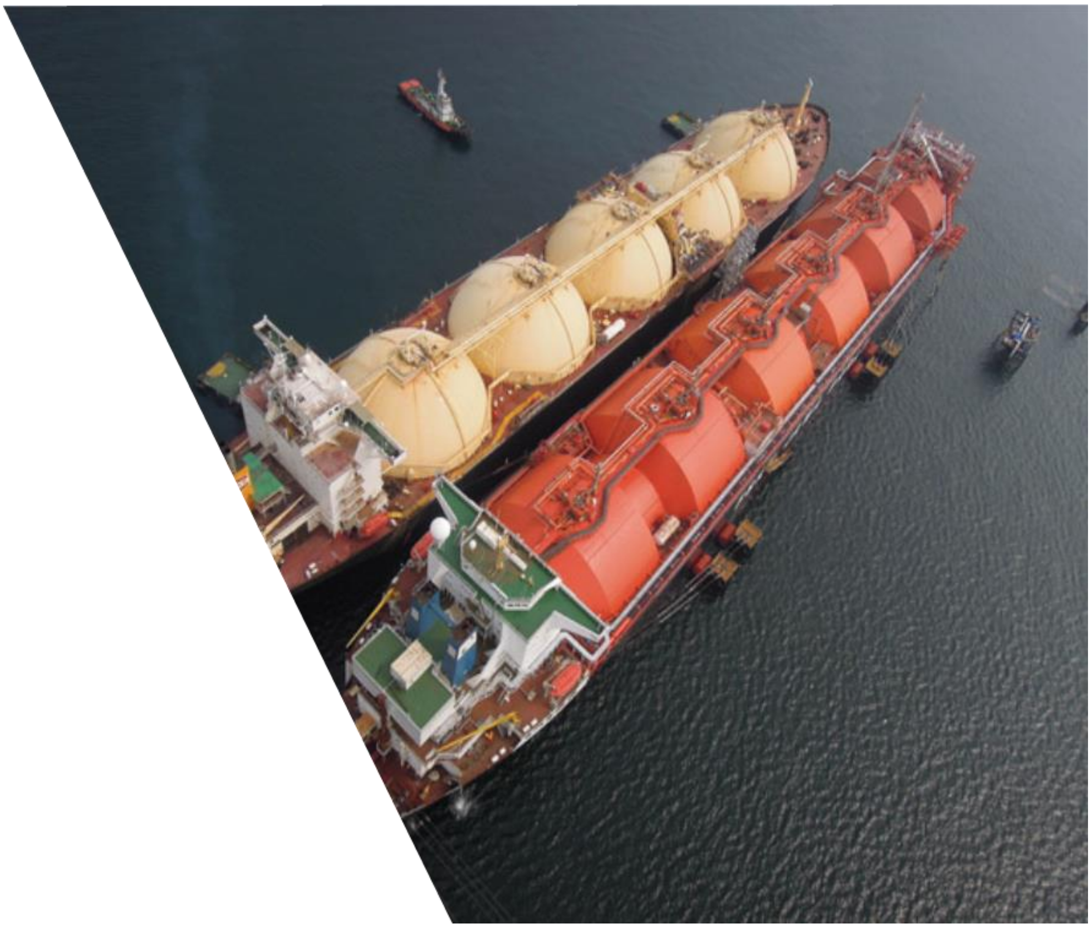
AUSTRALIAN INDUSTRIAL ENERGY

Port Kembla Gas Project

Preliminary Hazard Analysis Addendum - Seasonal Variations Supplementary Note



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PROJECT 401010-01496-SR-TEN-0004 – Port Kembla Gas Project

Rev	Description	Original	Review	WorleyParsons Approval	Date	Customer Approval	Date
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Contents

1. INTRODUCTION

This supplementary note is to be read in conjunction with the Process Hazard Analysis (PHA) Addendum - Seasonal Variations [1].

The Seasonal Variation PHA addendum [1] assessed the proposed operational changes at the planned Port Kembla Gas Terminal (PKGT) against the Hazard and Risk requirements of the Secretary's Environmental Assessment Requirements (SEARs) issued on 10 August 2018 specifically the requirements of the New South Wales (NSW) Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 Risk Criteria for Land Use Planning [2].

The operational changes are defined as two seasonal cases, low demand at a rate of 120 TJ/day, and high demand with 500 TJ/day. Further details of the operational cases are detailed in Section 2.

The objective of this supplementary note to the PHA Addendum - Seasonal Variations [1] is to provide additional clarification of the operational cases and the associated modelling assumptions. The clarifications are specifically for the following:

1. The definition of the annual average (base) case;
2. Risk modelling assumptions for each case:
    a. Number of Liquefied Natural Gas (LNG) regasification trains and booster pumps in operation.
    b. Number of LNG shipments per year.
    c. Release rate and corresponding ignition probabilities.
    d. Isolatable inventories.
3. Revised location of the LNG regasification module on the Floating Storage and Regasification Unit (FSRU).

1.1 Acronyms

The abbreviations utilised in this project are listed below.

Abbreviation	Definition
AIE	Australian Industrial Energy
EIS	Environmental Impact Statement
FSRU	Floating Storage and Regasification Unit
HIPAP	Hazardous Industry Planning Advisory Paper
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier
LOC	Loss of Containment

Abbreviation	Definition
LSIR	Location Specific Individual Risk
NSW	New South Wales
PHA	Preliminary Hazard Analysis
PKGT	Port Kembla Gas Terminal
SEAR	Secretary's Environmental Assessment Requirement
TJ	Terajoule

2. MODELLING CASES AND ASSUMPTIONS

Table 2-1 presents the modelled cases and the associated conditions. The modelled cases include:

- EIS PHA Base Case [3];
- PHA Addendum – Seasonal Variations Annual Average Case [1];
- PHA Addendum – Seasonal Variations Low Season Case [1];
- PHA Addendum – Seasonal Variations High Season Case [1]; and
- PHA Addendum – Seasonal Variations High Season Sensitivity Case [1].

The original PHA [3] presented in the Environmental Impact Statement (EIS) was based on an assumed flat demand profile of 309 TJ/day for any given season. This is referred to as the EIS PHA Base Case. The Seasonal Variation PHA Addendum [1] referenced a 'Base Case' which was an annual average case (i.e. 120 TJ/day for 6 months and 500 TJ/day for 6 months) while not the arithmetic average (i.e. 310 TJ/day) the difference is not significant enough to warrant remodelling the process risk from operation of 2 LNG trains with additional 1 TJ/day (i.e. 309 vs. 310 TJ/day). However, to ensure that the results were conservative the number of Liquefied Natural Gas Carrier (LNGC) deliveries per year was increased from 26 to 52. This case is referred to as the Annual Average Case in this supplementary note.

Note: The annual average case presented as Location Specific Individual Risk (LSIR) is quantified per annum. In practice the risk contours will move with production rate. If the facility operated for 12 months at the Low Season rate of 120 TJ/day the contours are as presented in Figure 3-4 and similarly for the High Season case at a rate of 500 TJ/day the contours are as presented in Figure 3-5. Figure 3-3 presents the annual average case, which presents the average risk per annum assuming 6 months of operation at 120 TJ/day and 6 months at 500 TJ/day.

Figure 2-1 depicts the production rates modelled for the annual average and seasonal cases.

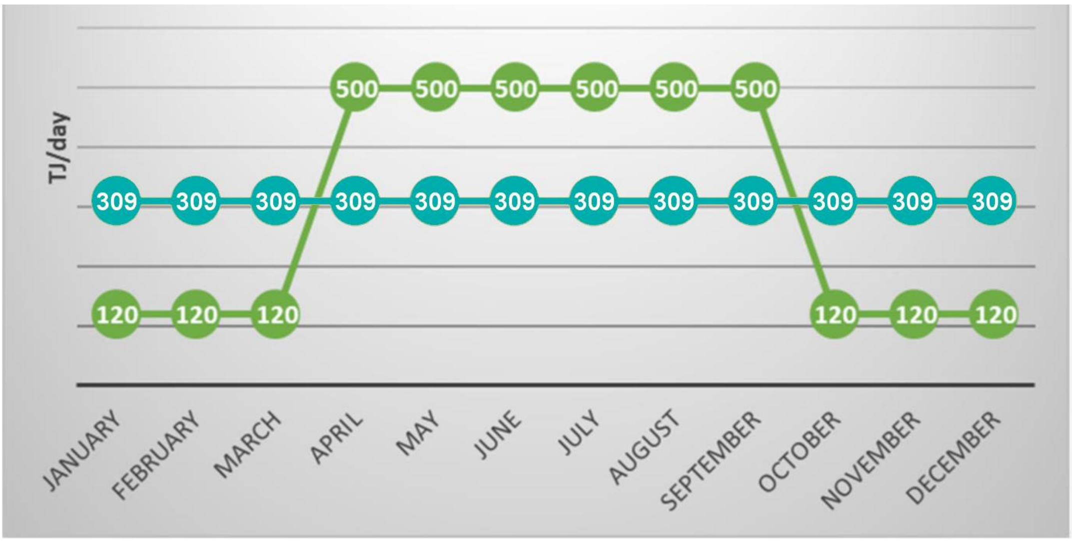

Figure 2-1: Average and Seasonal Demand Profile

The risk modelling conducted in the EIS PHA [3] and Seasonal Variation PHA Addendum [1] used the parameters presented in Table 2-1.

Table 2-1: EIS PHA [3] and Seasonal Variation PHA Addendum [1] Cases Modelled

Parameter Modelled	EIS PHA Base Case	Proposed Modification			
		Annual Average (Base Case)	Low Season	High Season	High Season (Sensitivity)
LNG Trains	2	2	1	2	2
Booster Pumps	4	4	2	4	4
LNG Train Operating Pressure (barg)	120	120	120	100	100
LNGC Deliveries per year	26	52	26	52	52
Loss of Containment (LOC) Release Rate Note 1	Peak Rate	Peak Rate	Peak Rate	Peak Rate	Averaged Rate Note 2
Release Volume	Volume modelled much larger than isolatable volume	Volume modelled much larger than isolatable volume	Volume modelled much larger than isolatable volume	Volume modelled much larger than isolatable volume	Largest topside isolatable volume applied to all above deck LOC scenarios Note 2
Export Rate TJ/day	309	309	120	500	500
LSIR Contour	Figure 3-2	Figure 3-3	Figure 3-4	Figure 3-5	Figure 3-6

Note 1: This release rate is used to determine the ignition probability.

Note 2: Reduction in release rate, ignition probability and isolatable inventory are applied to account for the fire and gas detection and shutdown systems onboard of the FSRU and LNGC.

3. REGASIFICATION MODULE LOCATION

During the Seasonal Variation remodelling process, the Regasification Module on the FSRU vessel was re-positioned to 36.8 m from the bow of the FSRU (see Figure 3-1). Previously in the EIS PHA [3] the Regasification Module was positioned at approximately 46 m from the bow of the FSRU.

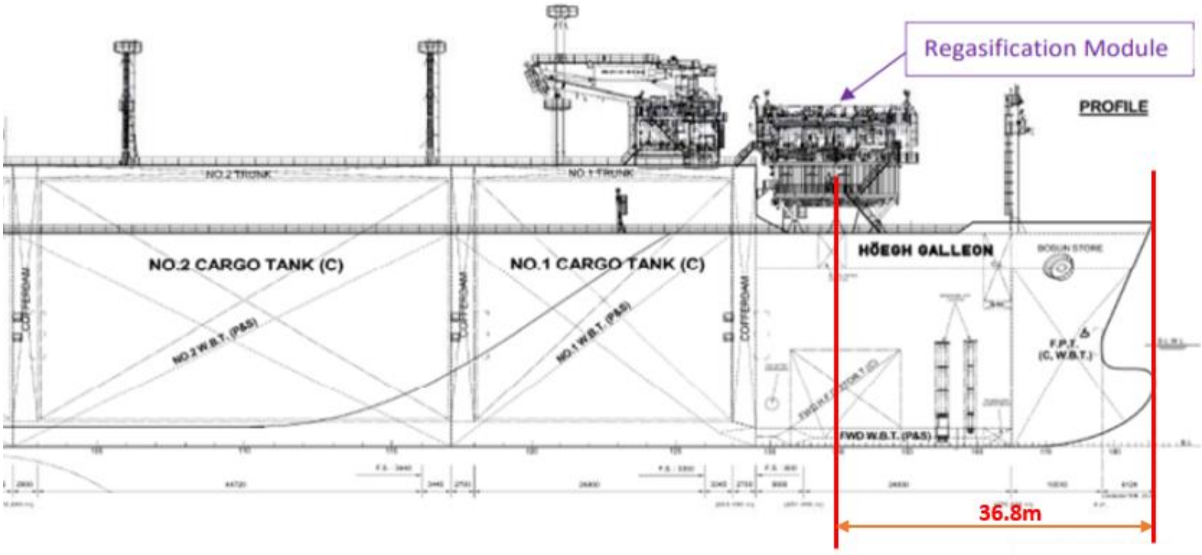

Figure 3-1: Regasification Module Distance from FSRU Bow

From this change, the inner higher risk contours have moved slightly south. This is due to the Regasification Module containing higher LOC potential compared to other areas on the FSRU.

The effects of the Regasification Module relocation together with other modelling differences for the Seasonal Variation cases [1] compared to the EIS PHA Base Case [3] are summarised below and the risk contours are shown in Figure 3-3 to Figure 3-6.

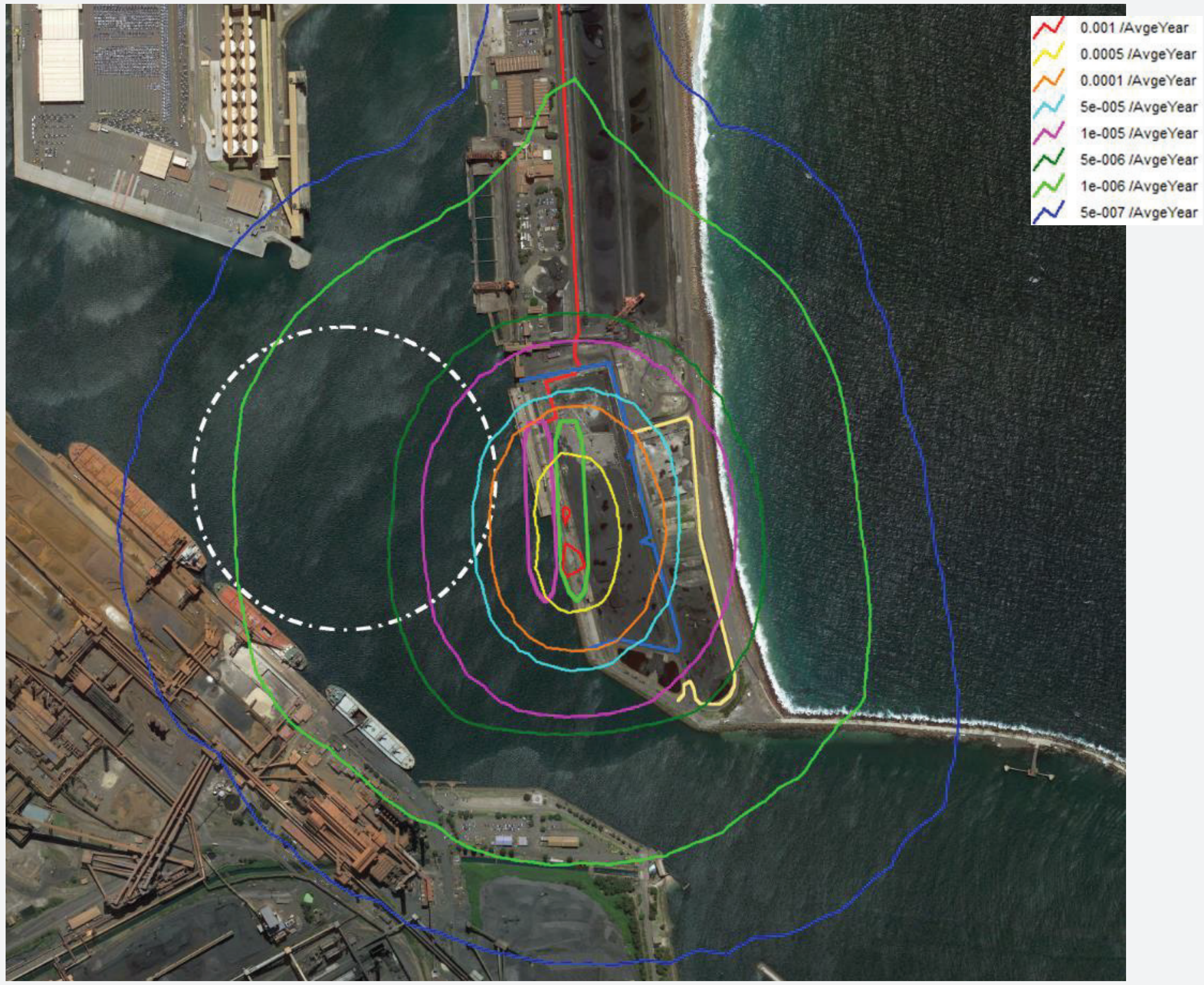

Figure 3-2: Berth Fatality Risk Contours – EIS PHA Case 309 TJ/day [3]

Figure 3-2 is the LSIR contours presented in the EIS PHA [3], which assumes flat demand of 309 TJ/day for any given season with 26 LNGC deliveries per year. Refer to Table 2-1 for other modelling parameters.

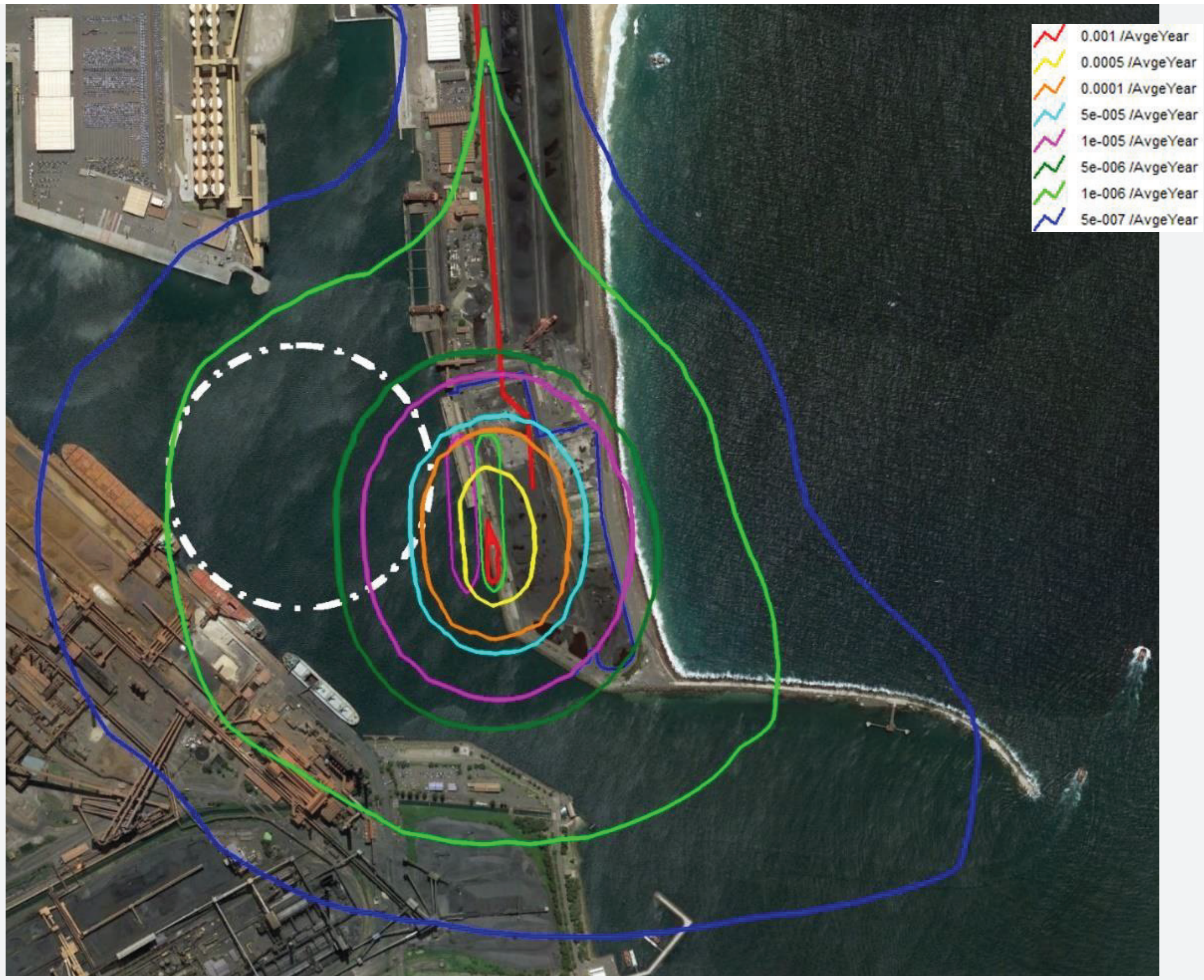

Figure 3-3: Berth Fatality Risk Contours – Annual Average Case 309 TJ/day 1]

Figure 3-3 is the LSIR contours presented in the Seasonal Variation PHA Addendum [1] for the Annual Average Case of 309 TJ/day (i.e. 6 months at 120 TJ/day and 6 months at 500 TJ/day).

The main changes to this case compared to the EIS PHA flat demand (i.e. 309 TJ/day) are an increase of LNGC deliveries per year from 26 to 52 and the re-positioning of the Regasification Module to 36 m from bow of the FSRU. These changes have the following effects on the contours:

- Increase in LNGC deliveries results in an increase in the outer risk contours (i.e. 1×10^{-6} and 5×10^{-7} pa).
- Regasification Module relocation resulted in movement of the inner risk contours southward (1×10^{-3} to 5×10^{-6} pa).

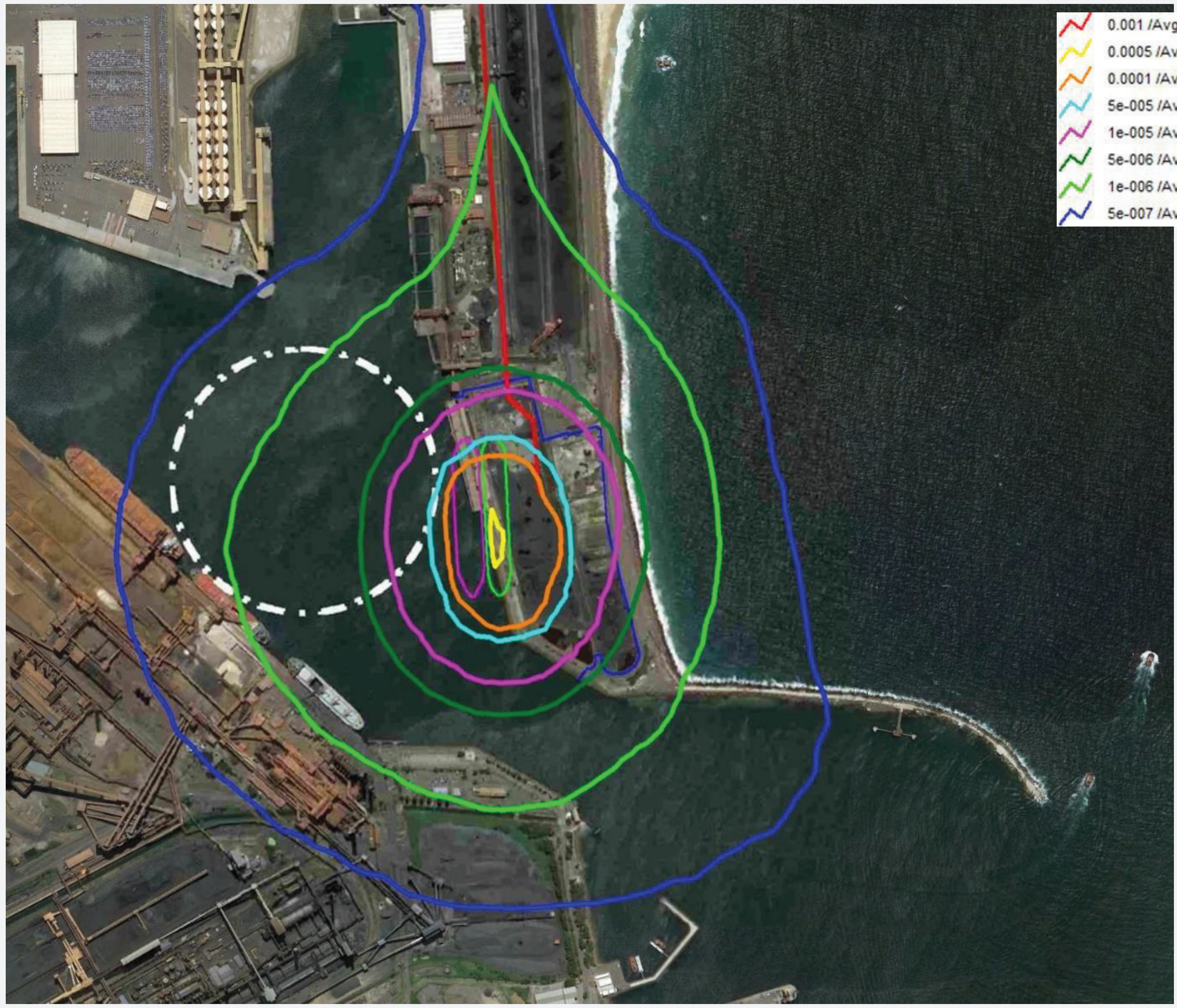

Figure 3-4: Berth Fatality Risk Contours – Low Season Case 120 TJ/day [1]

Figure 3-4 is the LSIR contours presented in the Seasonal Variation PHA Addendum [1] for the Low Demand Case of 120 TJ/day. Note the LSIR contours are per annum. The figure therefore presents the per annum risk at the production rate of 120 TJ/day.

The changes to this case compared to the EIS PHA flat demand (i.e. 309 TJ/da) are lower production rate, one less regasification train in operation and Regasification Module re-positioned to 36 m from bow of the FSRU:

- Process risk from the gas regasification module is halved (i.e. 1 train and 2 pumps in operation) resulted in reducing the inner LSIR contours.
- Regasification Module relocation resulted in movement of the inner risk contours southward (5 x 10^{-4} to 5 x 10^{-6} pa).
- Maximum unmitigated continuous full-bore release is limited to 120 TJ/day resulted in reducing all LSIR contours.

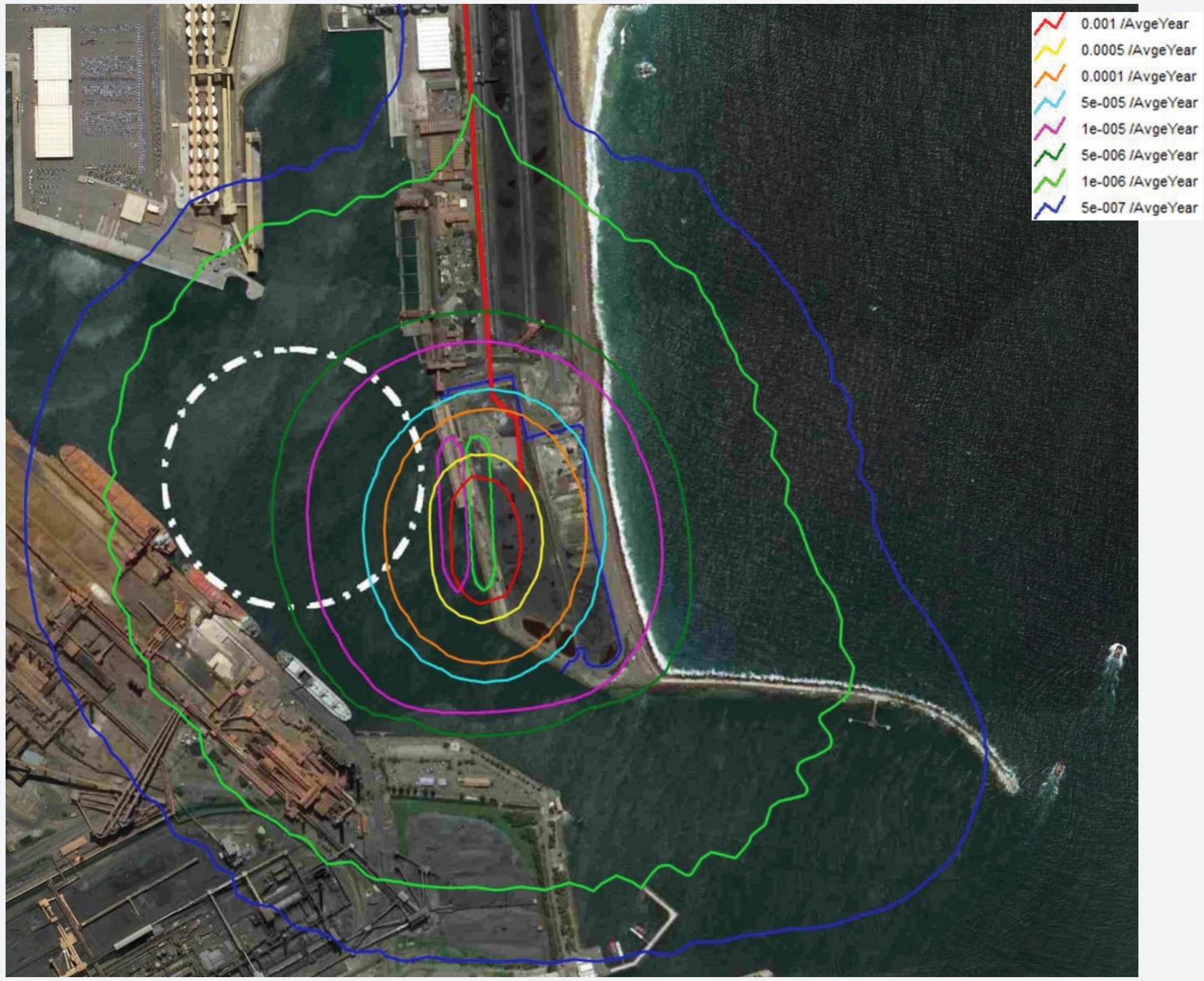

Figure 3-5: Berth Fatality Risk Contours – High Season Case 500 TJ/day [1]

Figure 3-5 is the LSIR contours presented in the Seasonal Variation PHA Addendum [1] for the High Demand of 500 TJ/day. Note the LSIR contours are per annum. The figure therefore presents the per annum risk at the production rate of 500 TJ/day.

The changes to this case compared to the EIS PHA flat demand (i.e. 309 TJ/day) are increase of LNGC deliveries per year from 26 to 52, higher production rate and Regasification Module re-positioned to 36 m from bow of the FSRU:

- Increase in LNGC deliveries results in an increase in the outer risk contours (i.e. 1 x 10^{-6} and 5 x 10^{-7} pa).
- Regasification Module relocation resulted in movement of the inner risk contours southward (1 x 10^{-3} to 5 x 10^{-6} pa).
- Maximum unmitigated continuous full-bore release of 500 TJ/day results in an increase of all LSIR contours.

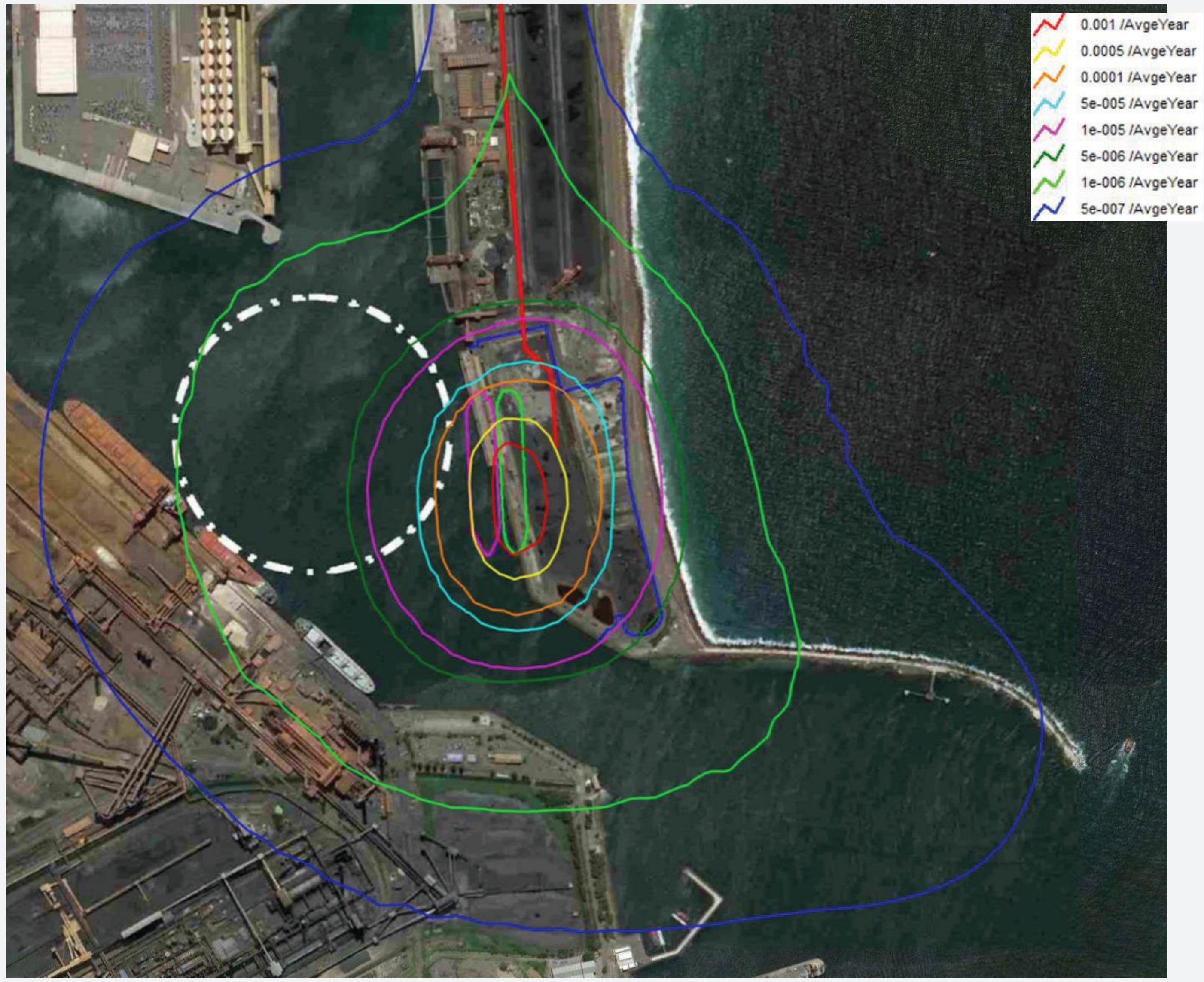

Figure 3-6: Berth Fatality Risk Contours – Sensitivity High Season Case 500 TJ/day with F&G Detection & Isolation [1]

Figure 3-6 is the LSIR contours presented in the Seasonal Variation PHA Addendum [1] for the Sensitivity High Demand case (i.e. 500 TJ/day) accounting for fire and gas shutdown and isolation systems onboard the FSRU.

The main changes to this case compared to the EIS PHA flat demand (i.e. 309 TJ/day) are reduced inventories for release, reduced/averaged release rates and associated ignition probabilities, higher production rate and Regasification Module repositioned to 36 m from bow of the FSRU:

- Topside inventories are limited to largest topside isolatable volume, averaged release rates and ignition probabilities resulted in a reduction in the maximum fire impact distances, which in-turn reduces all risk contours.
- Increase in LNGC deliveries results in an increase in the outer risk contours (i.e. 1×10^{-6} and 5×10^{-7} pa).
- Regasification Module relocation resulted in movement of the inner risk contours southward (1×10^{-3} to 5×10^{-6} pa).

4. REFERENCES

1. Port Kembla Gas Project Preliminary Hazard Analysis Addendum – Seasonal Variation, 401010-01496-SR-TEN-0003 Rev 00
2. Hazardous Industry Planning Advisory Paper No 4 – Risk Criteria for Land Use Safety Planning, January 2011
3. Port Kembla Gas Project Preliminary Hazard Analysis, 401010-01496-SR-REP-0002 Rev 00