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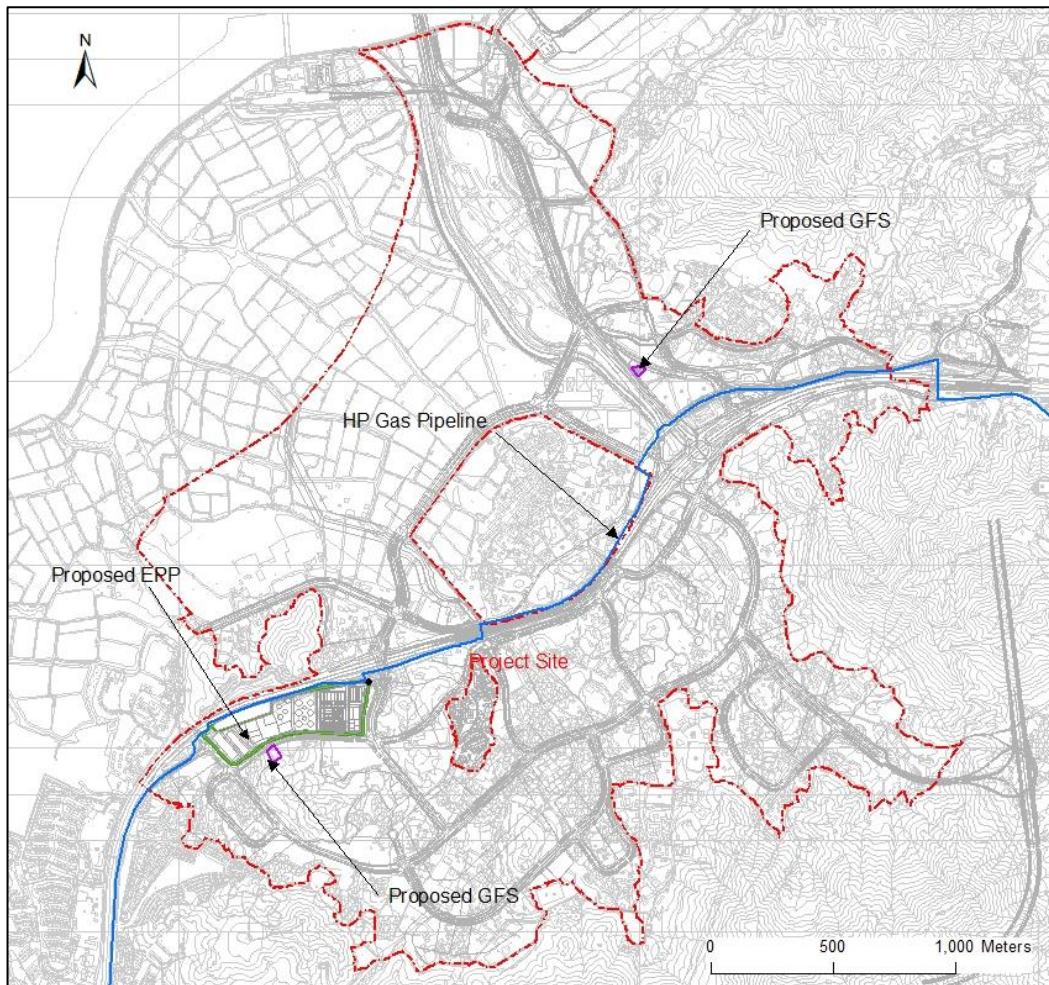
### **List of Appendices**

<u>Appendix 13.1</u>	Hazard to Life Assessment for Proposed Effluent Polishing Plant (EPP)
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### 13. HAZARD TO LIFE

#### 13.1 Introduction

- 13.1.1.1 This section presents the analysis and findings of the Hazard to Life Assessment undertaken for the Project in accordance with Section 3.4.14 of the EIA Study Brief (ESB-340/2021).
- 13.1.1.2 According to Section 3.4.14 and Appendix M of the EIA Study Brief, a hazard to life assessment shall be conducted to evaluate the risks associated with (i) manufacture, storage, use and on-site transport of chlorine at Ngau Tam Mei Water Treatment Works (NTM WTW); (ii) use, transport and overnight storage of explosives; (iii) generation, storage, use and on-site transport of biogas at the proposed sewage treatment works.
- 13.1.1.3 According to the latest study findings, the development of rock cavern is not recommended under the STLMC DN Project. Since the potential underground rock cavern will no longer be proposed for the development under the STLMC DN Project, the Project site will be located outside the 1km radius consultation zone (CZ) of NTM WTW. As such, hazard assessments for explosives and NTM WTW are not required.
- 13.1.1.4 In addition to the hazardous facilities mentioned in the EIA Study Brief, a high pressure underground town gas transmission pipeline (HP Gas Pipeline) running along San Tin Highway located in close vicinity to the proposed development site is identified, and a hazard assessment to address the risk associated with the HP Gas Pipeline was conducted.
- 13.1.1.5 Two Green Fuel Stations (GFSs) are also proposed within the Project site, and they are proposed to provide LPG filling services for the purpose of this EIA Study. A hazard assessment to address the risk associated with LPG operation of the two proposed GFSs was also carried out.
- 13.1.1.6 **Plate 13-1** shows the locations of hazardous facilities that were assessed in this section, with respect to the Project site.



**Plate 13-1 Locations of the Hazardous Facilities**

- 13.1.1.7 Details of the Quantitative Risk Assessment (QRA) for the Project are presented in the following appendices:
- (a) **Appendix 13.1:** Hazard to Life Assessment in association with the proposed Effluent Polishing Plant (EPP);
  - (b) **Appendix 13.2:** Hazard to Life Assessment in association with the HP Gas Pipeline; and
  - (c) **Appendix 13.3:** Hazard to Life Assessment in associated with the proposed GFSs.

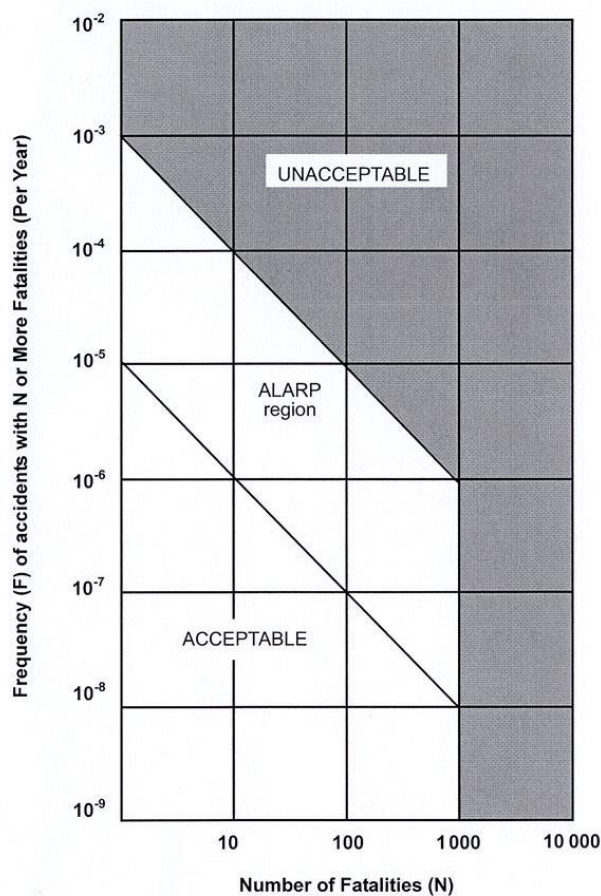
## 13.2 Environmental Legislations, Standards and Guidelines

- 13.2.1.1 The requirements and criteria for assessing hazard to life are outlined in Section 3.4.14 of the EIA Study Brief (ESB-340/2021) and Annex 4 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), respectively. The estimated risk levels due to operations of biogas-related facilities, the HP Gas Pipeline and the GFSs were compared with the individual and societal risk criteria set out in the Hong Kong Risk Guidelines (HKRG) to determine the acceptability of the risk levels.

### 13.2.2 Hong Kong Risk Guidelines (HKG), EIAO-TM Annex 4

13.2.2.1 Individual risk is the predicted increase in the chance of fatality per year to an individual due to a potential hazard. The individual risk guidelines require that the maximum level of individual risk should not exceed 1 in 100,000 per year i.e.  $1 \times 10^{-5}$  per year.

13.2.2.2 Societal risk refers to the risks to the whole population. It is expressed graphically by plotting the cumulative frequency (F) of N or more deaths in the population from incidents at a certain installation against the number of fatalities (N) (**Plate 13-2** refers). Two F-N risk lines are used in the HKRG to denote “Acceptable” or “Unacceptable” societal risks. To avoid major disasters, there is a vertical cut-off line at the 1,000 fatality level extending down to a frequency of 1 in a billion ( $1 \times 10^{-9}$ ) per year. The intermediate region indicates that the acceptability of societal risk is borderline and that it should be reduced to a level which is “as low as reasonably practicable” (ALARP). It seeks to ensure that all practicable and cost-effective measures that can reduce risk are considered.



**Plate 13-2 Societal Risk Guidelines**

### 13.3 Study Objective and Methodology

13.3.1.1 The main objective of this QRA is to assess the hazard to life of the general public from the hazards that arise from the proposed EPP and GFSSs, and the existing HP Gas Pipeline that are required to facilitate the construction and operation of the Project. The results of the QRA should then be compared with the HKRG.

13.3.1.2 The detailed requirements of the study are given in Section 3.4.14 of the EIA Study Brief. The main requirements are:

- (a) Identify hazardous scenarios associated with the operation of the proposed EPP and GFSs and the existing HP Gas Pipeline, and subsequently determine a set of relevant scenarios to be included in a QRA;
- (b) Execute a QRA of the set of hazardous scenarios determined in sub-section (a) above, expressing population risks in both individual and societal terms;
- (c) Compare individual and societal risks with the criteria for evaluating hazard to life stipulated in Annex 4 of the EIAO-TM; and
- (d) Identify and assess practicable and cost-effective risk mitigation measures.

13.3.1.3 This assessment consisted of the following six main tasks:

- (a) **Data Collection:** Collect relevant data / information including the operational details of the hazardous facilities, population, road traffic and weather data;
- (b) **Hazard Identification:** Identify a set of hazardous scenarios associated with the hazardous sources, project specific hazards due to the blasting operation, dangerous goods storage and handling in the hazardous facilities will be reviewed and considered in the assessment;
- (c) **Frequency Analysis:** Estimate the frequencies of the identified hazardous scenarios by using Fault Tree and Event Tree Analyses;
- (d) **Consequence Analysis:** Evaluate the potential hazard zones for each risk outcomes by using the well-established and widely accepted model, e.g. SAFETI;
- (e) **Risk Evaluation:** Evaluate the risks associated with the identified hazardous scenarios. The evaluated risks will be compared with the above-mentioned risk criteria to determine their acceptability. The estimation of fatality will be reviewed with consideration of site-specific conditions and properties of the hazardous materials in consideration.
- (f) **Mitigation Measures:** Where necessary, risk mitigation measures will be identified and assessed to comply with the “as low as reasonably practicable (ALARP) principle used in the above-mentioned risk criteria. Possible mitigation measures would include but not limited to staging of construction activities to manage the population increase during construction phase, provision of additional safety measures for the identified hazardous facilities to lower the failure probabilities, etc.

13.3.1.4 This hazard assessment covered the following two scenarios:

- Year 2032 (Construction phase) – The risk imposed by the operation of the biogas facilities in the proposed EPP and two GFSs, and the HP Gas Pipeline to the existing, committed and planned population in 2032. This scenario accounted for the commencement of the EPP and the two GFSs, and also the presence of the construction workers for areas of the proposed development located along the San Tam Road.
- Year 2039 (Operation phase) – The risk imposed by the operation of the biogas facilities in the proposed EPP and two GFSs, and the HP Gas Pipeline to the existing, committed and planned population in 2039. This scenario accounted for the ultimate situation with all the planned land users of the proposed development being considered.



### 13.4 Population Data

13.4.1.1 The land/ building population as well as road population were estimated based on the information collected from the following sources:

- (a) Desktop study and site survey;
- (b) 2030+ TPEDM data;
- (c) Latest Annual Traffic Census (ATC) from Transport Department;
- (d) Traffic Impact Assessment (TIA) report of this Assignment; and
- (e) Previous reports of similar studies.

13.4.1.2 The population data adopted in the hazard assessments are detailed in **Appendices 13.1 to 13.3**.

### 13.5 Hazard Identification

13.5.1.1 The hazards associated with the hazardous installations were identified by reviewing the past incidents (e.g. Major Hazard Incident Data Services (MHIDAS)), existing conditions of the hazardous installations and previous studies. The hazard scenarios include the loss of containment from the proposed EPP leading to fire and explosion, loss of containment from the HP Gas Pipeline leading to gas leak, fire, explosion and toxic release, and loss of containment from the proposed GFSs leading to fire and explosion, as detailed in **Appendices 13.1 to 13.3** respectively.

### 13.6 Frequency Analysis

13.6.1.1 With the potential hazards identified, the likelihood of each hazardous scenario was determined. The majority of the occurrence frequencies were adopted directly from previous studies and were supplemented by statistics from historical data if necessary. In some cases, event tree analysis was adopted to derive the frequencies of the hazardous scenarios.

13.6.1.2 **Appendices 13.1 to 13.3** provide the details of the frequency assessment in each hazard assessment.

### 13.7 Consequence and Impact Analysis

13.7.1.1 The consequence assessment estimates the impact of each outcome in the area of concern. It includes discharge rate modelling, dispersion modelling and fire and explosion modelling. The details of the consequence assessment are presented in **Appendices 13.1 to 13.3**.

### 13.8 Risk Evaluation

#### 13.8.1 Introduction

13.8.1.1 By combining the results of frequency estimation and consequence analysis, risk levels of the assessment scenarios were characterised in terms of individual risk (presented in individual risk contours plot) and societal risk (presented in FN curves and Potential Loss of Life).

#### 13.8.2 Individual Risk

13.8.2.1 The predicted individual risk contours for the proposed EPP are detailed in **Appendix 13.1**, while the predicted individual risk contours for the HP Gas Pipeline are detailed in

**Appendix 13.2** and the predicted individual risk contours for the two proposed GFSs are detailed in **Appendix 13.3**. The associated risk levels were based on 100% occupancy with no allowance made for shelter or escape, as specified in the user manual of Phast Risk.

- 13.8.2.2 Based on the operation details assumed for the proposed EPP, GFSs and the HP Gas Pipeline, the maximum off-site individual risks associated with their operations are less than  $1 \times 10^{-5}$  per year. The individual risk of  $1 \times 10^{-5}$  per year contour was observed due to operation of the proposed EPP but the contour would be confined entirely within the boundary of EPP. Given that there is no off-site risk with frequency greater than  $1 \times 10^{-5}$  per year, no off-site individual would be exposed to risk level greater than  $1 \times 10^{-5}$  per year. The level of individual risk associated with the operation of the proposed EPP, GFSs and the HP Gas Pipeline, as well as the individual risk imposed on the Project is considered acceptable and in compliance with the HKRG.

### 13.8.3 Societal Risk

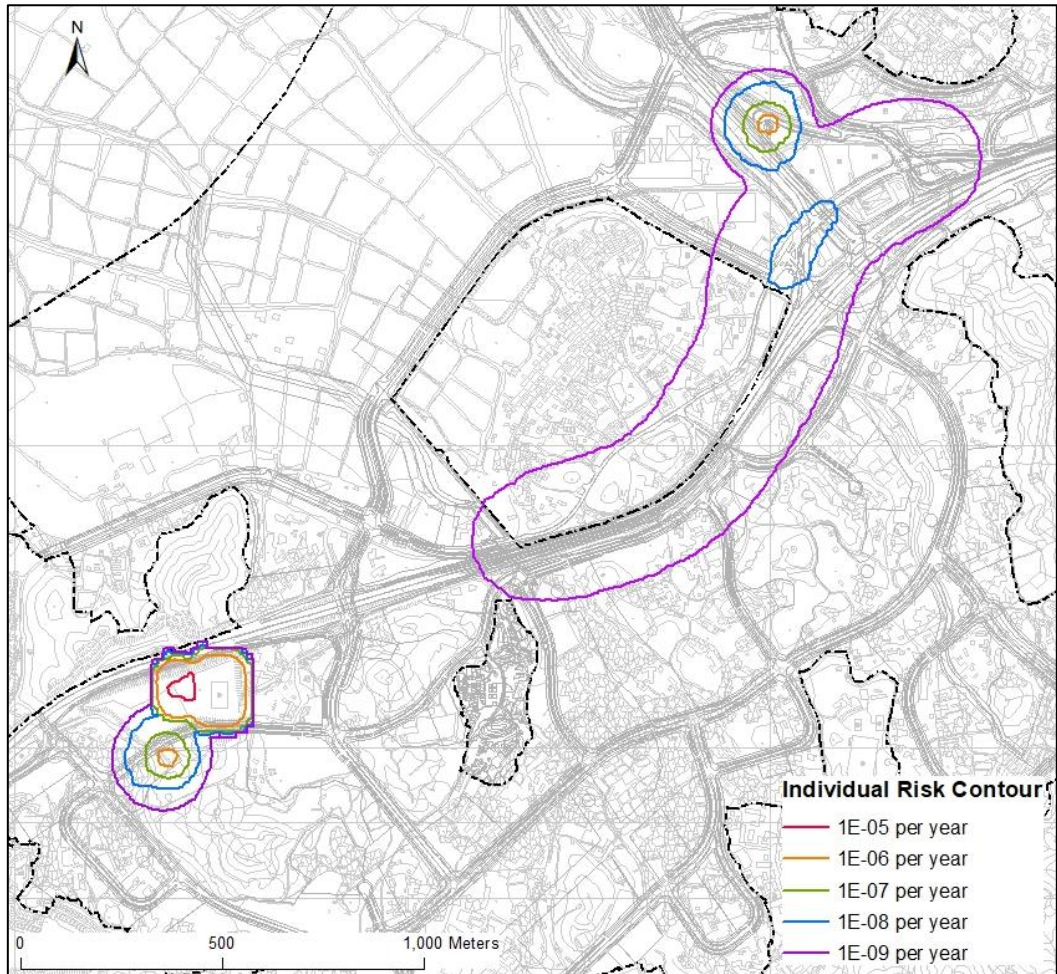
- 13.8.3.1 The societal risks of the proposed EPP, the HP Gas Pipeline and the two GFSs during both construction and operation phases of the Project, are presented in **Appendices 13.1 to 13.3** respectively. As shown in the FN plots, the societal risks for these facilities fall within the “Acceptable” region in both assessment years. The total Potential Loss of Life (PLL) associated with operation of the proposed EPP was found to be  $3.09 \times 10^{-6}$  per year and  $3.57 \times 10^{-6}$  per year for construction and operation phases; the total PLL associated with operation of the HP Gas Pipeline was found to be  $5.57 \times 10^{-6}$  per year and  $1.22 \times 10^{-5}$  per year for construction and operation phases; while the total PLL associated with operation of the two proposed GFSs was found to be  $3.83 \times 10^{-6}$  to  $5.16 \times 10^{-6}$  per year and  $3.89 \times 10^{-6}$  to  $5.62 \times 10^{-6}$  per year for construction and operation phases.

### 13.9 Cumulative Risk Assessment

- 13.9.1.1 Apart from the proposed EPP and two GFSs, no other concurrent, planned or committed projects leading to any other hazardous events have been identified at the present stage, it is then reasonable to conclude there will be no potential cumulative impacts expected to arise due to other projects during the Project cycle.
- 13.9.1.2 This section addresses cumulative impacts of the Project related to the proposed EPP and two GFSs, with the existing HP underground town gas transmission pipelines. These are presented as combined Individual Risk Contours and F-N curve following the same approach as the approved EIAs for the Sha Tin Cavern project<sup>1</sup> and the In-situ Re-provisioning of Sha Tin Water Treatment Works project<sup>2</sup>.
- 13.9.1.3 The Individual Risk contours presented in **Plate 13-3** show that cumulative risks are generally lower than  $10^{-5}$  per year for off-site areas of the proposed hazardous facilities. The F-N curves for the construction and operation phases of the Project are shown in **Plate 13-4** and **Plate 13-5** respectively. The cumulative societal risks from these facilities fall within the “Acceptable” region in both assessment years.

<sup>1</sup> AECOM, 2016. Sha Tin Cavern Sewage Treatment Works: Hazard to Life Assessment.

<sup>2</sup> AECOM, 2014. In-situ Re-provisioning of Sha Tin Water Treatment Works – South Works: Hazard to Life Assessment.



**Plate 13-3 Cumulative Individual Risk Contours**



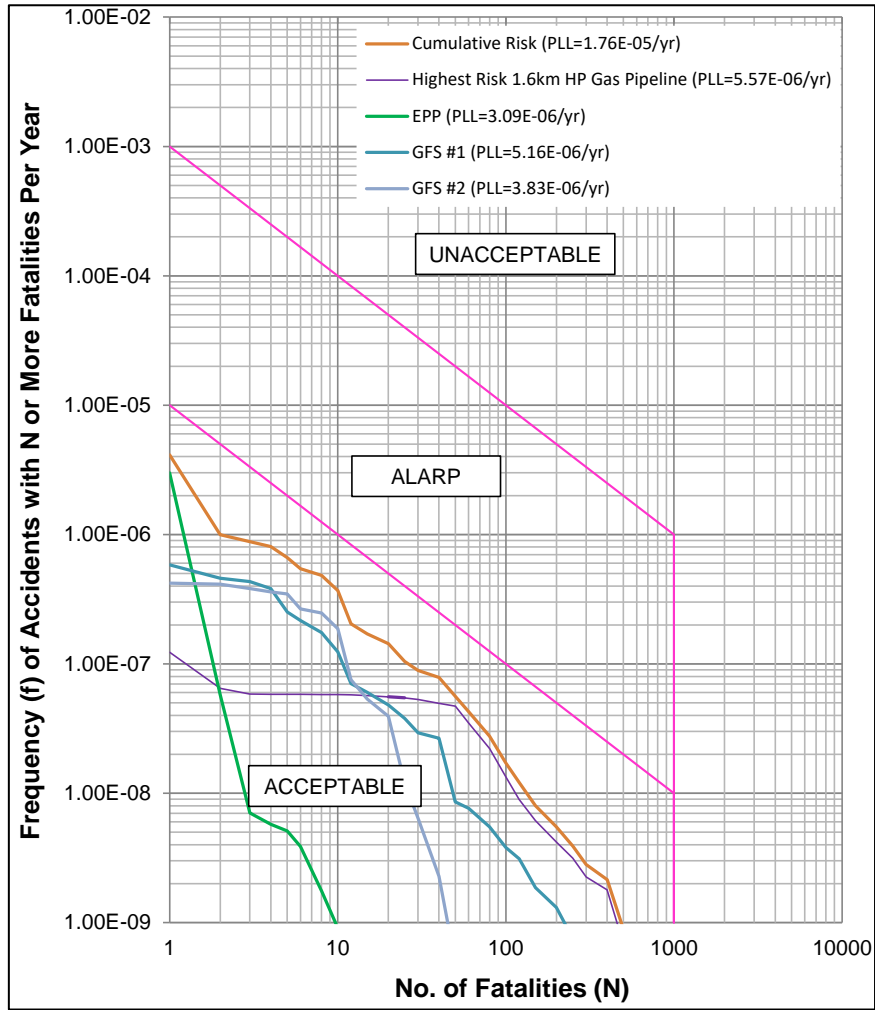


Plate 13-4 FN Curves of Cumulative Risks (Year 2032)

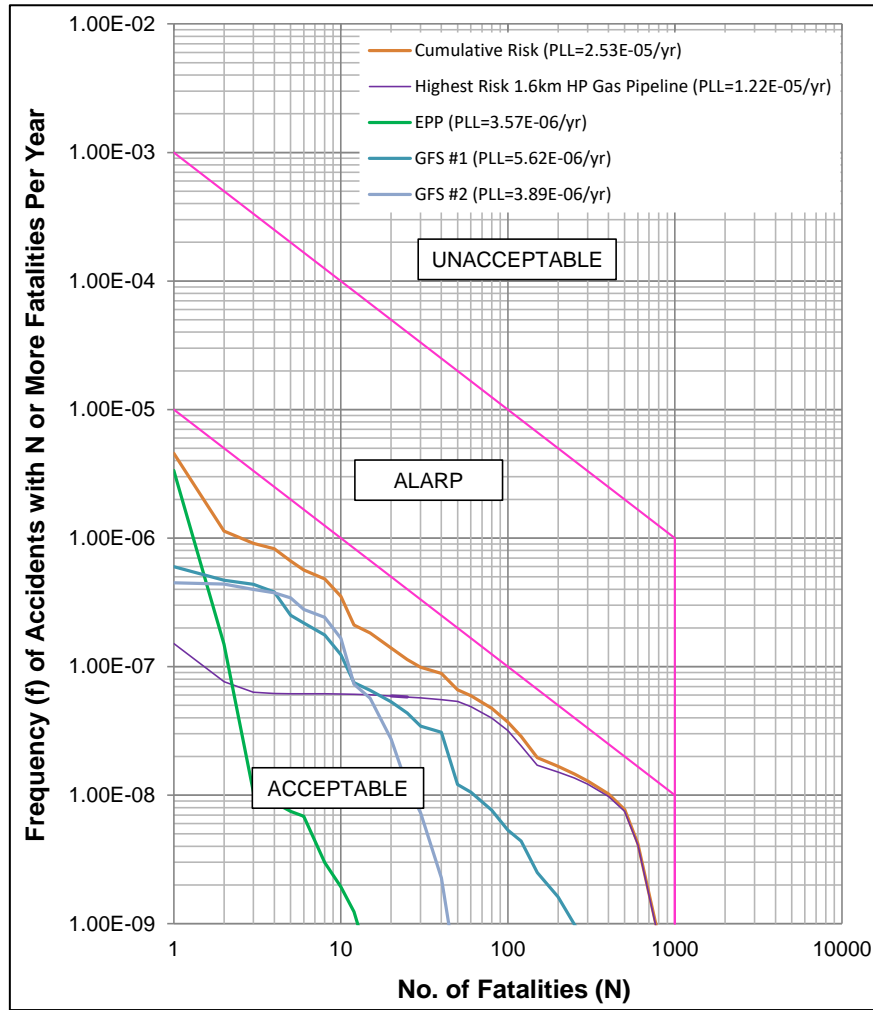


Plate 13-5 FN Curves of Cumulative Risks (Year 2039)

**13.10 Conclusions and Recommendations**

13.10.1.1 Hazard assessments were conducted to assess the risks associated with operation of the proposed EPP, the HP Gas Pipeline, and the proposed GFSs during the construction and operation phases of the Project. The results showed that both the individual risks and societal risks, taking into account the population induced by the Project, would be in compliance with the risk criteria stipulated in Annex 4 of the TM-EIAO, risk mitigation measures are therefore not required.