Callaghan Engineering
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REVIEW OF THE INFORMATION SUBMITTED BY THE APPLICANT ON THE TOPIC OF MAJOR ACCIDENTS IN RELATION TO PLANNING APPLICATION REF: ABP-304433-20

REPORT

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1 EXECUTIVE SUMMARY

Callaghan Engineering (CE) have been commissioned by An Bord Pleanála (ABP) to collaborate on an inspection at the Indaver site at Carranstown Co. Meath and to complete an independent technical review of the information submitted in the application for permission for the Site Sustainability Project submitted to ABP on 25th June 2020 and referred to by ABP as Case Number: ABP-307433-20. The scope of this application is summarised as follows:

"Increase in annual total waste for treatment from currently permitted 235,000 tonnes to 250,000 tonnes, increase in annual amount of hazardous waste from currently permitted 10,000 tonnes to 25,000 tonnes, development of an aqueous waste tank farm, hydrogen generation unit, bottom ash storage building, development of a single storage warehouse, new concrete yard, weather canopy, demolition and rebuilding of an existing single storey modular office and ancillary site works. Carranstown, Duleek, County Meath".

The focus of the CE assignment was to provide an additional technical review of the above application on the topic of Control of Major Accidents Hazards Involving Dangerous Substances Regulations 2015, otherwise known as the "Seveso III" directive, as implemented in Ireland under S.I. 209 of 2015.

From the site visit completed and the review of the information submitted by the applicant, CE is of the opinion that the information submitted in terms of control of major accidents is accurate and valid. CE concurs with the applicant that the changes in the inventory of substances caused by additional storage of aqueous wastes containing solvent and the proposed hydrogen generation development would not cause the site to qualify as a Seveso III establishment.

The analysis completed by the applicant reveals two worst cases for potential accidents. These are the potential for a full aqueous waste bund fire and the potential for a hydrogen explosion. The modelling completed indicates that both worst-case scenarios are not expected to constitute a major accident with consequences offsite. Nonetheless, the risk to personnel operating at the facility exists and needs to be carefully managed. In this regard CE has recommended a condition that the fire case in the tank farm is assessed during the detailed engineering design and resulting implications are incorporated into the design.

It is CE's opinion that the clarifications and commitments given by the applicant in relation to risk management during the detailed design process provide sufficient assurances that the fire and explosion risks will be adequately managed in accordance to the Safety, Health and Welfare at Work (General Applications) Regulations 2007 (SI No 299 of 2007) Part 8 Explosion Protection.

2 INTRODUCTION

All facility operators have a general obligation to prevent major accidents. Under the provisions of the SEVESO III directive, if dangerous substances are present above certain quantities defined in the directive, there is also a requirement to notify the Local Competent Authority (LCA) designated by the appropriate Minister of Government and draw up a major accident prevention policy (MAPP) setting out the operators approach, measures, and safety management systems for controlling major accident hazards.

This review completed by CE provides an additional independent report to ABP on the adequacy and validity of the information submitted by the applicant in relation to 1/ Compliance with the general obligation to prevent and control major accidents, and 2/ Review of the site inventory of dangerous substances as reported in appendix 17.1 of the EIA report, which concludes that the inventory changes associated with

the proposed increase of hazardous waste, new aqueous waste tank farm and the hydrogen generation facility will not qualify as a Seveso III establishment.

3 REVIEW OF THE INFORMATION SUBMITTED

3.1 DESCRIPTION OF CHANGES AND CONTEXT

3.1.1 NEW HYDROGEN PLANT

The applicant has described in section 4.5.4 of the EIAR the purpose and main design aspects of the proposed hydrogen generation unit. Indaver has established that for approximately 12.5% of the time, the energy produced by their WtE furnace cannot be used to produce electricity because the national electricity grid cannot accept it. The purpose of the proposed 10MWe hydrogen generation unit (HGU) is to utilise this excess electricity for producing hydrogen from electrolysis of water. This new emerging technology will recover 60 % of the energy currently dissipated as heat to the environment.

The generation of hydrogen and storage of hydrogen as a form to preserve energy has obvious environmental benefits. However, the technology has inherent risks associated with the highly flammable nature of the substance and its low ignition energy. The controls that will take place to mitigate the risk are discussed in section 3.4 of this report.

3.1.2 AQUEOUS TANK FARM

The applicant has described in section 4.5.3 of the EIAR the purpose and main aspects of the proposed tank farm for the storage and processing of aqueous liquid wastes currently accepted at the facility in accordance with the site EPA licence. The change is justified by the applicant due to an increase in the demand for this service and to make current operations more robust. CE evaluation of the changes proposed is limited to reviewing the impact of the new installation on the control of major accidents. The controls that will take place to mitigate the risk are discussed in section 3.4 of this report.

3.1.3 INCREASE IN ANNUAL TOTAL WASTE FOR TREATMENT

The increase in annual total waste for treatment is proposed to go from the currently permitted 235,000 tonnes to 250,000 tonnes. This increase relates solely to the increase in the currently permitted annual hazardous waste (packaged / aqueous) from the currently permitted 10,000 tonnes to 25,000 tonnes. The packaged fraction currently amounts to 2,000 tonne per annum, and this could increase up to 5,000 tonne per annum if the application is granted. The aqueous fraction currently amounts to 8,000 tonne per annum, and this could increase up to 20,000 tonne per annum if the application is granted. The split between packed and aqueous hazardous waste scenarios is shown in table 4.4 of the EIAR.

This change in yearly treatment capacity does not change the potential for the site for major accidents except for the new hazards associated with development of a new aqueous waste tank farm and hydrogen production and storage facilities.

As the facility is operated in compliance with an industrial emissions license issued by the EPA (industrial Emissions License W0167-03), a review of the licence and the impact of the proposed development changes on the existing licence has not been part of the scope of this review.

3.2 CONTROL OF MAJOR ACCIDENTS

Indaver Waste-to-Energy (WtE) site was constructed in 2011 and is designed to recover energy from the residual fraction of non-hazardous household, commercial and industrial waste.

All facilities operators have the general obligation to prevent and control major accidents. Given the nature of the Waste to Energy WtE operations already taking place at the site there is a core of information in relation to the existing facility included in Section 17 of the EIAR.

The EIAR included with the planning application provides an estimation of the worst-case consequences of conceivable accidents in the proposed new aqueous facility and hydrogen plant. The consequences modelling completed concludes that any accident associated with the sustainability project has no potential for significant consequences off-site. The two worst-case conceivable events are further detailed below with commentary provided:

- A full bund fire at the new aqueous waste facility with no impacts off site.

  This scenario involves a major release of aqueous solvent waste, with ignition to give rise to a pool fire on site. The tanks are fitted with shields in place around the perimeter of the tank walls, which will help to minimise the risks associated with a release outside the bund due to, e.g. overjetting or overtopping of the bund wall. In the event of a major release, the size of the resulting pool of liquid will be restricted by the installation of a bund at the tank. In the event of a major release, the risk of ignition is low when compared with other bulk storage facilities, e.g. in solvent or petroleum service, as the materials in the tanks are aqueous solutions, where the water content is in excess of 90%. Nonetheless a scenario involving a bund fire was considered credible and modelling was conducted to determine the impacts to the surrounding area. The modelling results show that, in the credible worst-case event of a full bund fire, there would be no impacts off site. The tank farm is located at the site boundary to the north of the site and so, in the event of a full bund fire, there would be high levels of thermal radiation at the boundary. However, the modelling also shows that heat flux decreases rapidly with distance, to a level of 4 kW/m2 at a distance of 22 m from the bund. There are no vulnerable offsite receptors within this range and therefore has no potential for significant off-site consequences.

- A hydrogen explosion causing maximum overpressures at the roadway of the order of 50 mbar not presenting a risk to people outside the plant.

  The credible worst-case scenario in this area of the site involves a major release following catastrophic failure of the hydrogen storage vessel, resulting in overpressures to the surrounding area. The hydrogen storage vessel operates at high pressure and so, in the event of an explosion, this would result in high levels of overpressure in the immediate vicinity. The nearest off-site receptor is the R152 road, which runs to the south of the site. At its closest point, this is located at a distance of approximately 85 m from the hydrogen plant. In the worst-case scenario, the maximum overpressures at the roadway would be of the order of 50 mbar. Exposure to this level of overpressure does not present a risk to people off-site.

Therefore, a major accidents prevention review needs to address the two main topics for review:

- Confirm the site does not qualify as SEVESO III establishment (Section 3.3)
- Confirm the facilities will be built in accordance EU/Irish standards and current employment legislation to protect the lives of personnel employed at the site (section 3.4)

3.3 SEVESO III INVENTORY ASSESSMENT

Callaghan Engineering has reviewed the Seveso III inventory assessment included in appendix 17.1 of the EIAR. In accordance with the provisions of the SEVESO III directive 2012/82/EC, dangerous substances have been quantified and classified into: health hazards, environmental hazards and physical hazards to determine if the quantities stored on each category fall under Seveso III establishment provisions.

For each category, there are two qualification thresholds, one of which is used to determine if the site qualifies as a lower tier SEVESO III establishment and another to determine if the site qualifies as a SEVESO III upper tier establishment. If no single material exceeds its threshold, there is an aggregation rule in which the individual ratios (q/Q) for all materials within the same hazard category are added together. There are three possible outcomes from this aggregation process:

1. The sum of the individual ratios against the lower tier thresholds for all three hazard types is less than one (1), in which case the regulations do not apply.

2. The sum of the individual ratios against the lower combined inventory is greater than the lower tier threshold but less than the upper tier threshold, in which case the site qualifies as a lower tier establishment.

3. The combined inventory is greater than the upper tier threshold, in which case the site qualifies as an upper tier establishment.

3.3.1 HEALTH HAZARDS

The applicant consultant's report in appendix 17.1 of the EIAR characterises the boiler ash residues, packaged hazardous waste shipments (drums), liquid hazardous waste (tankers). A review of the hazard statements for each shipment reveals that there are no listed carcinogenic substances or health hazards relevant to the Seveso III regulations in the hazardous waste feedstock to the furnace. The information reported has been reviewed leading to confirmation that the conclusions drawn by the applicant are plausible.

3.3.2 ENVIRONMENTAL HAZARDS

3.3.2.1 Aqueous Waste

The applicant has identified that some aqueous waste tankers can contain concentrations of active pharmaceutical ingredients (APIs) between 2.5% and 4%, which corresponds to a category chronic 2 mixture, which is a hazard to the aquatic environment as listed in annex I of the Seveso regulations.

The applicant has informed that up to two of these tankers can be on site at any given time. Based on this information the environmental (q/Q) ratio was calculated as follows:

q= Maximum amount of category chronic 2 mixture in tankers is 2 x 27 tonne.

Q= The applicable lower tier Seveso threshold for category chronic 2 mixture is 200 tonnes

(q/Q) for two tankers equal to 54 /200 = 0.270

The applicant has estimated that once the environmentally hazardous aqueous waste is pumped to the large 300 m^3 storage tanks the waste is diluted below 2.5% and it is no longer considered an environment hazard for the purpose of the SEVESO III inventory assessment.

3.3.2.2 Packaged Waste

The applicant has identified that circa 14% of the current packaged hazardous waste inventory is environmentally hazardous (E1). Based on worst case daily inventory of 40.72 tonnes, this equates to 5.76 tonnes of environmentally hazardous material. Based on this information the environmental (q/Q) ratio was calculated as follows:

q= Maximum amount of packaged environmentally hazardous material (E1) in drums 5.76 tonne.

Q= The applicable lower tier Seveso threshold for category E1 mixture is 100 tonnes

(q/Q) for two tankers equal to 5.76 /100 = 0.057

The information reported has been reviewed leading to confirmation that the inventory of environmental hazards has been correctly assessed in accordance with Seveso III.

3.3.3 PHYSICAL HAZARDS

Both the aqueous waste operation and hydrogen operations increase the physical hazard quotients for the physical hazards category.

3.3.3.1 Flammable Liquid

The aqueous waste tankers on site (14 x 27 m^3 tankers) and the new aqueous waste tanks (2x 300 m^3) will contain a mixture of water and flammable solvents. The solvent fraction will be up to 6% and will correspond with category P5c in Schedule 1 of the Seveso III regulations for which the lower tier threshold is 5000 tonnes.

The (q/Q) quotients for flammable liquids category P5c is calculated as follows:

q= Maximum amount of flammable aqueous waste in tankers and tanks= 14 x 27+ 2 x 300 = 978 tonne

Q= the lower tier Seveso threshold 5000 tonnes

(q/Q) quotient 978/5,000 = 0.2

3.3.3.2 Flammables from Packaged Waste

The applicant has identified that circa 38% of the packaged hazardous waste inventory is a physical hazard. Based on worst case daily inventory of 40.72 tonnes, this equates to 15.34 tonne of physical hazardous material. Based on this information the environmental (q/Q) ratio was calculated as follows:

q= Maximum amount of packaged environmentally hazardous material (p5c) in drums 15.34 tonne.

Q= The applicable lower tier Seveso threshold for category p5c flammable substance is 5000 tonnes

(q/Q) for two tankers equal to 15.34 /5000 = 0.003

3.3.3.3 Hydrogen:

The report identifies the requirement to store 2 tonnes of hydrogen at the site. This is based on the capacity of a 100m^3 storage tank operating at 350 bar. Hydrogen is listed in the Seveso III regulations for which the lower tier threshold is 5 tonnes.

The (q/Q) physical calculate as follows:

q= the maximum amount of hydrogen = 2 tonnes

Q= the lower tier Seveso threshold 5 tonnes

(q/Q) quotient 2/5 = 0.4

The information reported has been reviewed leading to confirmation that the inventory of physical hazards has been correctly assessed in accordance with the Seveso III directive.

3.3.4 TOTAL INVENTORY OF SEVESO SUBSTANCES

The quotients (q/Q) calculated for the proposed development were added to the existing quotients for other substances by the applicant and the revised sum of quotients reported in the EIAR, report ref: 462-20X0073, table 12:

Category	$\Sigma q/Q_{lower\ tier}$	$\Sigma q/Q_{upper\ tier}$
Health	-	-
Physical	0.655	0.067
Environmental	0.886	0.409

It can be observed from this table that the site summation of physical hazards is heavily influenced by the addition of the quotients associated with the proposed aqueous waste and hydrogen storage development which amount to 0.6 out of the 0.655 total. The new summation for the site 0.655 remains well below the lower tier Seveso limit.

It can also be observed that the summation of environmental hazards is influenced by the addition of the quotients associated with the hazardous waste in two aqueous waste tankers containing API and deemed an environmental hazard. The new summation for the site is 0.886 with the new development contribution 0.27. From review of the substances already stored at the site, it was observed that the main contributor for the environment summations is the storage of 54 tonnes of ammonium hydroxide (25%) for which the lower trier Seveso limit is 100 tonne and contributes with a quotient (q/Q) 0.54. The new summation for the site 0.886 remains below the lower tier Seveso limit.

Based on the inventory of substances reviewed, the increases in the inventory associated with the proposed development do not cause the site to qualify as Seveso establishment.

3.4 DESIGN AND OPERATION SAFETY

3.4.1 RISK IDENTIFICATION AND RISK CONTROL

As the site does not qualify as a Seveso III establishment, a major accident prevention policy (MAPP) is not required. The hazard and risk identification assessment framework (HAZID&RA) employed by the applicant is therefore an appropriate tool to screen hazardous scenarios and assess the risk for the environment and personnel.

The risk elimination / risk mitigation measures proposed by the HAZID&RA team included in the design will necessarily contribute to a reduction in the likelihood of a major accident taking place on site. However, while the measures are comprehensive, the semi-quantitative nature of the assessment and the lack of detailed design information as presented in the original application details do not provide full assurance that the detailed design will be executed in accordance to current safety legislation.

At the request of ABP for additional information, the applicant has provided further information and assurances clarifying that all relevant standards required to quantitatively evaluate and manage the explosion risk will be employed. This additional information provided by the applicant dated 31st of May 2021 is key to ensure the risk at the site is controlled to acceptable levels.

3.4.2 DETAILED RISK ASSESSMENT / FUNCTIONAL SAFETY

Indaver has committed to carrying out a detailed Hazard and Operability study (HAZOP) for the proposed development in conjunction with the suppliers of the plant. This assessment will cover all unit operations at the hydrogen plant and the functional interaction between the unit operations, including the electrolysis unit, scrubber unit, gas holder, compressors, and AGIs, and future de-ox plant and drier, as appropriate.

Indaver has also confirmed a Level of Protection Analysis (LOPA) for the plant will be carried out which will ensure that the relevant Safety Instrumented Systems (SIS) are implemented in accordance with IS EN 61511. This framework allows an evaluation of the required level of protection depending on personnel occupancy in the areas subject to explosion risk.

It is CE's opinion that the above methodology provides a great level of assurance that the plant will be safe to operate and that those risk scenarios, which may have the potential to cause fatalities within the plant, even with very low probability, will be adequately addressed.

3.4.3 EXPLOSION PROTECTION

As detailed in the information submitted by the applicant, the two main risks introduced re the proposed development are a full aqueous waste bund fire and a hydrogen explosion. Both worst- case scenarios do not present a risk to people outside the plant but do present a risk to personnel operating the plant.

Invader has confirmed that a hazardous area classification assessment will take place to include the proposed development in accordance with the standard IS EN 60079-10-1. The assessment will drive the ventilation and equipment specification in accordance with the standard.

In relation to the aqueous tank farm, the applicant has confirmed that the tanks will be designed in accordance with API 620 "Design and construction of large, welded, low-pressure storage tanks". This is

an appropriate standard for the aqueous farm tanks design. While not specifically stated in the submission, it is important that the venting system will cover the bund fire scenario described as anticipated worst case.

The applicant has confirmed that in accordance with the requirements of Part 8 of the Safety, Health and Welfare at Work (General Applications) Regulations 2007 (SI No 299 of 2007. Part 8: Explosive atmospheres at places of work. The site explosion protection document (EPD) will be updated to reflect the proposed development.

4 REVIEW OF VALIDITY OF CONCLUSIONS

CE has reviewed the applicant information in relation to the topic of major accidents. According to the information reviewed, the site does not qualify as a Seveso III establishment and the new sustainability development has no potential to generate major accidents with off-site consequences.

For the review it is also evident that the introduction of flammable aqueous waste and highly flammable hydrogen storage at the site needs to be adequately managed to reduce the risk to personnel working at the site to an acceptable low risk level.

The fire and explosion risk identified can be manged by the applicant and its consultants with the use of current design standards. The replies provided by the applicant to the request for additional information provide a high level of assurance that the detailed design of the facility will adequately mitigate the risk to personnel to broadly acceptable low risk levels.

It is CE's opinion that the clarifications and commitments given by the applicant provide sufficient assurances that the fire and explosion risks will be adequately managed in accordance to the Safety, Health and Welfare at Work (General Applications) Regulations 2007 (SI No 299 of 2007) Part 8 Explosion Protection.

5 RECOMMENDATION

The following planning condition is recommended:

As the risk of an aqueous bund fire is identified as the worst-case credible event for the new tank farm, the applicant shall design the tank farm catering for the fire case scenario as part of the design criteria, including the provision of adequately sized emergency relief venting and any other safety measures deemed appropriate to mitigate risk.

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