

## EVENT INVESTIGATION REPORT

**Site: Hinkley A**

### Root Cause Investigation

Event Reference Number (from SPEED):

Site Unique Reference Number:

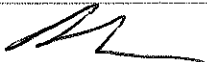
Q Pulse/EATS Reference: HKP-5733, HKP-5775, 5789

**Report Title: Radioactivity identified within sludge removed from site demineralised water tank.**

**Event Date: 31/08/23**

**Event Time: N/A**

### Issuing Signatures

|                                                                                                                                                                                                         | Signed& Dated*                                                                                  | Name (PRINT)  | Designation                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------|-----------------------------------------------|
| <b>SQEP Author:</b><br><i>This investigation is suitable and sufficient complying with requirements of S-039. The Guidance check sheet for Completion of F- 581 is complete.</i>                        | <br>11/10/23 | Oscar Yapp    | Head of Radiological Protection & Environment |
| <b>Responsible Mentor: (If applicable)</b><br><i>This investigation is suitable and sufficient complying with requirements of S-039. The Guidance check sheet for Completion of F- 581 is complete.</i> |                                                                                                 |               |                                               |
| <b>SQEP Verifier:</b><br><i>This investigation is suitable and sufficient complying with requirements of S-039. The Guidance check sheet for Completion of F- 581 is complete.</i>                      | <br>19/10/23 | Patrick Haley | Head of Profession Environment & Waste        |
| <b>Approval: (Site/Program Sponsor)</b><br><i>This investigation is suitable and sufficient and fulfils the requirements of the problem statement</i>                                                   |              | Paul Wildin   | EHSS&Q Manager                                |

\*NOTE: The signature dates should reflect first completion date of each individual's responsibilities and not be updated thereafter

## Investigation Event Report

For all events:

## Level of Investigation

The level of investigation for this event has been reviewed following the investigation findings.



Level Appropriate



Level Amended from ----- to -----

Justification:

Signed: 

(Sponsoring Manager) PAUL WILDIN

For ONR reportable events only, the following table should reflect the information contained on the INF 1 form and identify any updates (e.g. if final category has changed from initial categorisation)

|                                                                                                                         |       |                   |                    |            |    |    |
|-------------------------------------------------------------------------------------------------------------------------|-------|-------------------|--------------------|------------|----|----|
| <b>Event categorisation</b>                                                                                             |       |                   |                    |            |    |    |
| Initial S-495 Category (or Categories): Final S-495 Category (or Categories):                                           |       |                   |                    |            |    |    |
| ONR Category (or Categories):                                                                                           | NS    | RS                | SC                 | SG         | TS | AN |
| Original INES Rating:                                                                                                   |       |                   | Final INES Rating: |            |    |    |
| Reconciliation of the INES rating:                                                                                      |       |                   |                    |            |    |    |
| Report to other organisations:                                                                                          |       |                   |                    |            |    |    |
| EA/SEPA                                                                                                                 | Media | DECC for minister | Devolved Govt.     | Euratom SI |    |    |
| Other (detail):                                                                                                         |       |                   |                    |            |    |    |
| Identify any information that was contained in the preliminary notification report to ONR (INF1) that has been updated: |       |                   |                    |            |    |    |
| Date INF 1 (pdf) sent to ONR:                                                                                           |       |                   |                    |            |    |    |

## Investigation Team members:

| Role                      | Name       | Job Title / Department |
|---------------------------|------------|------------------------|
| Lead Investigator /Author | Oscar Yapp | HoRP&E                 |
| Mentor ( if applicable)   | N/A        | N/A                    |

List of those personnel interviewed (roles- no names):

| No. | Job Title / Department                          |
|-----|-------------------------------------------------|
| 1   | Head of Radiological Protection and Environment |
| 2   | Head of Operations                              |
| 3   | Provider of Advice (1-3)                        |
| 4   | Head of Profession for Environment and Waste    |
| 5   | N/A                                             |

## 1. PROBLEM STATEMENT (what needs to be solved)

### **Problem statement from Terms of Reference (ToR)-**

Please investigate the actions and decisions leading up to the discovery of the contamination and provide forward actions aimed to collate all available data on the extent of the condition within the system, identify other, potentially similar issues and prevent re-occurrence wherever possible.

Regarding disposal of liquor from the demineralised water tank, review the process for the authorisation of the discharge and scrutinise the methodology for analysing and permitting disposal of aqueous waste whether, or not it is radiologically contaminated. Contrast this with the requirement of the site Environmental Permit (EPR/ZP3693SL).

Regarding the demineralised water system, aim to establish whether:

- the contaminated sludge in the system could have impacted the quality of the demineralised water.
- there was any indication of demineralised water quality being inadequate.
- assess the potential impact on subsequent downstream system operations and potential impact in related to environmental discharges.

Summarise the environmental impact or potential impact from this event.

### **What happened-**

Poor water quality was identified within the demineralised water system at HPA. This led to analysis of conductivity and radiological properties of the water. The water was identified as not being suitable for the wet vaults due to its non-radiological properties.

A decision was made to remove the water from the Effluent Treatment Plant (ETP) Demin Reception tank to then allow removal of the sludge media to allow access for tank remediation/cleaning.

The Demin water was discharged via the permitted Storm Drains route prior to any knowledge of the presence and therefore analysis of radioactive contaminants within the sludge media at the base of the ETP Demin Reception tank.

### **What should have happened-**

Discharges of any liquor must be according to Best Available Techniques (BAT) and must be subject to a sound provenance argument. In this case, the assumption was made that the liquor within the tank was 'out of scope' of the Environmental Permitting Regulations 2016 (EPR 2016) by virtue of the influent to the tank consisting only of Demin water brought to site as required by tanker.

Having a sludge media within a demineralised water tank points to some level of contaminant being present (whether it is radiologically contaminated or not) having entered the tank at some stage.

In this case, the site arguably could have assumed the liquor from within the ETP Demin Reception tank to be contaminated because its provenance could no longer be adequately substantiated or relied upon as an argument for disposal.

However, given the age of the tank, some level of paint flakes or grit is to be expected and is not unusual to discover within a tank of similar construction. While the assumption could have been made that the sediment contained radioactive components, this assumption would still only be possible to substantiate upon accessing the waste itself after removal of the 5000 litres of liquor. The provenance

of this liquor was believed to be understood; hence questions were less likely to be asked about the potential for radioactive contaminants. The assumptions made based on provenance are considered to be reasonable given the information available at the time by those involved in the work.

Due to the fact there are no published 'out of scope' levels for contaminated or potentially contaminated liquors, all liquors must be treated as potentially contaminated and within the scope of the EPR 2016 regulations, unless the provenance can be demonstrably identified and be relied upon.

For example, rainwater collecting within a clean receptacle could be demonstrated to be out of scope of the regulations by way of provenance. However, a body of liquor from within an RCA that contained unexpected contaminants (radiological or otherwise) could not be considered out of scope by the same logic. This is true even if samples were taken and analysed because there aren't any out of scope activities (Bq) or specific activities (Bq/ml) to compare against when making this decision.

However, Process Document PD-026 Management of Waste, does require that waste not be disposed via sewers or drains unless approved by BAT and in consultation with a relevant SQEP.

### **Actual and potential consequences-**

Having stated the requirement for a sound provenance argument above, it is worth noting that data was collected on the specific activities of the liquor within the ETP Demin Reception tank and the R2 Intermediate Bulk Container (IBC). Neither analysis identified any detectable radioactivity above the Minimum Detectable Activity (MDA) for the liquor.

However, as mentioned, Cs-137 and Am-241 were detected in the Sludge media when this was tested on the gamma spectrometer (Gamma Spec). These radionuclides are associated with Hinkley A's ponds/vaults radioactive waste fingerprint.

In practice, data used to represent radionuclide transfer through the environment ([https://www-pub.iaea.org/MTCD/Publications/PDF/trs472\\_web.pdf](https://www-pub.iaea.org/MTCD/Publications/PDF/trs472_web.pdf)) indicate quantities of Cs-137 and Am-241 that would leach from the settled sludge is minimal as evidenced by high solid-solution partitioning ( $K_d$ ) coefficients (in order of  $10^4$  and  $10^5$  for Cs-137 and Am-241, respectively). This corroborates analyses indicating levels of both in water were below MDA.

The total mass of sludge/sediment removed from the ETP reception tank is circa **10kg**. The tank itself held **~5000litres** of liquor immediately prior to the discharge. Therefore, the contaminated sediment represents around **0.2%** of the total mass of the liquor.

I have outlined three separate dose assessments to show the potential dose to the public from the discharge of the Demin water from the ETP Demin Reception tank. The calculations supporting the assessment are available as a separate file upon request, they are not included here to protect the format of the report itself.

Scenario 1 assumes that the 5000 litres of Demin water discharged had the specific activity of the highest specific activity (Cs-137) sludge analysed from the ETP Demin Reception tank. This assessment is for illustrative purposes to show the potential 'worst-case' scenario as a consequence of this discharge assessment methodology. Evidence gathered on the visual condition and activity of the Demin water cannot necessarily be used to prove or disprove the liquor having a similar radiological makeup to the sludge uncovered beneath.

Scenario 2 dose assessment calculates the activity and potential dose to the public for the 5000 litres of water discharged assuming the MDA of the actual Demin water samples that were analysed utilising the site Gamma spec. All scenarios calculated utilised the relevant radiological waste fingerprint (9D913) and the relative abundancies of each radionuclide within that fingerprint to arrive at a value for total activity in Becquerels (Bq).

For Scenario 1 & 2 Company Standard S-731, Table 55 was utilised to provide accurate dose per unit release factors ( $\mu\text{Sv}\cdot\text{Bq}^{-1}$ ) for relevant pathways from disposal of aqueous wastes at HPA. *To be clear, this dose assessment methodology is based on discharge directly to the receiving water body and as such the results are an approximation for context only.*

Scenario 3, however utilises a different assessment methodology to estimate the potential dose to a member of the public on the shoreline. This assessment assumes the individual is stood at the location for 12 hours in 1 day. It also assumes the specific activity (Bq/g) of the MDA for the Demin water samples Cs-137 results mapped to the relevant radioactive fingerprint for the contaminants identified.

The 5000 litres of Demin has conservatively been assumed to be discharged into  $1\text{m}^3$  of beach sediment with a sediment density of  $1700\text{Kg}/\text{m}^3$  directly below the outfall of the storm drains system. This models the potential that the tide was out for 12 hours at the time of discharge meaning any activity would potentially be deposited within the beach sediment.

This dose assessment method makes use of the Generalised Derived Limits (GDLs) from [1,2] to give a dose to public for marine sediment. Again, the detail of this assessment is available at request.

[1] National Radiological Protection Board. Generalised Derived Limits for Radioisotopes of Hydrogen, Carbon, Phosphorus, Sulphur, Chromium, Manganese, Cobalt, Zinc, Selenium, Technetium, Antimony, Thorium, and Neptunium; Volume 16, No 3. 2005.

[2] National Radiological Protection Board. Revised Generalised Derived Limits for Radioisotopes of Strontium, Ruthenium, Iodine, Caesium, Plutonium, Americium and Curium; Application of Generalised Derived Limits; Volume 9, No 1. 1998.

### **Activity and Public Dose Assessment Summary**

**Scenario 1 Potential Total Activity (Bq)- 25.29 MBq.**

**Scenario 2 Potential Total Activity (Bq)- 428.78 kBq.**

**Scenario 1 - Assumed consequent dose to public=  $2.3 \times 10^{-3} \mu\text{Sv}$ .**

**Scenario 2 (MDA)- Assumed consequent dose to public =  $3.9 \times 10^{-7} \mu\text{Sv}$ .**

**Scenario 3 (Beach absorption)- Assumed consequent dose to public =  $0.35 \mu\text{Sv}$ .**

### **Comparison to annual limits for aqueous discharge-**

Annual limit for aqueous discharge of Cs-137 via all outlets= **1TBq.**

**Activity of Cs-137 in Scenario 1 (Bounding case) =  $(2.33\text{Bq/g} * 1000 * 5000) = 11.65\text{MBq}$ .** If Scenario 1 is believed to be credible, this amounts to **0.00117 %** of the sites annual limit for Cs-137 aqueous discharge via all routes.

**Activity of Cs-137 in Scenario 2 (MDA) =  $(2.15 \times 10^{-3} \text{Bq/g} * 1000 * 5000) = 10.75\text{kBq}$ .** If the measured result of the Demin water in Scenario 2 is believed to be credible, this amounts to  **$1.075 \times 10^{-6} \%$**  of the sites annual limit for Cs-137 aqueous discharge via all routes.

## 2. EXECUTIVE SUMMARY

The demineralised (Demin) water system at HPA is used to provide a supply of demineralised water to the wet waste vaults within the ponds building. Amongst other things this water is used for damping down the items retrieved from the wet vaults to assist in reducing the contamination hazard within the area.

Poor water quality was observed while utilising this system on 15<sup>th</sup> August.

A sample of liquor was taken from the Demin system for analysis of its conventional and radiological properties. This identified elevated conductivity levels but no radiological contaminants.

Liquor (~5000 litres) from the underground ETP Reception Tank, to allow inspection by confined space entry, was discharged on 18<sup>th</sup> August utilising site process and the aqueous waste disposal form, which was signed by the relevant, required specialists.

After discharge of the aqueous waste via the W2 (Storm Drain) route listed on the sites environmental permit, the tank was inspected. This inspection identified in addition to flaking wall paint, a thin layer of settled sediment that sat below undrained aqueous liquid. This sediment was sampled and analysed. These results identified elevated levels of Caesium-137 and Americium-241. At this point work stopped and an investigation was instigated via a Team Based Fact Find (TBFF).

A Root Cause Investigation (RCI) was instigated and the following Causal Factors (CF), broken barriers and Route Cause (RC) were identified.

**CF-** Demin tank aqueous discharge assumed to be 'out of scope' due to 'known' provenance of the tank contents.

**CF and broken barrier-**, Albeit the provenance assumption was reasonable, there may have been a missed opportunity to revisit the initial assumption.

**RC-** Lack of corporate understanding and site knowledge training and communication on aqueous waste disposals. This lack of understanding does not extend to the corporate specialists with knowledge of the environment, it seems that at a company and site documentation level and for those not specialising in environment, disposals via provenance argument not widely understood.

### Recommendations to fix these conditions-

Update of company standards, site level working documentation and instructions to make the methods and responsibilities related to discharging aqueous waste more explicit.

There should also be consideration of how well this is included within the training of those authorised to write clearance protocols for materials and waste under Company Standard S-051, known as 'ASQEP Ms' and Providers of Radiological Substances Legislation Advice (PoRSLAs) at Magnox sites. As part of this review, it has been identified that this topic is explicitly covered during the training and assessment/interview of new PoRSLAs.

Consultation with the corporate environmental specialists as to the level of knowledge of site specialists and the general awareness of other disciplines linked to aqueous discharges. Actions will be considered for reviewing competency relating to aqueous discharges of any activity level for involved persons and the effective training of new relevant SQEPs.

The requirement to only discharge aqueous waste that is believed to be 'out of scope' by using an argument of known provenance, needs to be communicated and understood. Furthermore, the conditions for this provenance argument to be broken will also need to be explicitly understood so that a change in condition is appropriately identified and so that the provenance assessment/BAT may be reconsidered.

In the case of this event, the appearance of contaminants of any form within the Demin system/tanks could have prompted an assessment of the understood provenance of the liquor to highlight any abnormalities potentially meaning this waste would likely be 'in scope' of the Environmental Permitting Regulations.

However, given the age of the tank, some level of paint flakes or grit is to be expected and is not unusual to discover within a tank of similar construction. While the assumption could have been made that the sediment contained radioactive components, this assumption would still only be possible to substantiate upon accessing the waste itself after removal of the 5000 litres of liquor.

The provenance of this liquor was believed to be understood; hence questions were less likely to be raised about the potential for radioactive contaminants. The assumptions made based on provenance are considered to be reasonable.

The potential environmental impact from this event is minimal based on the assessment conducted and the likelihood that there was radioactivity within the aqueous waste discharged. However, it cannot be said with 100% certainty that no radioactivity was discharged via the permitted route.

The site intends to continue to utilise the permitted W2 'Storm Drain' route for aqueous wastes that meet specific, agreed criteria. This will be justified via a detailed option assessment (BAT) after consultation and communication with the EA as this will necessitate changes to the site's techniques document and discharge reporting methodology.

*Note: there are no out of scope levels written within EPR 2016 or associated guidance for aqueous wastes of this form. They may only be disposed of as 'out of scope' via a suitable argument of their known provenance.*

***Images of the top of the ETP Demin reception tank and the storm drain that the liquor was discharged to can be found in Appendix A.***

### 3. DESCRIPTION (sequence of events)

The demineralised (Demin) water system at HPA is used to provide a supply of demineralised water to the wet waste vaults within the ponds building. This water is used for damping down the items retrieved from the wet vaults to assist in reducing the contamination hazard within the area.

The Demin water system also supplies a tap within a small laboratory inside the Radiation Controlled Area (RCA) in the Pond Water Treatment Plant (PWTP), the aqueous waste outlet of this tap is connected to the Effluent Treatment Plant (ETP) system which is a permitted outlet under the Sites Environmental Permit (EPR/ZP3693SL). Elements of the Demin water system have been decommissioned over time.

On 15/08/23 poor water quality was observed in the R2 Wet Vault. Upon investigation, a black sediment was observed emanating from the Demin water supply to the PWTP laboratory sink. Subsequent conductivity testing identified that this water was not suitable for use within the wet vaults at HPA due to its conductivity and non-radiological properties.

15/08/23- the final tank in the Demin water system (an IBC in the R2 wet vaults) was sampled and analysed by both Gamma Spectrometry and Liquid Scintillation instruments. These results did not identify any radiological contaminants in the water above the detection limitations for the individual instrumentation.

17/08/23- The conductivity of the water sample from the ETP Demin tank was found to be higher than that of the IBC previously sampled.

*Note: The ETP Demin tank is the initial tank within the system and the IBC is the last in line prior to use of the liquor within the wet vault.*

Decisions were taken to follow established process and analyse and dispose of the water within the Demin tank via the permitted storm drain route subject to the requirements of the aqueous waste disposal form (HINA/F/0984) and the advice and approval of relevant Suitably Qualified and Experienced Persons (SQEPs). Site analytical methodologies are covered within Work Specification WS 607-2445 – Techniques used for sampling and assessment of radioactive waste disposals.

The Local Site instruction covering the management of radioactive aqueous liquid waste is HINA/LSI/16/2, Company Standard S-037 details the standards for the assessment of radioactive liquid discharges. Process Document PD-012 Environmental Management signposts responsibilities of persons for management of environmental aspects and impacts.

The aqueous waste disposal form was completed with advice from relevant SQEPs. If the provenance of the aqueous waste is known, this process does not necessarily require a radiological analysis to be undertaken. As previously stated, radiological analysis had been conducted on the liquor within the R2 IBC that forms part of this system. To permit a discharge of aqueous waste an aqueous waste disposal form is required to be signed by- A Qualified Chemist, a PoRSLA and a Non-Rad Environmental Specialist, this combination of specialisms is required to cover all aspects of the waste disposal. The routes for discharge listed on the form are- The Pond Water Treatment Plant, Effluent Treatment Plant, Foul Drain and the Storm Drain.

*Note: Prior to the issue being identified, a proportion of the water within the ETP Demin tank had recently been pumped to the IBC at the final point of the system, making this a representative sample.*

18/08/23- Following approval via aqueous waste disposal form, approximately 5000 litres of demineralised water was pumped from the underground ETP reception tank to the adjacent storm drain. The process employed was designed to ensure the sediment at the bottom of the tank was not discharged as this was to be collected and disposed of separately.

*Note: Prior to this point, the presence of active sludge at the bottom of the tank was not readily detectable or accessible and none of the liquor samples analysed had identified any detectable radioactivity.*

30/08/23- After discharge of the liquor the sediment from the tank was retrieved into the Sludge Canning Building (SCB) by hand and was stored on a bunded 'spill deck'. Samples were taken of the sludge media for on-site radiological analysis prior to categorisation of the waste by the site Lower Activity Waste (LAW) team for eventual onward disposal.

31/08/23- Results from on-site radiological Gamma Spectrometry Analysis identified the sludge media to be contaminated with Cs-137 and Am-241.

The source of the radiological contamination and sludge media is unknown, and it may be difficult to postulate an accurate and credible route with any certainty due to the age of the tank and the lack of historical data relating to the tank itself.

#### Relevant radiological samples taken and analysed during investigation-

**ETP Demin Reception tank water sample-** Gamma Spec and Liquid Scintillation conducted- No activity detected above MDA.

**R2 Demin IBC sample-** Gamma Spec and Liquid Scintillation conducted- No activity detected above MDA.

**Demin water discharge hose swab Gamma Spec-** Potassium 40 detected only (Naturally occurring).

**ETP Demin Reception tank Sludge/Sediment sample-** Caesium-137 and low levels of Americium-241 detected (2.3 Bq/g Cs-137 and 0.061 Bq/g Am-241).

**Filtration sock Swab Gamma Spec-** Low levels of Caesium-137 detected (2.38Bq total on large area swab).

**Severn Estuary tide times on discharge dates-**

Routine discharges of radioactive aqueous waste are timed to be within 3 hours post high tide so that the liquor and any associated activity may be dispersed by the natural movement of the water out to sea during this tidal phase.

**18/08/23-** Discharge of approx. 5000 litres of Demin water. High tide was at **0954 BST**. The time of the discharge was **1000-1230 BST**. This discharge took place within the three-hour period of optimum dispersion after high tide.

**30/08/23-** Discharge of approx. 100 litres of residual liquor. High tide was at **0756 BST**. The time of the discharge was **2pm BST**. This discharge took place approx. 3 hours after the optimum high/post high tide period.

To be clear, these discharge times relate to the moment at which the aqueous waste was discharged and not the time at which they egressed from the storm drain system into the estuary/foreshore. The time taken for the waste liquor to exit the storm drains system is unknown.

The site intends to continue to utilise the permitted W2 'Storm Drain' route for aqueous wastes that meet specific, agreed criteria. This will be justified via a detailed option assessment (BAT) after consultation and communication with the EA as this will necessitate changes to the site's techniques document and discharge reporting methodology.

***Note: Images of the top of the ETP Demin reception tank and the storm drain that the liquor was discharged to can be found in Appendix A.***

Table of Events

| Date       | Time | What (was happening)                                                                                                                                                                                                                                                                                                                                                                                                                                                | Who (Role-no names)                                                                                                                                                                                                                                                                                                         | Where            | Comments                                                                                                                                                               |
|------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15/08/2023 |      | Following observations of poor water clarity in R2 Magnox Vault and a black sediment in the demineralised water supply to the PWTP laboratory, ion conductivity testing at various locations identified the demineralised water was not suitable for use in the Magnox Vaults. HKP-5733 raised.                                                                                                                                                                     | Site Chemist.                                                                                                                                                                                                                                                                                                               | R2 Magnox Vault. | Abnormality identified with liquor- Learning Capture Form (LCF) raised in line with Magnox event reporting process.                                                    |
| 15/08/2023 |      | Liquid samples from the R2 Magnox Vault IBC, the last tank of demineralised water in the system, were analysed by liquid scintillation and gamma spectrometry. The results identified no detectable contaminants.                                                                                                                                                                                                                                                   | Lead Waste Engineer,<br>Radiological Protection Engineer.                                                                                                                                                                                                                                                                   | R2 Magnox Vault. | Important: Demin liquor had recently been pumped from the ETP Demin Reception tank to the IBC making these samples representative- <i>Site Chemist</i> .               |
| 17/08/2023 |      | Discussions identified that the conductivity readings of the ETP tank were higher, and the following decisions were made: <ul style="list-style-type: none"> <li>Demin Water deliveries to be suspended.</li> <li>ETP Demin Tank to be drained and cleaned.</li> <li>Engineering inspection of tank integrity to take place.</li> </ul> Construction Manager to discuss with Head of Rad Protection & Environment and Environmental Coordinator for further advice. | Meeting Membership:<br>EHSS&Q Manager,<br>Construction Manager,<br>Lead Programme<br>Support Engineer (DC),<br>Head of HAW Operations,<br>HAWO Senior Project Manager,<br>OE Engineer,<br>OE Data Coordinator,<br>Industrial Safety Advisor,<br>Head of LAW Operations,<br>Work Control Coordinator,<br>AIC Work Pack Lead, | HPA offices      | Efforts were focused on identifying the source of the increased conductivity within the Demin tank.<br><br>Provenance considerations were not discussed at this stage. |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                          |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                          | Maintenance Engineer,<br>FM Site Manager. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| 17/08/2023<br>0930 | Meeting held to discuss options to resolve the high conductivity water in the Site's demineralised water tanks.<br><br>It was decided that the ETP Demin Tank and R1 & R2 Pile Cap Head Tanks required draining and inspecting prior to refilling with demineralised water.<br><br>The ETP Demin Tank was to be pumped to a local storm drain following preparation and acceptance of HINA/F/0984, Aqueous Waste Disposal Form.<br><br>The Pile Cap Head Tanks were to be drained to Active Effluent drains within the Ponds Buildings. This was decided for operational simplicity rather than because of any questionable provenance or sample results. | Construction Manager (Chair),<br>Head of Rad Protection & Environment,<br>Environmental Coordinator (Non-Rad),<br>Lead Programme Support Engineer (Duty Controller),<br>Senior Authorised Person (E&M & NR),<br>Head of HAW Operations,<br>Active Waste-Water System Engineer,<br>Site Chemist,<br>Environmental Advisor (Rad) (Provider of RSL Advice). | HPA offices                               | Conservative decisions made to protect generation of any further aqueous waste.<br><br>Site process for disposal of liquor was followed.<br>Radioactivity was not yet detected on samples taken.<br><br><i>Finding: HINA/LSI/16/2 Management of Radioactive Aqueous waste states that no aqueous waste shall be disposed of via storm drains. This comment is opposed to the wording of the Permit and the Techniques document (607-2445).</i><br><br><b>Action: Review and update 607-2445 and LSI-16-2. Environment Team.</b> |  |
| 17/08/2023         | To allow discharge of approximately 5,000 litres of demineralised water from the ETP Demin Tank to storm drains, the Aqueous Waste Disposal Form completed detailing 'no requirement to analyse for radioactivity given the known provenance of the liquor' and noting that 'a small quantity of settled particulate in base not to be discharged'.<br><br>These decisions considered the results of the R2 Magnox Vault IBC liquor analyses (no                                                                                                                                                                                                          | Site Chemist,<br>Environmental Advisor (Rad) (Provider of RSL Advice),<br>Environmental Coordinator (Non-Rad).                                                                                                                                                                                                                                           | HPA offices                               | The Aqueous Waste disposal form explicitly states that 'Settled Particulate is not to be discharged'.<br><br>Radiological analysis for the R2 Demin IBC was available at the time of this decision and was reviewed prior to discharge permission being granted.                                                                                                                                                                                                                                                                |  |

|                    |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                         |             |                                                                                                                                                                                                                             |
|--------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                    |           | contaminants).<br>Note: The Non-Radiological Environmental Permit, EPR/EB/3392VY, allows the discharge of up to 10,000 litres of General Services Water (this includes demineralised water) per day.                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                         |             |                                                                                                                                                                                                                             |
| 18/08/2023         | 1000-1230 | ETP Demin Water Tank pumped out, using 'puddle sucker' pump, to adjacent storm drain leaving settled solids in the bottom of the tank. Work was completed under HINA/MWC/064, Risk Assessment, Designated Work Certificate & POWSA, complying with Aqueous Waste Disposal Form.                                                                                                                                                                                                                                                                             | Lead Programme Support Engineer (DC), Programme Support Technician (X2), Infrastructure Manager (Observing).                                                                                                                                                                                            | ETP in RCA. | No Radioactivity in liquor detected prior to discharge.                                                                                                                                                                     |
| 23/08/2023<br>1147 |           | Email sent detailing the next steps required to return the ETP Demin Water Tank to service.<br>Included current position: <ul style="list-style-type: none"> <li>ETP Demin Tank drained and containing residual solids.</li> <li>R1 &amp; R2 Pile Cap Head Tanks drained and containing approximately 100 litres of residual liquor.</li> <li>PWTP Demin Tank contains 11,000 litres of out-of-spec Demin water.</li> </ul> Risk Assessment and Method Statement (RAMS), Selected Persons Report (SPR) & Rescue Plan prepared for ETP Demin Tank clean out. | From: Construction Manager.<br>To: Head of Rad Protection & Environment,<br>Senior Authorised Person,<br>Head of HAW Operations,<br>Active Wastewater System Engineer,<br>Site Chemist,<br>Head of Programme Support,<br>Mechanical Systems Engineer,<br>Head of Systems Engineering,<br>Lead Programme | HPA offices | Pile Cap Head tanks were drained to the ETP system due to having an operational route downstream to this system.<br><br>Out of spec- No longer believed to be true Demin water due to foreign media within the tank system. |

|                    |                                                                                                                                                                                                                                                                                                                                    |  | Support Engineer (DC).<br>Senior Authorised Person.                                              | HPA offices | No Comment.                                                                                                                                                                                                                                   |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29/08/2023<br>0841 | Safety Document prepared for entry into ETP Demin Water Tank to pump out residual liquor and clean out sediment in preparation for Engineering inspection of tank integrity.                                                                                                                                                       |  |                                                                                                  |             |                                                                                                                                                                                                                                               |
| 29/08/2023         | Safety Document issued.                                                                                                                                                                                                                                                                                                            |  | Senior Authorised Person,<br>Gen Ops Team Leader.                                                | HPA offices | No Comment.                                                                                                                                                                                                                                   |
| 29/08/2023         | Set up of work area for tank entry.<br>Entry did not take place due to filter sock, for capturing solids, having not arrived on site.                                                                                                                                                                                              |  | Gen Ops Team Leader,<br>Gen Ops Team,<br>Radiological Monitoring Person.                         | ETP in RCA  | No Comment.                                                                                                                                                                                                                                   |
| 30/08/2023         | Entry made to ETP Demin Water Tank; residual liquor pumped out to adjacent storm drain via filter sock to prevent carry over of solids, sediment cleaned up and transferred to Sludge Canning Building for storage on spill deck prior to final disposal.<br>Sediment samples taken for waste characterisation and final disposal. |  | Gen Ops Team Leader,<br>Gen Ops Team,<br>Radiological Monitoring Person                          | ETP in RCA  | Filter sock type-<br>From: Green Rhino Global company.<br>Model: XL sediment filtration system with oil detection indicator.<br>Information from Green Rhino Website- 'Sediment filtration system captures sediment particles down to 150µm.' |
| 31/08/2023         | ETP Demin Water Tank sediment samples analysed, and results identified Cs-137 and Am-241 above the minimum detectable activity.                                                                                                                                                                                                    |  | Lead Waste Engineer.                                                                             | HPA Lab     | No Comment.                                                                                                                                                                                                                                   |
| 31/08/2023         | Demineralised Water order cancelled pending further investigation into activity in ETP Demin Water Tank.                                                                                                                                                                                                                           |  | Head of Rad Protection & Environment,<br>Lead Programme Support Engineer (DC),<br>Administrator. | HPA offices | Decision made to prevent any mixing of new Demin water with the contents of the tank.                                                                                                                                                         |
| 31/08/2023         | Environment Agency informed of demineralised water discharge and active sediment present in                                                                                                                                                                                                                                        |  | Head of Rad Protection & Environment.                                                            | HPA offices | EA informed of the event without delay.                                                                                                                                                                                                       |

|            | the tank.                                                                                                                                                                                                                                                       | Head of Rad Protection & Environment. | HPA offices | No Comment.                                                                                                                                                                                            |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31/08/2023 | LCF HKP-5775 raised to record the presence of contaminated sediment in the ETP Demin Water Tank.                                                                                                                                                                | Gen Ops Team.                         | ETP in RCA  | Large area swabs undertaken of the floor where the sediment was located and the walls of the tank. Swab sampled were analysed together to give better precision and MDA on Gamma Spec instrumentation. |
| 04/09/2023 | Further entry made to the tank to take swabs of tank walls and floor for analysis.                                                                                                                                                                              | Lead Waste Engineer.                  | HPA Lab     | <i>Note: specific conclusions on contamination location within the tank cannot be drawn from this evidence alone.</i>                                                                                  |
| 04/09/2023 | ETP Demin Tank swabs agglomerated together to provide better result precision. The gamma spectrometry results identified Cs-137 and Am-241 above the minimum detectable activity for the collection of swab samples from all parts of the Demin tank internals. | Radiological Protection Engineer.     | HPA Lab     | No detectable radioactivity within liquid samples from ETP Demin tank.                                                                                                                                 |
| 05/09/2023 | Liquid samples taken from the ETP Demin Water Tank for conductivity testing were now analysed for radiochemistry by liquid scintillation and gamma spectrometry instrumentation. The results indicated no radionuclides were present at detectable levels.      | Radiological Protection Engineer.     | HPA offices | Review of the authorisation process for the disposal of Aqueous waste at HPA required.<br><u>Action: Review of Aqueous discharge methodology-EHSSQ Team.</u>                                           |
| 05/09/2023 | Learning Capture Form (HKP-5789) raised questioning the requirement to involve an ASQEP(M) in the decision making and authorisation to discharge aqueous waste using form HINA/F/0984.                                                                          |                                       |             |                                                                                                                                                                                                        |

#### 4. IMMEDIATE/MITIGATING ACTIONS

##### During discharge-

- Delivery of Demin water to the ETP Demin Reception tank was postponed.
- Radiological Gamma Spec analysis of R2 IBC of Demin water- This was requested as an additional step and was not strictly required by management system processes.
- Evidence gathered and information preserved for analysis (See Section 3).
- On site communication of the event via QPULSE system and daily Event Review meeting.
- Use of silt/sediment abatement system at 150 µm filtration.

##### Post event-

- Action set to analyse the condition of other tanks within the Demin system- Ongoing action from TBFF.
- Discharge activity assessment using measured data and bounding 'worst case' analysis.
- Discharge analysis used to create an entry in the site's aqueous discharge returns for August 2023 as required by HINA/LSI/16/2.
- Public dose assessment completed utilising measured data.
- Discussions and sharing of information with the site EA inspector.

#### 5. SAFETY SIGNIFICANCE/CONSEQUENCES OF THE EVENT (Including Actual and Potential Consequences)

##### Actual consequences

*To be clear, this dose assessment methodology is based on discharge directly to the receiving water body and as such the results are an approximation for context only.*

##### Potential dose to public-

The dose assessment conducted utilising the measured specific activity of the Demin water within the R2 IBC and the ETP Demin Reception tank indicates dose to the public from this discharge to be minimal at  $3.9 \times 10^{-7}$  µSv.

Company Standard S-731, Table 55 was utilised to provide accurate dose per unit release factors (µSv·Bq<sup>-1</sup>) for relevant pathways from disposal of aqueous wastes at HPA.

##### Activity potentially discharged-

**Total activity** fingerprint assessment conducted utilising the measured specific activity of the Demin water within the R2 IBC and the ETP Demin Reception tank of **428.78kBq**. This measured activity would amount to  $4.29 \times 10^{-5}$  % of the site's annual limit for discharges via all outlets.

Annual limit for aqueous discharge of Cs-137 via all outlets= **1TBq**.

**Activity of Cs-137 in Scenario 2 (MDA)** =  $(2.15 \times 10^{-3} \text{Bq/g} \times 1000 \times 5000) = \mathbf{10.75kBq}$ . If the measured result of the Demin water in Scenario 2 is believed to be credible, this amounts to  $1.075 \times 10^{-6}$  % of the sites annual limit for Cs-137 aqueous discharge via all routes.

### Potential consequences

This conservative, assessment assumes that the 5000 litres of water has the same specific activity as the 10kg of sediment recovered from the ETP Reception tank. This is not believed to be a credible assessment of activity or dose and is included purely as a bounding fault analysis.

#### **Dose to public-**

The dose assessment conducted utilising the measured specific activity of the Sediment from the base of the R2 Demin tank indicates dose to the public from this discharge to be minimal at  $2.3 \times 10^{-3} \mu\text{Sv}$ .

Company Standard S-731, Table 55 was utilised to provide accurate dose per unit release factors ( $\mu\text{Sv} \cdot \text{Bq}^{-1}$ ) for relevant pathways from disposal of aqueous wastes at HPA.

An alternative assessment (scenario 3) utilises an alternative methodology to estimate the potential dose to a member of the public on the shoreline. This assessment assumes the individual is stood at the location for 12 hours in 1 day. It also assumes the specific activity (Bq/g) of the MDA for the Demin water samples Cs-137 results mapped to the relevant radioactive fingerprint for the contaminants identified.

The 5000 litres of Demin has been assumed to be discharged into  $1\text{m}^3$  of beach sediment with a sediment density of  $1700\text{Kg}/\text{m}^3$  directly below the outfall of the storm drains system. This models the potential that the tide was out for 12 hours at the time of discharge meaning any activity would potentially be deposited within the beach sediment.

This dose assessment method makes use of the Generalised Derived Limits (GDLs) from [1,2] to give a dose to public for marine sediment. Again, the detail of this assessment is available at request.

**Beach Absorption Scenario-** Assumed consequent dose to public =  $0.35\mu\text{Sv}$ .

[1] National Radiological Protection Board. Generalised Derived Limits for Radioisotopes of Hydrogen, Carbon, Phosphorus, Sulphur, Chromium, Manganese, Cobalt, Zinc, Selenium, Technetium, Antimony, Thorium, and Neptunium; Volume 16, No 3. 2005.

[2] National Radiological Protection Board. Revised Generalised Derived Limits for Radioisotopes of Strontium, Ruthenium, Iodine, Caesium, Plutonium, Americium and Curium; Application of Generalised Derived Limits; Volume 9, No 1. 1998.

#### **Activity potentially discharged-**

**Total activity** fingerprint assessment conducted utilising the measured specific activity of the sediment from the base of the ETP Demin Reception tank of **25.29 MBq**. This measured activity would amount to **0.00253%** of the site's annual limit for discharge via all outlets. This is not believed to be credible for the reasons discussed in this report.

**Activity of Cs-137 in Scenario 1 (Bounding case)** =  $(2.33\text{Bq/g} \times 1000 \times 5000) = 11.65\text{MBq}$ . If Scenario 1 is believed to be credible, this amounts to **0.00117%** of the sites annual limit for Cs-137 aqueous discharge via all routes.

### Permit Requirements-

The sites Environmental Permit requires the Best Available Technique to be applied to aspects related to a radiological discharge.

Schedule 3- Disposals of Radioactive Waste and Monitoring, table S3.2 Disposals to water, outlines the annual limits for the approved disposal outlets W1 and W2.

W1 is the system provided for discharging radioactive waste from the Final Monitoring and Delay Tanks to the Bristol Channel.

W2 is the system for discharging storm water and 'general service water' to the Bristol Channel via the Storm Water Outlets.

The discharge described within this RCI was through the W2 route.

The Annual limits for Tritium, Caesium-137 and 'Other radionuclides' listed within this table are for All outlets (W1-W2, including approved outlets) the W2 limit is 1% of the total for all site outlets.

At the point of discharge of the Demin water from the ETP Demin Reception tank, the water was believed to be in line with the description of 'general service water' within this permit, this would allow it to be discharged via the W2 route.

However, the implication of there being an additional contaminant within the tank gave the opportunity to question the potential for the water to not be adequate to class as general service water. As aqueous wastes can only be sentenced via a strong provenance argument, the observed addition of a foreign contaminant should have raised the question about the suitability of the liquor to be discharged via this route.

#### **Process Document PD-026 Management of Waste**

Section 3.8, Page 9.

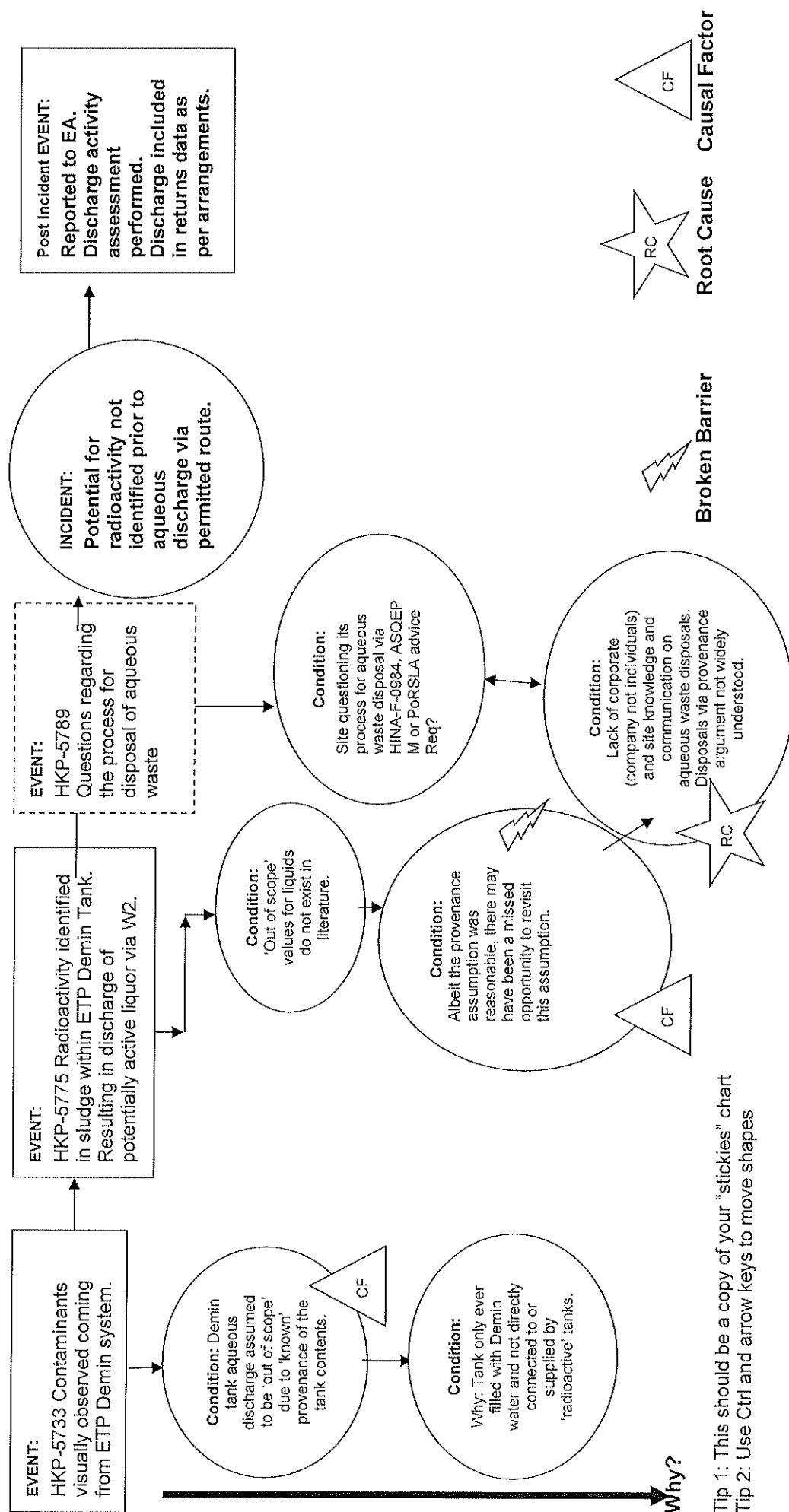
*Ensure that waste material is not disposed to drains, the sewer or other discharge routes unless this has been agreed to be BAT (exclusion of entrained solids/non-aqueous materials) with a relevant SQEP person and is permitted by the site's relevant permit.*

Further justification would have then been required by way of an Options Assessment by following Company Standard S-391 Options Assessment for Radioactive Substances Legislation (BAT) compliance and communication with the Environment Agency.

The site intends to continue to utilise the permitted W2 'Storm Drain' route for aqueous wastes that meet specific, agreed criteria. This will be justified via a detailed option assessment (BAT) after consultation and communication with the EA as this will necessitate changes to the site's local instruction documents and discharge reporting methodology to comply with the requirements of the site's techniques document.

**6. ANALYSIS/FINDINGS FROM THE INVESTIGATION (Including Immediate Cause, Causal Factors, Apparent or Root Cause, Latent Conditions and Missing or Broken Barriers Causes Include WANO/UK Cause Code)**

### Mandatory: Event and Causal Factor Analysis Chart



Tip 1: This should be a copy of your "stickies" chart

Tip 2: Use Ctrl and arrow keys to move shapes

Completed form is a permanent record



## Findings from the Investigation

### Causal Factors-

#### ***CF- Demin tank aqueous discharge assumed to be 'out of scope' due to 'known' provenance of the tank contents.***

Prior to this event, Hinkley Site had not considered the Demin tank system to be in scope of the EPR 2016 regulations for any radioactive properties. This is due to the system having no connections or in flows from any radioactive aqueous system and having only ever being filled with Demin water bought from off site by an approved supplier when required by the site.

How the radioactivity became present in the ETP Demin tank is not the subject of this RCI and is difficult to predict due to the tank having been in place for many decades performing a similar function.

The impact of this is, when the visual change in the quality of the liquid was identified, the history of the tank was assumed to be known and be free of any possible radioactive contaminant. The sludge/sediment identified was assumed to be of a non-radiological nature, and the testing undertaken initially utilised conventional methods such as pH, conductivity, and non-radiological particulate sampling to ascertain the type of aqueous contamination present.

### **CF and broken barrier-**

Albeit the provenance assumption was reasonable, there may have been a missed opportunity to double check this assumption.

As mentioned above, when the sediment/sludge was identified, the initial hypothesis was that the contaminant was non-radiological. Thus, when the aqueous disposal form was utilised to permission the discharge, the potential for radioactivity was not covered within the paperwork. This was a missed opportunity to stop and reflect upon the provenance of the waste sediment- Broken Barrier.

However, the radioactivity of the liquor within that system had been tested at the point of the IBC in R2 Vault which had recently received liquor from the ETP Demin tank. At this time, the site believed the liquor to be out of scope and not to have the potential for radioactivity due to the analysis of the liquor sample showing no detectable activity and the history of the influent to the tank.

### **NDA guidance states that:**

*'There are ongoing issues associated with sentencing aqueous waste that has an extremely low level of activity. There is no equivalent of the solid radioactive waste 'Out of Scope (OoS)' or de minimis values.*

*Potentially, this means that aqueous waste can be unnecessarily categorised and managed as radioactive waste, leading to plants or processes being developed that are disproportionate to the hazard associated with such waste. 'Nuclear Industry Aqueous Waste Management Good Practice Guidance*

**December 2020, Issue 1, Section 1.6.**

This good practice guidance outlines the challenges in selecting an appropriate disposal route for aqueous wastes if they are believed to be 'out of scope'. In the case of this event, all aqueous waste samples from the Demin system tanks that were tested failed to identify any man-made radioactive isotopes above the MDA for the instrumentation. However, as there are no written 'out of scope' levels pertaining to aqueous wastes, the only way the site may have acted correctly in this instance is to immediately sentence the Demin water as 'potentially active' upon identifying the sediment at the base of the Demin tank.

For clarity, to have avoided the discharge of this aqueous waste, the site would have had to identify the potential for radioactive contamination at the time at which the sediment was identified. They would then

have been required to remove the aqueous waste from the tanks so that it could be appropriately examined and characterised (requiring storage of 5000 litres of liquor) thus allowing the sediment at the base of the tank to be exposed sufficiently, such that required samples could be acquired in a safe manner.

**RC- Lack of corporate and site knowledge and communication on aqueous waste disposals. Disposals via provenance argument not widely understood.**

The causal factors have identified that the understood history and provenance of the influent to the Demin water system contributed to event, in that the potential for radioactivity within this system arguably could have been highlighted at an earlier stage. The addition of a 'clear' Gamma spec sample of the liquor within the IBC Demin tank further solidified this tacit understanding prior to the discharge of the liquor from the tank to W2.

Why? When I spoke to a number of key stakeholders for the disposal of aqueous wastes at Hinkley, it became apparent that the requirement to only discharge or dispose of aqueous wastes of an understood provenance, was not known by every individual. Some believed that an ASQEP M and or PoRSLA could analyse a sample of liquor and decide upon its ongoing disposal or treatment based on the levels identified by radiological analysis. This also links to HKP-5789 where the site questioned the approval route of the HINA/F/0984 form and asks whether ASQEP Ms should be included to identify potential routes for disposal.

To be clear, the requirements and arrangements surrounding the disposals of aqueous wastes are covered in PoRSLA training and the interview for this role conducted by the Head of Profession for Environment and Waste for Magnox.

Why? From my investigation, the only place within the Company Standard for Radiological Clearance of material and waste (S-051) that mentions aqueous wastes is the following passages-

***Company Standard S-051 Assessment, control and Radiological Clearance of Material and Waste  
Section 2: Considerations for monitoring, Page 30-31. Potentially contaminated liquid with sludge or suspension?***

*Disposal of aqueous and non-aqueous liquids containing solids in suspension (which are insoluble) should take into account the activity content of both the solids and the liquid. Assessment should be carried out of both components to determine whether the material can be released. Both components shall be below the relevant levels.*

***Potentially contaminated liquids present?***

*Prior to the disposal of aqueous and non-aqueous liquids representative samples shall be taken. Bulking of samples is acceptable if they come from similar sources with similar activity. Prior to sampling ensure liquid is well mixed.*

These passages suggest that samples should be taken and analysed to help decide whether the potentially contaminated liquid can be released. It suggests that the analysis should be below the relevant levels prior to releasing the waste. As outlined previously, there are currently no parameters (de-minimus values) at which aqueous waste can be deemed 'out of scope' of EPR 2016.

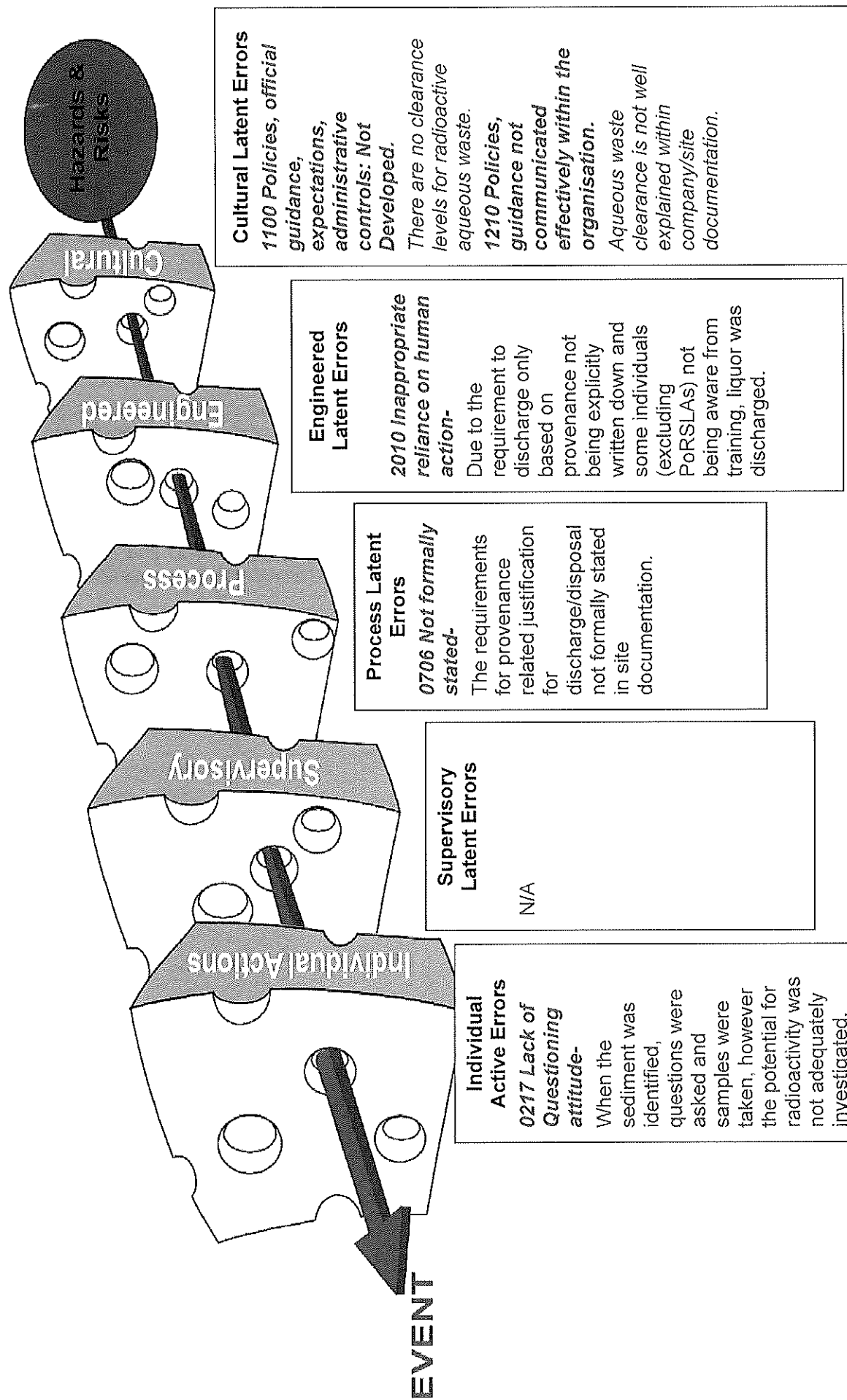
I believe this passage in S-051 to be misleading as it is not explicit enough to determine the type or volume of wastes being considered by the standard, nor does it outline the disposal routes which S-051 is attempting to permission disposals through.

In summary, the identified Route Cause is the lack of knowledge and tacit understanding of procedures at a site and operational level to allow the issue of provenance to be identified at an early stage. If this had been

identified, procedures would have been enacted which require an options assessment (BAT) to be completed to re-assess the available data and options.

To be clear, the site intends to continue to utilise the permitted W2 'Storm Drain' route for aqueous wastes that meet specific, agreed criteria. This will be justified via a detailed option assessment (BAT) after consultation and communication with the EA as this will necessitate changes to the site's local instruction documentation and discharge reporting methodology. The EA do not permission arrangements in this regard but will be consulted to allow the discharge to be articulated and represented within the current agreed arrangements.

MANDATORY Swiss Cheese Model for Demin water supply contamination



## 7. EXTENT OF CONDITION (Cause and Effect)

The knowledge and guidance relating to appropriate discharge of aqueous wastes does not appear to be at a sufficient level within company documentation, site documentation and SQEPs.

Communication and discussion of this event will take place via the company Head of Environment meetings and routine Radioactive Waste Advisor (RWA) forums as well as the communication already undertaken via the company event reporting system. The stakeholders at these locations will then ascertain the extent to which they are susceptible to the cause and effect of this event.

The cause of this event has been outlined as the lack of corporate and site knowledge training and communication on aqueous waste disposals. Disposals via provenance argument not widely understood by those not specifically trained in the detail.

The effect of this is that the potential for a systematic error existed relating to the disposal of aqueous wastes believed to be 'out of scope'. This existed, where the provenance argument had been challenged by a change in circumstances or radiological properties of the waste.

At Hinkley A, we will be revisiting our assumptions for the discharge of aqueous wastes believed to be 'out of scope' of the EPR 2016 regulations. This analysis will be conducted in an open and transparent way with the Environment Agency Inspector. We will ensure that all discharges of in and out of scope aqueous wastes will be covered by an appropriate provenance argument and/or BAT assessment.

**8. OPERATING EXPERIENCE**

*HKP-1670 – This event concerns fixed contamination that was identified in a Demin water tank in the Sludge Canning Building. The tank is fed from the ETP Demin reception tank. However, the source of this contamination is believed to emanate from the SCB itself as there were historical spills near the tank.*

*HKP-2613- This discolouration in Demin liquor was assessed to be due to the specific line not having been used for a number of years and the line being made of steel at this point which may have rusted over time.*

*COOL Event 012926- this concerns the discharge to ground of a number of carboys of liquid from a trench at a Berkeley Site. Additional carboys were sourced for the liquor which turned out to be contaminated. The provenance of these carboy containers was not identified prior to using them for the liquor from the trench.*

*Chapelcross (CHX 606 and 670) identified evidence of radioactive contamination in parts of their towns main water system within their ponds complex. The source of this contamination was not ascertained, it was thought to be due to possible 'back flow' of the system in scenarios where a hose is connected to the pond from the towns main system.*

**QPulse/EATS Operating Experience Search**

| Search Criteria Used      |                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |
|---------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Locations                 | All sites                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |
| Criteria                  | Demin, Discharge, Provenance and Out of Scope for all Sites     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |
| Date Boundaries           | From : All To: 03/10/23                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |
| Eats/QPulse Reference No. | Record Title                                                    | Record Summary                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Repeat Yes/No |
| HKP-1670 (Jun 2019).      | Contamination found during de-plant of demineralised water tank | The Sludge Canning Building (SCB) decommissioning project were de-planting a redundant de-mineralised water storage tank. The work was being carried out in C2 conditions under an HPC as it was already known that the system had seen historic contamination. As part of the controls within the RCD, a pre-survey was carried out, which identified levels of fixed contamination within the tank. The permit instructed the CP(NR) to inform the SAP(NR) if any intended cut sites were >1cps alpha or >30cps beta-gamma. Fixed contamination up to 5cps alpha and 40cps beta-gamma were found uniformly on the internal surfaces of the tank. | No            |
| HKP-2613 (Mar 2020).      | PWTP Demin water discoloured                                    | During preps for commissioning the new PCF Demin water system, the PCF team started drawing Demin water from the PWTP - valve number R1 PWTP wash water DW 613, into two IBC's. It was immediately noted the water was very dark/discoloured/dirty. This was expected as the line had not been used                                                                                                                                                                                                                                                                                                                                                | No            |

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|                         |                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |    |
|-------------------------|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|                         |                                                     | for some time. Approx 100 litres was placed into the first IBC. The team then switched to fill IBC 2, expecting the liquor to have flushed the line, however it was still very dirty. The team then used STAR, and halted the operation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |
| CHX-606<br>(17/05/2018) | Activity Found During Ponds Towns Main Pipe Removal | During Ponds break tank installation ops, a section of Towns Main pipework was being removed as per instructions. Pre work survey recorded background levels for Beta and nil Alpha.<br>On completion of pipework removal a post work survey was carried out by the HP&S monitor and 130cps Beta (EP15) and nil Alpha (AP2) was detected from inside the open cut pipework.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | No |
| CHX-670<br>(13/06/2018) | Positive Cs-137 In Pond Drench Shower               | As part of the ODM process, questions were raised on the possibility of drench shower water also containing sediment found as part of LCF-606 due to the filling arrangements of the tank via the same towns mains water pipe.<br>Visual internal inspection is not possible.<br><br>The original gamma spec of the shower drench water samples (E47757, E47802, E47830) came back <0.01 Bq/ml for Co-60, Cs-134, Cs-137, Am-241 when analysed whole as a water sample, However it was noted for sample E47802 that 9ppm of total suspended solids was found. This raised the question of checking the 9ppm of solids present for gamma spec.<br>Unfortunately prior to the question being raised at the ODM, E47757 and E47802 have been placed in the tech labs carboys awaiting disposal via the approved radioactive effluent disposal route. E47830 remained and sample was analysed.<br><br>Pond drench shower water sample (E47830) was filtered and 0.0119g collected and analysed using gamma spec. Positive Cs-137 found at 50+/-32 Bq/g. | No |

## COOL Operating Experience Search

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| Search Criteria Used |                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |
|----------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Locations            | Describe Company Site Locations Searched e.g. All Sites or External           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |
| Criteria             | Deminerallised, Discharge, Aqueous, Provenance, Out of Scope, liquid, carboy. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |
| Date Boundaries      | From : All                                                                    | To: 03/10/23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |
| COOL Event No.       | Record Title                                                                  | Record Summary                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Repeat Yes/No |
| COOL-012926          | Event Green Brief brk00115 - Contaminated Carboy                              | <p>Routine secondary containment trench inspection required pumping out of ground water. Due to rain, greater than anticipated quantities of water were found, and additional carboys were required to hold this liquid.</p> <p>On completion of the work, the water was discharged, on agreement with the RSL Provider of Advice. However, post-use contamination survey of the carboys identified one with loose contamination. Based on pre-discharge analysis of the water, this contamination is thought to have been pre-existing, and therefore had the potential to cross-contaminate the ground water.</p> | No            |

## 9. LEARNING FOR OTHER PLANT

As discussed, the understanding of the requirements for aqueous waste disposal may not be as widespread as intended. Magnox sites should review their provenance arguments and ensure that all of their aqueous waste disposals are in line with the relevant requirements of EPR 2016, national guidance and the company management system.

The company management system documents outlined within this RCI should be reviewed by a SQEP environmentalist to ensure they are fit for purpose in their explanation and instruction of what is required for the disposal of aqueous wastes that are believed to be 'out of scope'.

This report and the information contained within it will be shared with other Magnox sites, the Central Magnox Environment Team and the Environment Agency.

## 10. RECOMMENDATIONS/PREVENTIVE OR CORRECTIVE ACTION PLAN

| <i>Finding/Cause (including code number and description)</i>                                                                                                                                             | <i>Evidence</i>                                                                                                                  | <i>*Associated Process, Standard or Instruction (if applicable)</i> | <i>Recommendation/Action Description</i> | <i>Desired Outcome &amp; Measurable Closure Criteria</i> | <i>Proposed Assignee</i> | <i>Due Date</i> | <i>Major Or Minor Finding</i> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------|----------------------------------------------------------|--------------------------|-----------------|-------------------------------|
| 1<br><b>0217 Lack of Questioning attitude</b><br>When the sediment was identified, questions were asked and samples were taken, however the potential for radioactivity was not adequately investigated. | Incomplete understanding at a site level of the provenance arguments for discharge of aqueous waste believed to be out of scope. |                                                                     | See 5                                    | N/A                                                      | N/A                      | N/A             | N/A                           |
| 2<br><b>0706 Not formally stated-</b><br>The requirements for provenance related justification for discharge/disposal not formally stated in site documentation.                                         | Lack of understanding at a site level of the provenance arguments for discharge of aqueous waste believed to be out of scope.    |                                                                     | See 5                                    | N/A                                                      | N/A                      | N/A             |                               |
| 3                                                                                                                                                                                                        | Incomplete                                                                                                                       |                                                                     | See 5                                    | N/A                                                      | N/A                      | N/A             | N/A                           |

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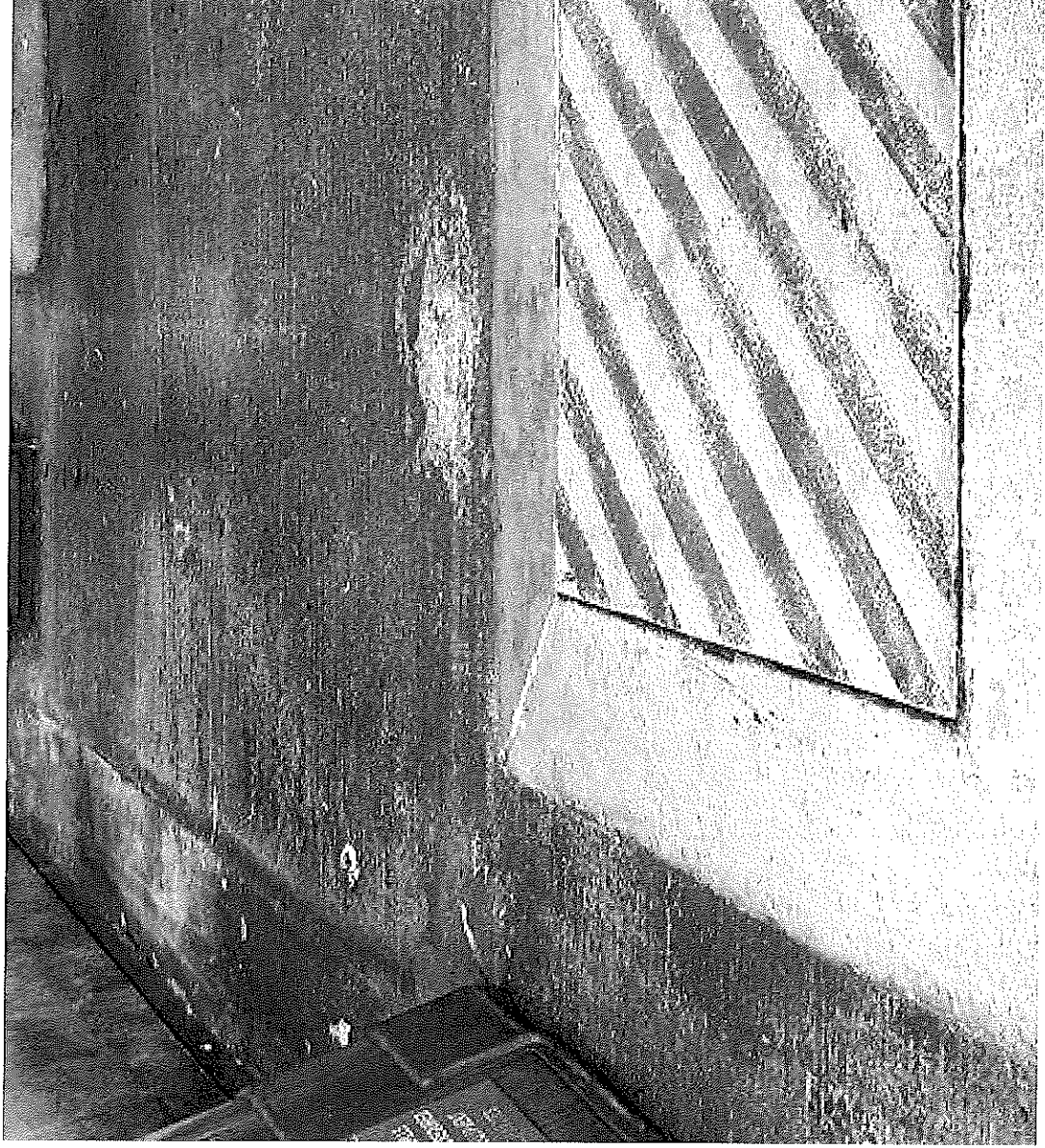
|   |                                                                                                                                                                                                                  |                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                              |                                |                              |       |      |     |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------------|-------|------|-----|
|   | <b>2010 Inappropriate reliance on human action-</b><br>Due to the requirement to discharge only based on provenance not being written down and individuals not being aware from training, liquor was discharged. | understanding at a site level of the provenance arguments for discharge of aqueous waste believed to be out of scope.            |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                              |                                |                              |       |      |     |
| 4 | <b>1100 Policies, official guidance, expectations, administrative controls: Not Developed.</b><br><i>There are no clearance levels for radioactive aqueous waste.</i>                                            | As written. This is something he NDA and the EA are discussing and working on.                                                   | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                      | N/A                                                                                                                                                                                                                                                                          | N/A                            | N/A                          | N/A   | N/A  | N/A |
| 5 | <b>1210 Policies, guidance not communicated effectively within the organisation.</b><br><i>Aqueous waste clearance is not well explained within company/site documentation.</i>                                  | Incomplete understanding at a site level of the provenance arguments for discharge of aqueous waste believed to be out of scope. | Action: Review and update 607-2445 and LSI 16/2.<br>Action: Review of aqueous discharge methodology, update documentation where required and communication of this to relevant stakeholders.<br>Action: communication of requirements to site stakeholders.<br>Action: Inform central Env team of the findings of this RCI so that company documents and statutory training and required knowledge for staff and SQEPs can be addressed. | Requirements explicitly stated within documentation. Any inconsistencies between documents outlined and amended.<br>Adequate disposal arrangements for all wastes of this type.<br>Communication of requirements to relevant site stakeholders and consultation with the EA. | Environment Team<br>Oscar Yapp | TBD at Event Review Meeting. | Major |      |     |
| 6 | Effectiveness review                                                                                                                                                                                             |                                                                                                                                  | Carry out effectiveness review of actions.                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                              |                                |                              |       | TBD. |     |

\*Where a finding is associated with a deficiency in a Process, Standard or Instruction, identify the document here

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11. Appendix A- Images

ETP Demin reception tank lid.



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Storm drain that received Demin liquor discharge



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## Guidance Check Sheet for Completion of F- 581

## GENERAL REQUIREMENTS

The format of the report template is such that it satisfies minimum reporting requirements for ONR reporting.

The report is be clear and concise with a level of detail reflecting the significance of the event.

Each section is expanded as appropriate.

The language kept simple. Avoiding the use of acronyms where possible or a glossary is provided if several acronyms are used.

Visual aids (photographs, diagrams, schematics) should be included to reduce text and aid understanding.

Analytical tools used are included within the body of the report

## 1. PROBLEM STATEMENT (What needs to be solved)

A problem statement is included which:

- Identifies what happened, where, when and, if appropriate, who (job title – not name)- actual performance;
- Identifies what should have happened – acceptable performance;
- Identifies the gap between actual and acceptable performance;
- Uses simple and direct, active, language;
- tells what, where, when and, Consequences are clearly and completely identified

Signed/Date Author: *QJY* 11/10/23

Signed/Date Verifier: *P. K. H. H. H.* 19/10/23

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COE Identified Opportunities for Improvement:

## 2. EXECUTIVE SUMMARY

**Best Practice:** The summary should be clear and concise (\*no more than half of a page), providing an overview of the event, the investigation, the cause of the event, extent of condition, and summarises preventive/corrective actions. It is suitable for unedited transmission to the board, regulators and can be pasted directly to a learning brief if required, to share the investigation learning

- The Extent of effect / cause are clearly and completely identified
- The Root Causes and preventive/corrective recommendations to prevent reoccurrence are clearly stated /summarised

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## 3. DESCRIPTION (When, what, who[job title], where chronology)

**Best Practice:** The description is a concise, factual synopsis that sticks to the chronology of key dates and main events.

It allows staff at other plants to assess the level to which the event may apply at their plant by including sufficient detail of the plant/process involved. Detailed plant descriptions are avoided, or, are provided as separate appendices where essential. The use of photos and diagrams is encouraged as a way to provide clarity and reduce text.

- Include a brief description of the area/plant/equipment where the event occurred.
- Include a chronology of the event, including as required:
  - Specific activities being performed;
  - Work group carrying out work;
  - additional commentary

Include photographs, drawings and figures to reduce text and clarify understanding.

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**4. IMMEDIATE/MITIGATING ACTIONS**

**Best Practice:** Immediate or mitigating actions which have been taken in the interest of safety or to prevent another occurrence are detailed. Any actions which are 'holding' pending a more permanent solution are identified. Actions resulting from the findings of the investigation are detailed in section 9.

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**5. SAFETY SIGNIFICANCE/CONSEQUENCES (injured personnel, damaged equipment, plant shutdown, abnormal occurrence, business loss etc)**

**Best Practice:** The safety significance/consequences are to the point, described in sufficient detail and include reference to potential issues.

- Actual safety consequences and implications of the event are clearly described.
- Potential safety consequences and implications of the event are clearly described.
- Assessment considers if the event would have been more severe under reasonable and credible alternative conditions.

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**6. ANALYSIS/ FINDINGS FROM THE INVESTIGATION**

**Best Practice:** Clear causes are identified and soundly supported by facts and reflect the Event & Causal Factor Analysis Chart. Facts and evidence independently verified to support causes. The analysis addresses both technical and organisational issues. Clear demonstration of techniques applied and supporting conclusions developed.

- Investigation report reflects use of appropriate analysis technique/tool(s) used in this investigation. Where specific tools are claimed, supporting evidence should be included. Multiple tools are used as required to provide breadth and depth of analysis.
- Each cause clearly states what the issue is, and the resulting impact of this issue
- Data is translated into pertinent facts and/or sequence of events. The facts provided substantiate the conclusions of the investigation.
- Organisational and Human performance elements are addressed where applicable.
- The root cause(s), causal factor(s) and any other contributors are clearly defined
- Failed or missing barriers/defences are clearly identified.
- All requirements stated in the investigation Terms of Reference have been clearly addressed.

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**7. EXTENT OF CONDITION (Cause and Effect). Where else are we vulnerable? How could this cause another event?**

**Best Practice:** The extent of effect/cause review must have considered plant design, station processes, and organisational structure across functional boundaries. The report should clearly address both cause and effect aspects and remedial actions applied.

- An assessment has been carried out to determine where else the organisation is susceptible to issues arising from the same cause.
- An assessment of products, components, or processes that exhibit (or could exhibit) the same deficiency as the

**DO NOT DELETE ON COMPLETION***event has been carried out.*Signed/Date Author: *Oscar Gapp* 23/10/23 Signed/Date Verifier: *P. Hume* 19/10/23

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**8. OPERATING EXPERIENCE (Why didn't we see this coming?)**

**Best Practice:** The cause evaluation must have considered both internal and external operating experience, identified whether or not the event was a "repeat", evaluated the missed opportunities from previous similar events, incorporated lessons learned into the evaluation, and offered preventive/corrective actions to improve both the deviation and the operating experience. The search parameters are clearly identified (locations, criteria and date boundaries).

Internal and External sources of OE are utilised to:

- Determine if there are any potential causal factors or failure mechanisms not previously recognised.
- Evaluate the effectiveness of previous preventive/corrective actions taken to ensure that current preventive/corrective actions planned will be effective.
- Determine if the condition constitutes a repeat event

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**9. LEARNING FOR OTHER PLANT**

**Best Practice:** If the investigation has identified consequences for other plants/facilities, this is detailed.

- Identify plants/facilities which the information has or should be disseminated to.
- Identify offsite bodies/agencies which the information has or should be disseminated to.

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**10. RECOMMENDATIONS/PREVENTIVE OR CORRECTIVE ACTION PLAN**

**Best Practice:** The actions address and are linked to the identified causes. The actions are actionable and focussed with distinction made between global and localised issues; individual performance issues are appropriately separated. If the action(s) is long term, appropriate interim actions are identified. They are SMART actions. Completion criteria and effectiveness measures are explicitly defined as required

- There is a clear link between the Problem Statement and preventive/corrective actions.
- Actions are clearly linked to associated causal factors.
- Completed actions are identified and adequate documentation or references are provided.
- Planned actions have appropriate due dates.
- Actions will clearly prevent the problem from recurring, clearly state completion requirements, and consider how effectiveness will be measured.
- The actions are reasonable (i.e., commensurate with the safety significance of the event/condition), measurable, and achievable.
- It is clear that all identified causes are being addressed, or, that the decision not to address them is explicitly stated and substantiated.

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