximately 2.2 tonnes), as documented in the Sludge Containment Assessment (Ref: B16399-123532-ZZ-XX-RP-WA-HY1008) submitted to NRW. According to CIRIA C736, this volume corresponds to a medium fire severity classification.

Using the FPP benchmark proportionally, and assuming the biogas holder contains combustible material, the estimated firefighting water requirement would be approximately 800 m³/hr for a minimum of 3 hours, totalling 2,400 m³. This estimate is precautionary and does not reflect the lower combustibility and fire risk typically associated with biogas systems, which are enclosed and subject to strict operational controls.

Justification for Excluding Firefighting Water from Containment Capacity Calculations

The total containment volume available is 6622.00 m³ (Excluding space occupied by equipment's and structures within the containment boundary). The digester has a volume of 4250 m³, and the calculated requirement for firefighting water is 2400 m³. In the event of a catastrophic failure and fire event, the digester and firefighting water volumes amounts to 6650.0 m³. This indicates a shortage of 28 m3 in given containment boundary. To accommodate 6650.0m3 volume in containment boundary we will install minimum

100mm high upstand beneath the lower section of containment wall to accommodate the shortage of 28 m3 volume. Hence, the containment system is adequately sized to accommodate catastrophic failure and firefighting water volume, while also providing a small buffer for unforeseen scenarios.

CIRIA 736 guidelines specify that a 100mm freeboard for firefighting agents shall be included as part of the bund wall design.

The Afan secondary containment wall locations and heights have been assessed on the assumption that a sludge tank failure is catastrophic and instantaneous. This is a conservative approach, as a reinforced concrete digester would never fail in such a rapid manner. As a result, the wall heights generated using this approach are higher than any other failure scenario. This ensures that the wall heights are sufficiently sized for the initial event when the first high momentum surge strikes the bund wall. Furthermore, the modelling assumes that the tank content to be water thereby introducing an additional safety factor due to the lower viscosity of water. Water exhibits a higher hydrodynamic velocity upon interaction with the bund wall, compared to sludge with a solid concentration ranging from 2% to 8%. This further increases the bund wall height, enhancing the safety margin and mitigates any design risks.

Following the ‘surge’ event, the sludge will spread across the secondary containment area, and a noticeable drop in sludge level will be observed along the areas of the bund. Please refer to Figure 1 below, for the sludge depth within the containment area after a period of 1hr. These levels correspond to the point when the breach inflow has settled (end of modelling simulation).

For example, the wall located adjacent to the easternmost digester is sized at 1.9m - 2m above local ground level based on the results of the surge modelling. However, once the energy of the sludge dissipates, the level in the bund is expected to be a maximum of 0.8m - 1m as per modelling assumption, but in reality, the depth would be insignificant due to the extensive bunded area.

The freeboard between the steady state condition and the modelled wall heights (sized for surge), are magnitudes greater than the 100mm stated in the CIRIA guidelines. Even at the location of the automated flood gate (where the modelling outcomes reveal the lowest available freeboard within the containment area once the sludge is settled) the available free board is at least 200mm – 400mm. Please note that this freeboard value is determined based on the modelling of settled sludge under the worst-case scenario, which assumes a complete failure of all above ground sludge holding tanks.

Welsh Water operations team have confirmed that there is no fire hydrants located within the site boundary, for the local fire service to connect to. Also, there are no automatic fire suppressant systems located within the bunded area. In the event of a fire, local fire rescue trucks are automatically called out to site and use the fixed volume of water/foam that they carry on board. As there is no immediate fire suppression response, it is not practical to include firefighting agents in the ‘surge’ event. Therefore, the 100mm allowance that is stated in CIRIA 736 guidelines would only be applicable for the settled sludge scenario.

The likelihood of a fire causing digester failure and spillage during a 1-in-10-year rainfall event is extremely low (<1 in a million), so firefighting water is not considered a source in this study.

The containment is designed based on 110% of the capacity of the largest tank within the bund. As per CIRIA the 10% is considered to marginally cover a few factors out of which one factor is to provide allowance for firefighting agents, including a foam blanket on the surface or firefighting water.

As mentioned above, the settled sludge levels will be at least 200mm-400mm below the coping level of the containment walls. This equates to a safety of factor >2 when evaluated against the CIRIA 736 guidelines. It would take an unfeasible number of fire trucks to fill the remaining freeboard within the bund. For instance, the total area of the containment bund is approximately 6,894.0m^2(but the actual available containment area will be less than this as area utilized by tanks and building are not included in the storage volume). This translates to a freeboard volume of 1378.00m^3 (using the lower threshold freeboard of 200mm). Assuming

fire trucks with upper-level volume of 12,000 litres are used, then the minimum number of fire trucks to create an overflow scenario from the bund would be 114 nos. Firefighting freeboard and water volumes have not been considered in the containment capacity calculations for the above reasons.

There are a few potential fire sources located inside the bund, the main fire risk being the gas holder. The methane content within the gas holder would produce a high energy but short-lived explosion, rather than a sustained fire. Fire service response for this scenario would be as per existing site arrangement. It's also important to note that the gas holder is located on a raised reinforced concrete slab approximately 1.5m – 1.6m above local ground level, bringing the gas holder above the settled sludge level as per Figure 1.

The other fire risks within the containment area would originate from any substations/transformers during a tank failure event, thus starting an electrical fire. The bund wall route has been designed in such a way that 1No of the substations is located outside of the containment area. The other substation will be surrounded by mechanical-based walls within the bunded area, to isolate the substation from the rest of the containment area. Any electrical fire risks/sources have been mitigated as far as practically possible.

Figure 1 – Modelling output map showing the sludge depth within the secondary containment area after 1 hour.