Appendix B*

Hazards and Risk Assessment

HAZARD AND RISK ANALYSIS OF THE PROPOSED CALTEX KURNELL REFINERY DEMOLITION WORKS

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Document Number: URS\26-B388

Revision 0

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4 November 2014

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Hazard and Risk Analysis of the Proposed Caltex Kurnell Refinery Demolition Works

Acknowledgment

The author would like to thank Dr Jos Kusters (Caltex) and Rachel O'Hara (URS Australia) for their assistance in preparing this report.

Disclaimer

Rev	Date	Description	Prepared By	Reviewed By	Authorised By
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EXECUTIVE SUMMARY

E1 Introduction

Caltex Refineries (NSW) Pty Ltd (hereafter referred to as Caltex) announced in July 2012 that it would progress with converting the Kurnell Refinery (the Site) to a viable and sustainable terminal to receive and distribute refined petroleum product (the Project).

In accordance with the Department of Planning and Environment (DP&E) Director General's Requirements for the Project, a Preliminary Hazard Analysis (PHA, Ref 1) was prepared for inclusion in the Environmental Impact Statement for SSD 5544. The PHA was prepared with reference to the State Environment Planning Policy (*SEPP)* No 33 – *Hazardous and Offensive Development* (Ref 2) and in accordance with the DP&I *Hazardous Industry Planning Advisory Papers* (*HIPAP*) Number 4 - *Risk Criteria* (Ref 3) and HIPAP Number 6 - *Hazard Analysis* (Ref 4).

The PHA for the Project concluded that the risk levels calculated for the proposed finished product terminal satisfy the criteria specified in HIPAP4 and that, when compared to the refinery operations, the off-site risk profile would be considerably reduced. The works to convert the refinery to a finished product terminal and the operation of the terminal (i.e. the Project) were approved as SSD 5544.

The works for which Caltex are seeking a modification to development consent SSD 5544 relate to the demolition, dismantling and removal of refinery process units, redundant tanks, redundant pipelines, redundant services and redundant buildings as well as associated minor civil works and waste management activities (the demolition works).

A hazards and risk assessment has been prepared by Planager Pty Ltd for the demolition works. This assessment has been completed in accordance with the DP&E Secretary's Environmental Assessment Requirements (*SEARs*) for the demolition works, as follows:

> *Hazards and risks – including a Hazards in Demolition (HAZDEM) study that identified all significant demolition related hazards, and the assessment of the risks associated with these hazards. The analysis shall cover all phases of the proposed modification (i.e. demolition / removal of redundant assets and infrastructure), and include all components and stages (e.g. demolition of refinery process units, tanks, pipelines etc.). The demolition hazards and risk assessment shall particularly examine the following:*
>
> - *The potential risk impacts from the proposed demolition works onto the existing simultaneous terminal operations;*

- *The potential for any of the identified demolition related risks to alter during the proposed works associated with the modification, individually or through interaction with existing operations, the offsite risk profile of the facility as assessed in the PHA report for SSD-554.*

The results of the hazards and risk assessment for the demolition works are summarised in this report, which forms an appendix to the *Statement of Environmental Effects* for the modification application.

The report has been prepared with reference to *SEPP No 33* and in accordance with the HIPAP4 - *Risk Criteria* and HIPAP6 - *Hazard Analysis*.

The demolition works comprise the demolition, dismantling or removal of the following principal components:

- refinery process units and associated infrastructure;
- redundant tanks and associated infrastructure;
- redundant pipeways and underground pipelines; and
- redundant buildings and services.

As well as:

- associated civil works with works outlined;
- waste management activities including concrete crushing; and
- returning the works areas to ground level.

Following the demolition works, the Site would operate as a finished product terminal as approved by SSD 5544.

E2 Results

The demolition works would be subject to rigorous scrutiny by Caltex and by the company contracted to carry out the demolition works. All parties would be responsible for safeguarding delivery and operation of the demolition works in a manner that minimises the risk to workers, contractors and the community.

The significant demolition related hazards have been identified. Their associated risk would be minimised through the implementation of a hierarchy of controls in accordance with the requirements under the NSW Work Health and Safety Act and associated Regulations, 2011 (*WHS Regulations,* Ref 5). The management of activities associated with the demolition work would ensure that the probability of an incident happening is minimised and that, should an incident occur, its consequences would be managed.

This hazard and risk assessment of the demolition works has found that the levels of risks to the biophysical environment and to the safety of the public, staff and contractors are reduced to *So Far As Is Reasonably Practicable* (SFAIRP) levels (as required by NSW WHS Regulations). This conclusion is based on:

- Caltex continuing to implement a number of established processes for managing the Site;
- the demolition contractors undertaking the demolition works in general accordance with Demolition Code of Practice (2013) and relevant Australian Standards; and
- the recommendations formulated through the hazard and risk assessment process being implemented.

The present hazard and risk assessment has shown that the overall risk associated with the demolition works is low and does not introduce an excessive additional risk to the Site or to the community surrounding the Site.

Further, the hazard and risk assessment has shown that the risk profile, determined in the *Preliminary Hazard Analysis* for the Project (as reported in the Environmental Impact Assessment for the approved Project SSD 5544), remains valid during the demolition works. As such, the risk levels for the Site continue to satisfy the risk criteria specified in HIPAP 4 during demolition works.

GLOSSARY

ALARP	As Low As Reasonably Practicable
C	Consequence
CHAIR	Construction Hazard Assessment and Implication Review
DGRs	Director-General's Requirements
DPE	Department of Planning and Environment
ESD	Emergency Shutdown
HAZDEM	Hazards in Demolition Study
HAZID	Hazard Identification
HIPAP	Hazardous Industry Planning Advisory Paper
JHA	Job Hazard Analysis
JSA	Job Safety Analysis
L	Likelihood
mbgl	metres below ground level
MHF	Major Hazard Facility
OH&S	Occupational Health and Safety
OPCO	Operating Company
PHA	Preliminary Hazard Analysis
PPE	Personal Protective Equipment
PTW	Permit to Work
SEARs	Secretary's Environmental Assessment Requirements
SEE	Statement of Environment Effects
SFAIRP	So Far As Is Reasonable Practicable
SSD	State Significant Development
SWMS	Safe Work Method Statements
T&I	Turnaround and Inspection

REPORT

1 INTRODUCTION

1.1 BACKGROUND

Caltex announced in July 2012 that it would progress with converting the Kurnell Refinery (the Site) to a viable and sustainable finished product terminal to receive and distribute refined petroleum product (the Project).

In accordance with the DP&E Director General's Requirements for the Project, a Preliminary Hazard Analysis (PHA, Ref 1) was prepared for inclusion in the Environmental Impact Statement for SSD 5544. The PHA was prepared with reference to the State Environment Planning Policy (*SEPP)* No 33 – *Hazardous and Offensive Development* (Ref 2) and in accordance with the DP&I *Hazardous Industry Planning Advisory Papers* (*HIPAP*) Number 4 - *Risk Criteria* (Ref 3) and HIPAP Number 6 - *Hazard Analysis* (Ref 4).

The PHA for the Project concluded that the risk levels calculated for the proposed finished product terminal satisfy the criteria specified in HIPAP4 and that, when compared to the refinery operations, the off-site risk profile would be considerably reduced.

The works to convert the refinery to a finished product terminal (i.e. the Project) were approved as SSD 5544 in January 2014.

The works for which Caltex are seeking a modification to development consent SSD 5544 relate to the demolition, dismantling and removal of refinery process units, redundant tanks, redundant pipelines, redundant services and redundant buildings as well as associated minor civil works and waste management activities (the demolition works).

A hazards and risk assessment has been prepared by Planager Pty Ltd for the demolition works. This assessment has been completed in accordance with the DP&E Secretary's Environmental Assessment Requirements (*SEARs*) for the demolition works. For the Hazards and Risks assessment the *SEARs* request:

> *Hazards and risks – including a Hazards in Demolition (HAZDEM) study that identified all significant demolition related hazards, and the assessment of the risks associated with these hazards. The analysis shall cover all phases of the proposed modification (i.e. demolition / removal of redundant assets and infrastructure), and include all components and stages (e.g. demolition of refinery process units, tanks, pipelines etc.). The demolition hazards and risk assessment shall particularly examine the following:*

- *The potential risk impacts from the proposed demolition works onto the existing simultaneous terminal operations;*

- *The potential for any of the identified demolition related risks to alter during the proposed works associated with the modification, individually or through interaction with existing operations, the offsite risk profile of the facility as assessed in the PHA report for SSD-554.*

The results of the hazards and risk assessment for the demolition works are summarised in this report which is appended to the *Statement of Environmental Effects* for the modification application.

The assessment has been prepared with reference to the *SEPP No 33,* and HIPAPs Numbers 4 (*Risk Criteria*, Ref 3) and 6 (*Hazard Analysis*, Ref 4).

1.2 SCOPE AND AIM OF THE DEMOLITION WORKS

The demolition works comprise the demolition, dismantling or removal of the following principal components:

- refinery process units and associated infrastructure;
- redundant tanks and associated infrastructure;
- redundant pipeways and underground pipelines; and
- redundant buildings and services.

As well as:

- associated civil works with works outlined;
- waste management activities including concrete crushing; and
- returning the works areas to ground level.

Following the demolition works, the Site would operate as a finished product terminal. The demolition works would support the operation of Site as a finished product import terminal, as approved by SSD 5544.

The Site would not be remediated as part of the demolition works.

1.3 SCOPE AND AIM OF THE HAZARD AND RISK ASSESSMENT

This hazard and risk assessment identifies and assesses hazards and risks associated with the following aspects of the demolition works:

- demolition of process plant, equipment, pipelines and buildings;
- removal of demolished material;
- storage on site prior to disposal off-site;
- loading onto trucks; and
- transport off-site.

In line with the requirements in the SEARs, this hazards and risks assessment assesses the potential for demolition activities to:

- impact on the tanks, interconnecting pipes and pipelines;
- impact the existing simultaneous terminal operations; and
- alter the offsite risk profile of the facility as assessed in the PHA for the terminal (Ref 1) during the demolition works, both individually or through interaction with the terminal operation.

As per the methodology (Ref 4), the assessment focusses on potential high consequence – low likelihood incidents.

The following risks are assessed as part of this assessment:

- risk from flammable material;
- environmental risk from spills;
- health and safety risks to staff and to contractors; and
- health and safety risk to the community.

The following activities are outside of the scope of the analysis as they do not form part of the demolition works:

- Shutdown of process plant, pipes, conduits and tanks; and
- Decommissioning, cleaning and purging of all units.

The aim of the hazard and risk assessment is to:

- provide an assessment of the hazards and risks associated with the demolition works;
- determine the incremental change (increase or decrease) in the risk levels associated with the operating terminal during demolition activities;
- evaluate the resulting risk levels against *So Far As Is Reasonably Practicable* (SFAIRP) principles in accordance with the WHS Regulations (Ref 5); and
- assess the potential for any of the identified demolition related hazards and risks to alter the offsite risk profile of the facility, as assessed in the PHA for the terminal (Ref 1) during the demolition works, individually or through interaction with the terminal operation.

The risk associated with the demolition works is assessed qualitatively using the Caltex risk assessment process and risk matrix. The incremental impact on the off-site risk profile, as determined in the PHA for the terminal (Ref 1), is assessed quantitatively.

Note that the aim of this assessment is to inform the SEE for the demolition works. This assessment does not constitute a task based hazards and risk assessment and does not replace any of the hazard identification or risk assessment activities normally expected to be carried out by the demolition contractor in compliance with the legislative requirements as a minimum.

2 SITE AND PROJECT DESCRIPTION

2.1 PROJECT LOCATION

The Kurnell Refinery is located on the Kurnell Peninsula within Sutherland Shire Local Government Area (LGA), approximately 15 km south of Sydney's CBD, as shown Figure 1 below.

Land uses surrounding the Site are as follows:

- to the east and south of the Site is the southern portion of the Kamay Botany Bay National Park;
- to the north-west of the Site, is the village of Kurnell;
- to the west of the Site is Quibray Bay; and
- land to the south west has the following landuse zonings:
  - General Industrial;
  - Light Industrial;
  - Special Industrial; and
  - Special development.

The Site is immediately to the south of the Kurnell Village and the Kurnell Village lies immediately to the south of Botany Bay.

The Kurnell Peninsula is serviced by Captain Cook Drive. Captain Cook Drive has one lane for the majority of its length, travelling in each direction and is the only route of access and egress from the peninsula.

2.2 SITE OPERATIONS

When operating as a refinery, the Kurnell Refinery was the largest oil refinery in NSW and the second largest of the seven oil refineries in Australia, based on crude oil processing capacity. As approved in SSD 5544, the Site is currently being converted to a terminal. Refinery operations will cease in the fourth quarter of 2014.

Once the conversion works are complete, Caltex will only import finished products (gasoline, jet fuel, diesel and fuel oil) through the two fixed berths at the existing wharf and the additional sub berth located in Botany Bay. These products will be stored in existing and converted tanks. The Site will have a nominal maximum storage capacity of 925 megalitres (ML) of fuel products and by products.

Figure 1 – Project Location

2.3 DEMOLITION WORKS

A summary of demolition works is provided below. Chapter 4 in the SEE provides further details on these works.

The demolition works would involve the demolition, dismantling or removal of refinery process units, redundant tanks, redundant pipelines, redundant services and redundant buildings as well as associated minor civil works and waste management activities. These works are planned to commence in mid-2015 and be completed by the end of 2017. The areas proposed for demolition (the proposed modification area) are shown in Figure 2.

Major demolition activities are listed below:

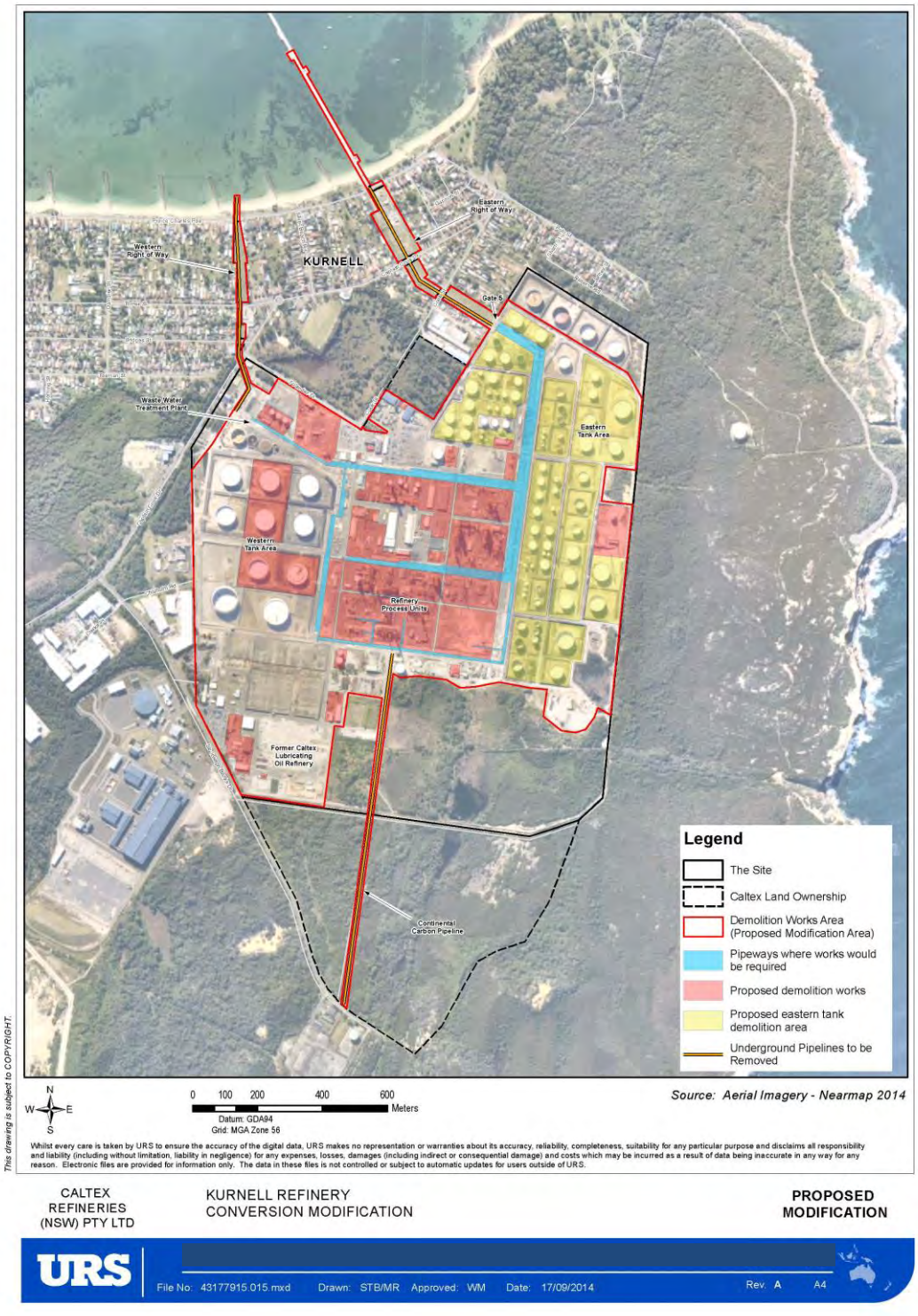
- **Refinery Process Units and Associated Infrastructure**
  - disconnection and removal of pipelines from the process units area;
  - removal of insulation, corrosion protection materials and other building materials prior to demolition taking place;
  - demolition of the refinery process units by lowering to a level where they can be more easily cut up using heavy machinery;
  - intermediate storage of demolished material within the demolition works area, as required prior to disposal, recycling or divestment;
  - removal of the foundations and slabs below the process units; and
  - removal of redundant cabling and some underground services including the Oily Water Sewer from the area beneath the refinery process units.

  These demolition works would require excavation work which may extend down to 2 metres below ground level (mbgl).

- **Tanks and Associated Infrastructure**
  - disconnection and removal of a number of tanks and vessels from both the eastern and western tank areas;
  - demolition of the tanks using heavy machinery to cut them up;
  - intermediate storage of the demolished material within the demolition works area, prior to disposal or recycling; and
  - removal of redundant infrastructure associated with the tanks (such as water draw equipment and pipelines).

  These demolition works may require excavation work which may extend down to 1 mbgl. The bunds associated with the demolished tanks would remain intact and in situ. Bund drainage would be by manual drain valve actuation.

Figure 2 – Proposed Demolition Works



- Pipelines: the demolition work would also include the removal of seven underground pipelines, as follows:
  - the cooling water outlet line running from the refinery through the Western right-of-way;
  - two cooling water intake lines running through the Eastern right-of-way;
  - three redundant product lines running through the Eastern right-of-way; and
  - the Continental Carbon pipeline running south from the Site.

  The depth of excavation required for the removal of pipelines would be approximately 2 mbgl.

- Interconnecting pipes: some pipes within the refinery process area would also need to be removed.

- Buildings:
  - the demolition and removal of a number of redundant buildings on Site related to the operation of the refinery;
  - demolition would be undertaken using heavy machinery such as bulldozers and hydraulic excavators;
  - intermediate storage of the demolished material within the demolition works area prior to disposal or recycling; and
  - removal of foundations and services associated with the redundant buildings.

  These demolition works may require excavation work which may extend down to 1 mbgl.

- Services: Removal of redundant cabling and underground services from within the refinery process area and buildings across the Site. These services would include:
  - connection points and underground pipes to the Oily Water Sewer beneath the refinery process units; and
  - redundant sewer lines and cabling from redundant buildings that included amenities.

3 STUDY METHODOLOGY

The methodology for the hazards and risk assessments is well established in Australia. This assessment has been carried as per the Department of Planning's HIPAP No 4 (*Risk Criteria for Land Use Planning*, Ref 3) and HIPAP No 6 (*Guidelines for Hazard Analysis*, Ref 4).

3.1 HAZARD IDENTIFICATION

The hazard identification process includes a review of potential hazards associated with demolition activities. It includes a comprehensive identification of possible causes of potential incidents and their consequences to public safety and the biophysical environment. It also outlines the proposed operational and organisational safety controls required to mitigate the likelihood of hazardous events occurring.

This process involved a two-day workshop where relevant data and information was reviewed and discussed in a multi-disciplinary team environment to highlight specific areas of potential concern and points of discussion. The team involved in the hazard identification workshop is listed in Table 1 below.

Table 1 – Hazard Identification Team

Name	Title and Company	Day 1	Day 2
Jos Kusters	HSE Technical Superintendent for Decommissioning and Demolition, Caltex	X	
Rick Rech	Demolition HSE Consultant	X	X
Clinton Dick	Demolition Operations Engineer	X	
Craig Collard	Demolition Project Manager, Caltex	X	X
Steve Whitwell	Project Coordinator, Caltex	X	X
Alex Mann	EHS Specialist, Caltex	X	X
Nicole Brewer	Environment, URS Australia	X	X
Rachel O'Hara	Environment, URS Australia	X	X
Karin Nilsson	CHAIR Leader, Planager	X	X
Anne Lewis	Risk management specialist and minute taker, Planager	X	X

During the hazard identification workshop, a preliminary hazard identification (*HAZID*) word diagram was prepared. This word diagram is provided in Section 4.

The HAZDEM methodology employed the *Construction Hazard Assessment and Implication* Review (*CHAIR*) safety in design tool (Ref 6), developed by NSW WorkCover.

The aim of the workshop was to identify and assess hazards and risks during construction and demolition activities. *CHAIR* is usually performed in three stages, with Stages 1 and 2 being relevant for the early design phase and Stage 3 generally being run later during the project phase. Hence, the hazard identification methodology for the demolition works used a combination of *CHAIR* Stages 1 and 2.

The review takes into account both random and systematic errors, and gives emphasis not only to technical requirements, but also to the management of the safety activities and the required competence of people involved.

3.2 RISK ANALYSIS

The risk associated with each incident scenario was evaluated in turn for:

- the situation during the demolition works; and
- the situation after the demolition works.

This evaluation used the *Chevron Integrated Risk Prioritization Matrix*, presented in Figure 3 below.

In performing the qualitative risk priority ranking, each cause-consequence scenario has been evaluated based on the severity of potential consequences and how probable it is that these consequences might fully develop (likelihood) with safeguards in place, according to:

Risk = Consequence x Frequency

The consequence ranking (1 to 6) and likelihood ranking (1 to 6) have been combined in the matrix to provide a risk priority ranking (1 to 10). Risk rankings are documented with “C” representing consequence, “L” representing likelihood, and “Risk” representing risk priority levels.

While the Chevron risk matrix above is qualitative, a quantitative interpretation of the likelihood ranking must be made to allow assessment of the effect of the demolition hazards on the terminal risk profile, as determined in the PHA for the Project (Ref 1). The table below shows Planager’s quantitative interpretation of the likelihood indices and descriptions provided in the Chevron risk matrix. This interpretation is based on ISO31000 (*Risk Management – Principles and guidelines*, Ref 7), AS3931 (*Risk analysis of technological systems – Application guide*, Ref 8), discussion during the demolition workshops and risk engineering judgment.

Figure 3

Chevron Integrated Risk Prioritization Matrix

For the Assessment of HES & Asset Risks from Event or Activity

Likelihood Descriptions			Likelihood Indices
Event can reasonably be expected to occur in life of facility	1	Likely	
Conditions may allow the event to occur at the facility during its lifetime, or the event has occurred within the Business Unit	2	Occasional	
Exceptional conditions may allow consequences to occur within the facility lifetime, or has occurred within the OPCO	3	Seldom	
Reasonable to expect that the event will not occur at this facility. Has occurred several times in the industry, but not in the OPCO	4	Unlikely	
Has occurred once or twice within industry	5	Remote	
Rare or unheard of	6	Rare	

Likelihood Descriptions & Index
(with confirmed safeguards)

Decreasing Likelihood ↓

Legend

Legend applies to identified HES risks
(see guidance documents for additional explanations)

1, 2 , 3, 4 - Short-term, interim risk reduction required. Long term risk reduction plan must be developed and implemented.

5 - Additional long term risk reduction required. If no further action can be reasonably taken, SBU management approval must be sought to continue the activity.

6 - Risk is tolerable if reasonable safeguards / management systems are confirmed to be in place and consistent with relevant requirements of the Risk Mitigation Closure Guidelines.

7, 8, 9, 10 - Manage risk. No further risk reduction required. Risk reduction at management / team discretion.

1	6	5	4	3	2	1
2	7	6	5	4	3	2
3	8	7	6	5	4	3
4	9	8	7	6	5	4
5	10	9	8	7	6	5
6	10	10	9	8	7	6

Consequence Descriptions & Index
(without safeguards)

Decreasing Consequence/Impact →

Consequence Indices		6	5	4	3	2	1
		Incidental	**Minor**	**Moderate**	**Major**	**Severe**	**Catastrophic**
Consequence Descriptions	**Safety**	**Workforce:** Minor injury such as a first-aid. *AND* **Public**: No impact	**Workforce:** One or more injuries, not severe. *OR* **Public**: One or more minor injuries such as a first-aid.	**Workforce**: One or more severe injuries including permanently disabling injuries. *OR* **Public**: One or more injuries, not severe.	**Workforce:** (1-4) Fatalities *OR* **Public**: One or more severe injuries including permanently disabling injuries.	**Workforce**: Multiple fatalities (5-50) *OR* **Public**: multiple fatalities (1-10)	**Workforce**: Multiple fatalities (>50) *OR* **Public**: multiple fatalities (>10)
	Health (Adverse effects resulting from chronic chemical or physical exposures or exposure to biological agents)	**Workforce:** Minor illness or effect with limited or no impacts on ability to function and treatment is very limited or not necessary *AND* **Public:** No impact	**Workforce**: Mild to moderate illness or effect with some treatment and/or functional impairment but is medically managable *OR* **Public**: Illness or adverse effect with limited or no impacts on ability to function and medical treatment is limited or not necessary.	**Workforce**: Serious illness or severe adverse health effect requiring a high level of medical treatment or management *OR* **Public**: Illness or adverse effects with mild to moderate functional impairment requring medical treatment.	**Workforce** (1-4): Serious illness or chronic exposure resulting in fatality or significant life shortening effects OR **Public**: Serious illness or severe adverse health effect requiring a high level of medical treatment or management.	**Workforce** (5-50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** (1-10): Serious illness or chronic exposure resulting in fatality or significant life shortening effects.	**Workforce** (>50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** *(>10)*: Serious illness or chronic exposure resulting in fatality or significant life shortening effects.
	Environment	Impacts such as localized or short term effects on habitat, species or environmental media.	Impacts such as localized, long term degradation of sensitive habitat or widespread, short-term impacts to habitat, species or environmental media	Impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species or environmental media	Impacts such as significant, widespread and persistant changes in habitat, species or environmental media (e.g. widespread habitat degradation) .	Impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.	Loss of a significant portion of a valued species or loss of effective ecosystem function on a landscape scale.

The above legend applies only to HES risks, where risk levels 1-6 are actionable and mandatory.
For risks that may result in facility damage, business interruption, loss of product, the "Assets" category below should be used.
Asset risk reduction is at the discretion of management. Under no circumstances may a direct or indirect translation of Asset loss to HES consequences, or between any discrete categories of HES consequences be inferred.

Consequence Descriptions & Index
(without safeguards)

Consequence Indices		6	5	4	3	2	1
		Incidental	**Minor**	**Moderate**	**Major**	**Severe**	**Catastrophic**
Consequence Descriptions	**Assets** (Facility Damage, Business Interruption, Loss of Product)	Minimal damage. Negligible down time or asset loss. Costs < $100,000.	Some asset loss, damage and/or downtime. Costs $100,000 to $1 Million.	Serious asset loss, damage to facility and/or downtime. Costs of $1-10Million.	Major asset loss, damage to facility and/or downtime. Cost >$10 Million but <$100 Million.	Severe asset loss or damage to facility. Significant downtime, with appreciable economic impact. Cost >$100MM but <$1billion.	Total destruction or damage. Potential for permanent loss of production. Costs >$1billion

This matrix is endorsed for use across the Company.
It is not a substitute for, and does not override any relevant legal obligations.
Under no circumstances should any part of this matrix be changed or modified, adapted or customized.
This matrix identifies health, safety, environmental and asset risks and is to be used only by qualified and competent personnel.
Where applicable it is to be used within the Riskman2 structure and governance of an OE Risk Management Process. If applied outside of these Processes, it is also mandatory to manage identified intolerable risks and comply with the Risk Mitigation Closure Guidelines.

Table 2 – Likelihood Interpretation

Chevron Risk Matrix		Planager Interpretation to Allow Comparison with Terminal Risk Profile (Ref 9)	
Likelihood Descriptions	**Likelihood Indices**	**Likelihood Interpretation**	**Quantitative Estimate**
Consequences can reasonably be expected to occur in the life of the facility	**1 Likely**	You may have heard of (or could well imagine) it happening at the plant since it started up	1 / 10 years
Conditions may allow the consequences to occur at the facility during its lifetime, or the event has occurred within the Business Unit	**2 Occasional**	You may have heard of it happening at a similar plant somewhere in the world (if one plant life time is approximately 30-50 years, then this corresponds to 2 or 3 plant lives)	1 / 100 years
Exceptional conditions may allow the consequences to occur within facility lifetime, or the event has occurred within the Operating Company (OPCO)	**3 Seldom**	You may not have heard of this happening at a similar plant but you can imagine that it could, in exceptional circumstances	1 / 1,000 years
Reasonable to expect that the consequences will not occur at this facility. Has occurred several times in the industry but not within the OPCO	**4 Unlikely**	Most people have not heard of this event but it is not too difficult to imagine that it could happen somewhere in industry. Difficult to imagine that it would happen here.	1 / 10,000 years
Has occurred once or twice within industry	**5 Remote**	You have probably not heard of this happening at any plants that you are aware of, but it is not an impossible event for industry, and you could imagine it happening elsewhere	1 / 100,000 years
Rare or unheard of	**6 Rare**	Very slight probability, almost impossible / non credible (but not quite)	1 / 1,000,000 years

3.3 Risk Reduction and Comparison with Risk Tolerability Criteria

3.3.1 Qualitative Risk Assessment

The Chevron *Integrated Risk Prioritization Matrix* rankings are numbered and aligned with associated required actions for health, environment and safety risks, as listed below.

In accordance with the Chevron risk management rules, risk reduction requirements depend on the level of risk, as follows:

- *Risk levels 1, 2, 3, 4 – Short-term, interim risk reduction required*. Long term risk reduction plan must be developed and implemented.
- *Risk level 5 – Additional long term risk reduction required. If no further action can be practicably taken, Strategic Business Unit (SBU) management approval must be sought to continue the activity*.
- *Risk level 6 – Risk is tolerable if reasonable safeguards / management systems are confirmed to be in place and consistent with relevant Risk Reduction Procedure and Closure Guidelines*.
- *Risk levels 7, 8, 9, 10 – No further risk reduction required if risk level is As Low As Reasonably Practicable (ALARP)*.

In the Caltex Safety Case regime, recommendations are provided for risk priority rankings 5 and above, as well as for events or conditions with low likelihood and high consequence that may require further risk evaluation. Recommendations are also provided for risks where they would eliminate or mitigate the potential causes and / or consequences predicted for the scenario.

The *Integrated Risk Prioritization Matrix* and associated required actions are used consistently by Caltex when developing the Safety Case for the refinery and associated facilities, as part of the requirements under the Major Hazard Facility requirements.

To ensure that the risk is managed in accordance with SFAIRP principles (in accordance with *NSW Work Health and Safety Act* and *Regulations* 2011), and to ensure that the risk profile for the Site during the demolition works does not exceed that of the terminal (as defined in the risk profile reported in the PHA for the Project (Ref 1)), the risk of each potential hazardous scenario has been minimised, regardless of it's risk level. This is done through the assessment of existing (proposed) risk management controls and by recommending further controls where the risk is not deemed to follow SFAIRP principles. Particular attention has been paid to areas where potential existed for a risk profile of the Site to be affected by a hazardous scenario.

3.3.2 Quantitative Risk Assessment

The tolerability of the calculated risk is assessed by comparison with an appropriate risk target or criterion. The risk criteria used to make this assessment are specified in HIPAP4 (Ref 3). The risk criteria are detailed below.

A. Individual Risk of Fatality

The individual risk of fatality criteria described in HIPAP4 that are applicable to proposed hazardous developments are as follows:

- Hospitals, schools, child-care facilities and old age housing development should not be exposed to individual fatality risk levels in excess of half in one million per year (0.5×10^{-6} per year).
- Residential developments and places of continuous occupancy, such as hotels and tourist resorts, should not be exposed to individual fatality risk levels in excess of one in a million per year (1×10^{-6} per year).
- Commercial developments, including offices, retail centres, warehouses with showrooms, restaurants and entertainment centres, should not be exposed to individual fatality risk levels in excess of five in a million per year (5×10^{-6} per year).
- Sporting complexes and active open space areas should not be exposed to individual fatality risk levels in excess of ten in a million per year (10×10^{-6} per year).
- Industrial sites should not be exposed to individual risk levels in excess of 50 in a million per year (50×10^{-6} per year) and, as a target, this risk level should be contained within the boundaries of the site where applicable.

These criteria were developed based on a principle that if the risk from a potentially hazardous installation is less than most risks being experienced by the community (e.g. voluntary risks, transportation risks), then that risk may be tolerated. This principle is consistent with the basis of risk criteria adopted by most authorities internationally.

The criterion for residential areas is demonstrably very low in relation to the background risk. It is considered conservative, as it assumed an individual is present and exposed for 24 hours per day, 365 days per year.

B. Individual Risk of Injury

HIPAP4 also outlines risk criteria for effects that may cause injury to people but will not necessarily cause fatality. The injury risk criteria are separated based on

the different effect types, i.e., heat radiation, explosion overpressure and toxic exposure. HIPAP 4 sets the following injury risk criteria:

- Heat flux radiation at residential and sensitive use areas should not exceed 4.7 kW/m^2 at a frequency of more than 50 x 10^{-6} per year.
- Explosion overpressure at residential and sensitive use areas should not exceed 7 kPa at frequencies of more than 50 x 10^{-6} per year.
- Toxic concentrations at residential and sensitive use areas should not exceed a level which would be seriously injurious to sensitive members of the community following a relatively short period of exposure at a maximum frequency of 10 x 10^{-6} per year.

C. Societal Risk of Fatality

The NSW DP&E has adopted indicative criteria to assess the off-site societal risk. The criteria take into account the fact that society is particularly intolerant of accidents, which although infrequent, have the potential to cause multiple fatalities. The criteria define three risk regions as follows (Ref 3):

- Intolerable: above the “intolerable” line, the activity is considered undesirable, even if individual risk criteria are met.
- ALARP (“as low as reasonable practicable”): within the ALARP region, the emphasis should be on reducing risk as far as possible towards the “negligible” line (i.e. ensuring that risks have been reduced to as low as reasonably practicable). Provided other quantitative and qualitative criteria of HIPAP4 are met, the risks from the activity may be considered tolerable within the ALARP region as long as all “reasonably practical” risk reduction measures have been implemented.
- Negligible: below the “negligible” line the societal risk is not considered significant, provided other individual risk criteria are met.

D. Risk of Property Damage and Accidental Propagation

HIPAP4 sets risk criteria that reflect the potential for property damage and accident propagation. Assessment against the criteria provides an indication of the risk that an accident at the facility may cause damage to buildings and / or propagate to involve neighbouring industrial operations, causing further hazardous incidents, i.e. the so-called 'domino effect'. HIPAP4 sets the following criteria for risk of damage to property and accident propagation:

- Heat flux radiation at neighbouring potentially hazardous installations, or at land zoned to accommodate such installations, should not exceed a risk of 50 x 10^{-6} per year for the 23 kW/m^2 heat flux level.

- Explosion overpressure at neighbouring potentially hazardous installations, at land zoned to accommodate such installations or at nearest public buildings should not exceed a risk of 50 x 10^{-6} per year for the 14 kPa explosion overpressure level.

E. Biophysical Risk

HIPAP 4 (Ref 3) outlines risk criteria addressing the risk from accidental releases to biophysical environment. The criteria focuses on the potential acute and chronic toxic impacts that an accidental release may have on whole systems and populations, rather than individual plants or animals. HIPAP4 expresses the criteria as follows:

- Industrial developments should not be sited in proximity to sensitive natural environmental areas where the effects (consequences) of the more likely accidental emissions may threaten the long-term viability of the ecosystem or any species within it.

- Industrial developments should not be sited in proximity to sensitive natural environmental areas where the likelihood (probability) of impacts that may threaten the long-term viability of the ecosystem or any species within it is not substantially lower than the background level of threat to the ecosystem.

4 HAZARD IDENTIFICATION AND CONTROLS

4.1 HAZARDOUS INCIDENT SCENARIOS

A list of the hazards associated with the demolition works is listed in Table 3 below.

A detailed *Hazard Identification Word Diagram* has been prepared for the demolition works and is presented in Table 4, in line with the requirements for hazard analysis (Ref 4). It includes initiating causes, consequences and proposed / existing safeguards to minimise the consequences or likelihood of an incident.

Further discussion and evaluation of safeguards is provided in Section 4.2.

This *Hazard Identification Word Diagram* draws from the potential incident scenarios identified during the hazard identification exercise that was undertaken (and detailed in Ref 9), as well as Planager experience.

A total of 20 hazards were identified, five (5) of these were associated with process safety related hazards; ten (10) with general health and safety hazards; and five (5) with loss of amenity and risks to the biophysical environment (not previously covered under other headings).

Table 3 - Summary of Identified Hazards

Hazard
Process Safety Related Hazards
Scenario 1: Damage to adjacent plant or equipment due to uncontrolled and/or unplanned falling of structure, object or crane collapse
Scenario 2: Damage to live pipework during removal or inadvertent cutting into live pipe or pipeline
Scenario 3: Failure to isolate process equipment
Scenario 4: Damage to underground cables and/or oily water sewer
Scenario 5: Introduction of ignition sources in area classified as Hazardous Area
General Health and Safety Related Hazards
Scenario 6: Crushing or impact injuries
Scenario 7: Fall from heights
Scenario 8: Working over water with a potential for drowning
Scenario 9: Worker trapped (at end of wharf, at height etc.)
Scenario 10: Subsidence and collapse/fall into excavation
Scenario 11: Public and traffic hazardous interaction on public roads or footpath
Scenario 12: Loss of material in transit leading to traffic incident and potential injury

Hazard
Scenario 13: Exposure to airborne hazardous material, or skin contact with such material (heavy metals, asbestos etc.)
Scenario 14: Damage to overhead power lines
Scenario 15: Injury during diving operations
Loss of Amenity to Workforce and Community
Scenario 16: Discomfort from odour associated with removal and disposal of cooling water pipelines (smell – no health hazard)
Scenario 17: Offensive odour and community complaints from mercaptan
Scenario 18: Noise generation (no health risk to community)
Other Risk to the Biophysical Environment
Scenario 19: Incorrect classification of waste leading to contamination of trucks and potential delivery to wrong landfill location
Scenario 20: Re-contamination of opened pipework

Table 4 – Hazard Identification Word Diagram

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
Process Safety Related Hazards							
1	Damage to adjacent (potentially in-service) tank, pipelines, utility, building or machinery due to: • uncontrolled and/or unplanned falling of structure/object; • crane collapse leads to process safety incident with potential for loss of containment, fire and explosion.	**Prevention**: Exclusion distances (workers/heavy machinery), access control. Separation distance between most tanks containing product and demolition activities. Caltex & contractor Permit to Work (PTW) systems. Safe Work Method Statements (SWMS) & Job Hazard Analysis (JHA) for all activities as per with Caltex Risk Management Framework (RMF). Top down deconstruction of tanks and buildings to maintain structural integrity and limit debris zone. Pre-start checks of vehicles and machinery. Specific for cranes: Crane operation and lifts to be carried out under Caltex Safe Work Standard *Use of Lifting Equipment* which sets stringent requirements for inspection of ground, site preparation and concrete slab / pavement thickness where crane outriggers are to be located. Lifting study to be certified/approved by competent person. Crane driver licence. **Detection and communication**: Supervision during all demolition activities; radio communication with control room. **Protection**: Bund to contain the spill should an adjacent tank containing product be damage. Leak detection & ESD (automatic and remote activated) in case of damage to pipelines. ESD of electrical system. Splashes outside bund, or leaks from unbunded pipes, captured in the secondary (site) containment and treatment. Closure of sluice gates as per ERP. **Recommendations**: 1. Demolition activities to be coordinated with terminal activities. Where high risk demolition activities are to occur (e.g. where there is a risk of damage to terminal operations), an assessment needs to be completed in conjunction with terminal operations to formulate a hazard control plan specific to the high risk activity. This may include, but not limited to: a) timing the activity such that alternative product transfer options are available from other tanks / lines; b) changing the work methodology to lower the risk of equipment damage; or c)	Conseq.: 3 Likelihood:6 Risk: 8	**Tank farm area:** Conseq.: 3 Likelihood:5 Risk: 7 **All other areas:** Conseq.: 3 Likelihood:6 Risk: 8	The risk is marginally increased in the tank farm area during demolition activities due to the increased work with heavy machinery adjacent to (potentially in-service) tanks. The risk in other areas would, provided the recommendations are implemented, remain identical to the risk for the operating terminal. Existing and recommended controls considered to align with SFAIRP principles.		

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
		developing a product supply contingency plan. 2. Demolition works plan to include framework for considering the demolition of individual tanks in shared tank farm areas (sequence activities for max space around in-service tanks). 3. Develop access control plan for the demolition area that reflects demolition operator having limited visibility when using heavy machinery / vehicles. 4. Determine requirements for evacuating buildings and blocking roadways during felling of tall structures.					

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
2	Damage to live pipework during removal of adjacent redundant pipe or pipeline, or inadvertent cutting into live pipework causing loss of containment of flammable liquid. Environmental damage if not contained and fire/explosion if ignition source present. Interruption to terminal and airport refuelling operations (if Banksmeadow jet fuel pipeline is damaged)	**Prevention:** Identification and marking of live and redundant lines. Open drains and vent lines on redundant pipework. PTW, SWMS, coordination (pre-start) meeting. Pipelines in rights of way: Pipelines to be unearthed prior to removal; cooling water lines are easily identified (vastly different diameters). **Detection and communication:** Gas testing. Manned activity allows manual ESD and communication with control room. Leak detection initiates ESD (tank farm and interconnecting pipes). **Protection:** In the case of work at tank farm and interconnecting pipes, Loss of Containment (LOC) will be contained on site in bunding and secondary (site) containment and treatment; ERP and fire water systems available; closure of sluice gates; oil spill response capability. **Recommendation:** As above regarding coordination of demolition activities and cessation of transfer operations during high risk demolition work. 5. Determine additional requirements for work on interconnecting pipework adjacent to live pipes (e.g. cold cutting and controlled removal; protective barriers). 6. Increase surveillance (use spotters) for work adjacent to (within 1 meters of) live pipes / pipelines.	Conseq.: 3 Likelihood:6 Risk: 8	Conseq.: 3 Likelihood:6 Risk: 8	Provided recommendations are implemented, the risk remains the same during demolition activities compared with that for an operating site (potentially in-service) pipes or pipelines. Existing and recommended controls align with SFAIRP principles.		

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
3	Failure to isolate process equipment (tank, piping etc.) results in LOC of flammable liquids, fire/explosion or exposure to high voltage electricity; environmental pollution and worker injury.	**Prevention:** Purging and cleaning of process equipment, tanks etc. prior to demolition works by competent, experienced Caltex personnel. Provision of positive isolation. Drains and vent lines opened on redundant pipework. Caltex SMP (minimum standard) used by contractor. Caltex reviews contractor SMP. PTW) including JHA. SWMS, communication and supervision. Pre-start review(s). Gas testing as part of PTW process. Independent verification of cleaning process carried out by demolition contractor, as per Demolition Code. **Detection and communication**: Supervision during all demolition activities; radio communication with control room. **Protection**: Bunding around tanks (able to contain 100% of contents). Leak detection with ESD system (automatic and remote activated) in case of damage to pipelines. Automatic shutdown of electrical system. LOCs outside the bund captured in secondary (site) containment and treatment. Closure of sluice gates as per ERP. Radio communication with control room. **Recommendations:** 7. Caltex to check contractor capability for independent verification carried out by contractor (refer Demolition Code of Practice, Ref 10). 8. Investigate additional precautions required for floating roof tanks where pontoons may entrap flammable material which may not be detected during normal gas testing.	Conseq.: 3 Likelihood:5 Risk: 7	Conseq.: 3 Likelihood:5 Risk: 7	The risk also exists at an operating site (refinery or terminal) and may in fact be marginally reduced during demolition activities due to the systems in place. Proposed and recommended controls make for very robust risk management of this potential hazard, in particular the positive isolation and the independent verification (Caltex and contractor). SFAIRP principles are adhered to.		

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
4	Damage to underground cables and/or oily water sewer in tank bunds and process area, due to compression/ slewing/ vibration, results in loss of containment of environmentally polluting material or short-circuiting of electrical connection	**Prevention:** Drawings show locations of cables and underground pipes. Procedure for work with heavy machinery including laying of protective plates. Use special tool (*wanding* tool) to locate electrical cables. **Protection:** Emergency Response Procedures (ERP) and Fire Water systems available. Closure of sluice gates as per ERP. Oil spill response capability.	Conseq.: 6 Likelihood:4 Risk: 9	Conseq.: 6 Likelihood:4 Risk: 9	Heavy machinery is used on the Site. No significant change to the risk level. SFAIRP principles are maintained.		
5	Introduction of ignition sources in area classified as Hazardous Area under Australian Standard	**Prevention:** Hazardous Area Classification and equipment rated in accordance with requirements. Plans and drawings show Hazardous Area zones. **Protection:** ERP, fire water. **Recommendation:** 9. Review and update Hazardous Area classification drawings for demolition works, particularly in areas where demolition activities are to take place in parallel with an operating terminal. Particular attention should be paid to the fact that demolition contractors may not be well versed with the requirements for control of ignition sources at the Site.	Conseq.: 3 Likelihood:5 Risk: 7	Conseq.: 3 Likelihood:5 Risk: 7	The risk of unplanned / uncontrolled introduction of ignition sources into a Hazardous Area is well known and understood by Caltex plant personnel and is relevant also for the operating site. The safeguards are well established and the risk adheres to SFAIRP principles.		

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
General Health and Safety Related Hazards							
6	Crushing or impact injuries, e.g. from: • vehicle toppling on ramp; • instability of sphere or bullet during lay down; • crane toppling over; • collapse of uncontrolled movement of building; • truck driver crushed during loading operation leading to injury or fatality of workforce.	**Prevention**: Induction, PTW, SWMS, JHA. Exclusion zone during demolition activities. Pre-start checklist for machinery. Use of ramps minimised and ramps designed and constructed by competent persons. Traffic management plan. Bullets are cut up in situ; spheres are collapsed and restricted from movement (chocked) prior to cutting. Lifting study for heavy lifting machinery (including cranes); competent person certifies/approves lifting study; high risk licenced crane workforce. Truck driver is supervised at all times on site; driver is required to move to a safe area. Caltex Operating Procedures and work methods, in relation to the integrity of access and egress points for heavy vehicles into bunds, set requirements for inspection by *competent person* prior to heavy vehicle entering the bund. **Protection**: ERP, injury management. **Recommendations**: 10. Where ever possible, construct ramps away from operational pipework.	Conseq.: 3 Likelihood:6 Risk: 8	Conseq.: 3 Likelihood:5 Risk: 7	There will be an increase in the risk of health and safety related hazards associated with the demolition works due to the very nature of these activities. The hazards are well known and understood by Caltex and contractors. The safeguards established for these activities are heavily regulated and proceduralised. Detailed safeguards for each task will be developed in due course to ensure adherence to generally accepted SFAIRP principles for this type of industry.		
7	Working at heights, e.g. to remove roofing material from building, results in fall and injury	**Prevention:** PTW and SWMS. Working at heights standards and codes of practice **Protection:** Working at heights training and rescue procedures. ERP.	Conseq.: 3 Likelihood:5 Risk: 7	Conseq.: 3 Likelihood:4 Risk: 6	As there will be more work at heights during demolition works the risk is considered to increase. Hazards associated with work at heights are well known and understood by Caltex and contractors. The safeguards established for these activities are heavily regulated and proceduralised. Detailed safeguards for each task will be developed in due course to ensure adherence to generally accepted SFAIRP principles for this type of industry.		

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
8	Working over water results in drowning	**Prevention:** Wharf is fully hand railed. Provision of working platform with appropriate safety provisions. PTW and Safe Work Method Statement. **Protection:** Caltex procedures include wearing of self-inflating vests outside the hand railed area. ERP, injury management, first aid training.	Conseq.: 3 Likelihood:5 Risk: 7	Conseq.: 3 Likelihood:5 Risk: 7	There is no expected change to the risk level of this activity. The safeguards are well established and adhere to SFAIRP principles.		
9	Worker trapped in case of an external incident, e.g. at end of wharf, at height etc.	**Prevention:** Procedure for working at height or on wharf. **Protection:** Emergency response procedures including muster points and communications, rescue procedures.	Conseq.: 3 Likelihood:5 Risk: 7	Conseq.: 3 Likelihood:5 Risk: 7	No expected change in risk level. The safeguards are well established and the proposed controls adhere to SFAIRP principles.		
10	Subsidence and collapse/fall into excavation (of equipment, machinery, substation / building adjacent to right-of-way, person) due to sandy substrate with shallow angle of repose	**Prevention:** Exclusion zone and fencing. Excavation Code of Practice (2014). Procedure is to 'go wide or shore'. PTW (includes excavation hazards and controls) and SWMSs, JHA. **Protection:** ERP, injury management. **Recommendation:** 11. Minimise the risk of subsidence of the substation and potentially of the nearby residential dwelling both of which are in very close proximity to the pipelines being removed within the eastern right-of-way.	Conseq.: 3 Likelihood:4 Risk: 6	Conseq.: 3 Likelihood:4 Risk: 6	There is no expected change to the risk level of this activity. The safeguards are well established and the proposed controls adhere to SFAIRP principles.		
11	Public and traffic interaction on public roads and footpath causing vehicle or pedestrian accidents and injury	**Prevention:** Rights of way are fenced and gated. Traffic management plan (including traffic controllers). Traffic rules. Licenced HV drivers.	Conseq.: 4 Likelihood:4 Risk: 7	Conseq.: 4 Likelihood:4 Risk: 7	The potential for traffic incidents is in general well known and understood by people in the vicinity of heavy vehicles (HVs). There will be an increase in the number of HVs entering and leaving the Site during demolition activities and hence there will be an equal increase in risk. The risk level will however remain unchanged. The safeguards are well established and the proposed controls adhere to SFAIRP principles.		

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
12	Loss of material in transit leading to traffic incident and potential injury	**Prevention:** Available truck checklist includes items related to keeping load secure. Trained and licenced truck drivers and loaders. Load sequencing (lighter gauge material loaded first). Penalties for inappropriate behaviour/activities is a deterrent. **Protection:** RMS guidelines for covering of loads. Weighbridge allows detection of an overloaded truck, allowing rectification prior to leaving the Site. **Recommendations:** 12. Implement Caltex inspection program to include truck loading activities (e.g. use Tipper Truck Loading / Unloading Safety Inspection Checklist FORM 4.00.03.027)	Conseq.: 4 Likelihood: 5 Risk: 8	Conseq.: 4 Likelihood: 5 Risk: 8	There is no expected change to the risk level of this activity. The safeguards are well established and the proposed controls adhere to SFAIRP principles.		
13	Exposure to airborne hazardous material or skin contact with such material during demolition activities, including to: • Chromium or lead from paint released during hot work of pipes; • Contaminated soil (asbestos, hydrocarbons, heavy metals • Asbestos (lagging etc.)	**Prevention:** Site is split into contamination management zones; a contamination management plan will be prepared as part of DEMP. Asbestos Containing Material Control Program, focussing on each zone. Handling procedures will be prepared. Training programs (awareness and induction) will be delivered to the workforce. Demolition contractor to have asbestos removal licence (Class A) and must comply with AS 2601-2001 and *Safe Removal of Asbestos* Code of Practice (2005). Managed disposal of asbestos containing material as per regulation. Testing for lead and chromium prior to hotwork - if lead/chromium is present paint will first be removed or material will be cold cut. **Protection:** Monitoring/observation/testing for contaminants during the demolition works. Dust control requirements (procedural and hardware) to be included in Safety Management Plan and Demolition Environment Management Plan.	**Workforce and Community** Conseq.: 3 Likelihood: 6 Risk: 8	**Workforce** Conseq.: 3 Likelihood:5 Risk: 7	**Workforce** The risk is currently present on Site, but the risk to the workforce may increase due to the extent of the demolition works. However the works will be staged, the safeguards are well established and the proposed controls adhere to SFAIRP principles.		
				Community Conseq.: 3 Likelihood: 6 Risk: 8	**Community** The risk is present on the operating Site. The safeguards are well established and the proposed controls adhere to SFAIRP principles.		

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
14	Damage to overhead power lines leading to: - loss of power to community - damage to equipment - electrocution of demolition contractor	**Prevention:** Compliance with WorkCover Work Near Overhead Power Lines Code of Practice (2006). Signage. Caltex procedure for work near overhead power lines. PTW, SWMS. Tip-over axel trucks are not allowed on the Site (Caltex land, including rights-of-way). **Protection:** ERP, injury management. **Recommendation:** 13. Determine the requirements for isolation and/or installation of protective barriers at the overhead power lines (in the rights-of-way), and notify the energy authorities prior to work being undertaken.	Conseq.: 3 Likelihood:5 Risk: 7	Conseq.: 3 Likelihood:5 Risk: 7	The risk of damage to the power lines is well known and understood by plant personnel and is relevant also for the operating site. With the controls in place the level of risk should remain unchanged compared with that from the operating site or possibly slightly reduced. The risk adheres to SFAIRP principles.		
15	Injury during diving operations	**Prevention:** Training; use of buddy system; SOPs, limited depth of water. **Protection:** Emergency response procedures and rescue plan.	Conseq.: 4 Likelihood: 5 Risk: 8	Conseq.: 4 Likelihood: 5 Risk: 8	There is no expected change to the risk level of this activity. The safeguards are well established and the proposed controls adhere to SFAIRP principles.		
Loss of Amenity to Workforce and Community							
16	Discomfort (neighbours, workforce) from odour associated with removal and disposal of cooling water intake pipelines in eastern right of way (smell – no health hazard)	**Prevention:** Safe work method statements, PTW. Pipeline shutdown/removal schedule allows time for smell to dissipate. Cut-up cooling water pipework is to be removed from the area in a timely fashion.	-	-	This is not considered a major hazard and is not ranked in the Caltex risk matrix		
17	Offensive odour and community complaints if demolition rubble from the small mercaptan building contains contamination from mercaptan. Need to follow contaminated waste requirements.	**Prevention:** All mercaptan containing equipment/ canisters have already been removed. Building is to be emptied and aired prior to demolition. **Protection:** PPE used by workforce. **Recommendations:** 14. Determine chemical cleaning requirements to remove contamination prior to removal. 15. Determine waste disposal requirements for mercaptan building rubble.	**Workforce** Conseq.:6 Likelihood:4 Risk: 9 **Community** None	**Workforce** Conseq.:6 Likelihood:4 Risk: 9 **Community** None	The risk will decrease from that of the operating refinery. It will temporarily remain on-site during the demolition activities, after which it will have been eliminated. This is not considered a major hazard and is not ranked in the Caltex risk matrix		

No	Hazard	Safeguards	Residual Risk for Operating Site	Residual Risk During Demolition	Increase / Decrease of Risk Level		
					Decrease	Increase	No change
18	Community and workforce discomfort and generating complaints due to excessive noise generation. No health risk to community.	**Prevention**: Traffic management plan. Defined laydown and scrap processing areas located away from community. Scheduling of noisy demolition works during daylight hours. PPE for persons in immediate proximity, as determined in PTW and Safe Work Method Statements. Noise impact assessment as part of SEE. The HAZDEM workshop recommended that a noise assessment be undertaken in line with relevant NSW guidance to identify and mitigate potential noise impacts on the local community from the demolition works. This noise assessment has been completed and is provided in Appendix E of the SEE for the demolition works. **Protection**: Community consultation/ hotline for complaints. **Recommendations**: 16. High noise generating demolition works would be confined to less sensitive times of the day and not outside the hours of 7.00 am to 6.00 pm Monday to Saturday.	**Workforce** Conseq.: 5 Likelihood: 3 Risk: 7	**Workforce** Conseq.: 5 Likelihood: 3 Risk: 7	**Workforce** Risk is well known and understood and will be assessed for each task (SWMS, PTW, JHA). The safeguards will be established based on SFAIRP principles.		
			Community Risk: none	**Community** Risk: none	**Community** This is not considered a major hazard to the community and is not associated with any health hazards. As such it is not ranked in the Caltex risk matrix.		
Other Risk to the Biophysical Environment							
19	Incorrect classification of waste leading to contamination of trucks and delivery to wrong landfill location.	**Prevention:** Waste is classified, streamed and stored in designated and signed locations in accordance with Waste Classification Guidelines (DECCW). Inspection of soil to identify potential contamination. Testing of potentially contaminated soil which is stored independently until results received. Disposal at appropriately licensed facilities. **Protection:** Lining of trucks and bins as required.	Conseq.:5 Likelihood: 4 Risk: 8	Conseq.:5 Likelihood: 4 Risk: 8	No expected change in risk level. The safeguards are well established and the proposed controls adhere to SFAIRP principles.		
20	Rain event re-contaminates opened pipework leading to environmental contamination in work area.	**Prevention:** Scheduling of work to minimise open pipework. Weather monitoring through, for example, the BOM website. **Protection:** de-contamination process prior to removal off site.	Conseq.:5 Likelihood:4 Risk:8	Conseq.:5 Likelihood:3 Risk:7	Some increase in risk due to increased activities associated with opening up pipework and equipment. The risk is well known and understood and the methods available ensures risk adheres to SFAIRP principles		

4.2 Detailed Consideration of All Hazards and Associated Controls

The Hazard Identification Word Diagram in Table 4 above lists the control mechanisms for each identified hazard associated with the demolition works. Further details on these controls are provided below.

4.2.1 Process Safety Related Hazards

The following hazards and controls are identified for the demolition activities adjacent to operating facilities, plant and equipment (including interconnecting pipes and pipelines). Where the controls were not deemed as sufficient to reduce the risk level to SFAIRP, further safeguards have been recommended.

A. Damage to Plant and Equipment or Cutting into Live Pipes

(Scenarios 1, 2, 3 and 4)

Following damage to process plant, equipment and pipelines, or inadvertent cutting into live pipework, there is potential for loss of containment of process fluids which may result in a fire, an explosion, or a pollution event if the spill is not contained.

This hazard already exists at the Site and will continue to exist during the operation of the terminal, well after the demolition works have ceased.

The risk may be somewhat increased during demolition works within the tank farm area, compared with that for an operating site, due to the increased work with high structures and with heavy machinery adjacent to (potentially in-service) tanks. In other areas the risk is believed to remain as per the operating site.

A number of well-established controls apply to manage this hazard, including establishment of exclusion and separation distances; purging and cleaning processes (with independent verification); and isolation processes, including the requirement to prove positive isolation to process fluids. Further, the tank bunds will continue to provide protection should an adjacent (full) tank be damaged, allowing 100% of the tank's contents to be contained within the bund.

Where damage occurs to interconnecting pipes on Site but outside of the bunds, the leak detection system, with automatic and remote activated Emergency Shut Down (ESD) system will limit the size of the spill to that between isolation valves. The secondary (site) containment and treatment system (including the ability to close sluice gates) will ensure that the spill remains on Site.

In the case of pipelines in the rights of way, these would be uncovered prior to removal to ensure identification.

As the management of this process safety hazard is key to ensuring that the risk profile of the Site remains unchanged from that of the terminal, as assessed in the PHA (Ref 1), a number of additional recommendations have been made (refer to Section 6). These recommendations include coordination between demolition and terminal activities; additional requirements for work on interconnecting pipework adjacent to live pipes; and increase surveillance for work adjacent to live pipes / pipelines.

B. Introduction of Ignition Sources into a Hazardous Area

(Scenario 5)

The hazard associated with an inadvertent and/or uncontrolled introduction of ignition sources into a Hazardous Area is well known and understood by Caltex plant personnel and is relevant for the refinery, the conversion works and ongoing operation of the terminal.

The controls available to manage such risks are well established and currently implemented by Caltex at the Site. These controls include Permit to Work (PTW) system, Safe Work Method Statements (SWMS) and Job Hazard Analysis (JHA) as well as Hazardous Area Classification drawings and equipment rated in accordance with zoning requirements that follow the Australian Standard for Hazardous Areas.

To maintain the level of rigour in the control of this hazard during the demolition works it is recommended that the Hazardous Area Classification drawings be updated to account for the demolition activities, particularly in areas where demolition activities are to take place in parallel with the operating terminal. Particular attention should be paid to the fact that demolition contractors may not be well versed with the requirements to control ignition sources at the Site.

4.2.2 General Health and Safety Related Hazards

A. Crushing, Impact, Falling, Drowning, Trapped or Subsidence

(Scenarios 6 to 10 and 15)

Demolition works are associated with a number of inherent health and safety risks due to the very nature of the activities likely to be carried out. Such activities include work at heights, work adjacent to heavy machinery and work with heavy loads. Caltex would work with the demolition contractor to ensure that these risks are well known and understood by the contractors licenced to carry out such activities and relevant Caltex employees.

The safeguards established for demolition activities are heavily regulated and proceduralised in Australia. Safeguards include training and induction; the use of standards and codes of practice, PTW systems, SWMS and JHA. The establishment of exclusion zones during demolition activities to separate people from machinery and overhanging objects and structures is critical.

Subsidence hazards are managed in accordance with the Excavation Code of Practice (2014, Ref 10).

Detailed safeguards would be developed prior to demolition works commencing to ensure adherence to *SFAIRP* principles for each task.

Further, a competent person would verify / inspect access ramps to bunds, ramps would be constructed away from operating pipework wherever possible; and the risk of subsidence of the substation and potentially also of the residential building in very close proximity to the right of way pipelines would be minimised.

B. Exposure to Hazardous Material or Dusts

Certain buildings and soils contain materials which could be harmful to humans if they are not managed appropriately. Potentially harmful material include asbestos (e.g. from old lagging), paints (containing heavy metals e.g. chromium, lead) and contaminated soil.

While this hazard is already present on the Site it is believed that it will be somewhat increased during demolition activities in contaminated areas or during works involving potentially harmful material.

Caltex has undertaken previous assessments of the Site and identified contaminated areas (Coffey, 2007). The *Contamination Management Plan* as part of the *Demolition Environmental Management Plan* (DEMP) would set up the framework for the management of contaminated soil during the demolition works. It would include procedures for monitoring soils as they are excavated, measures for handling and storing the contaminated soil (including loading and disposal), measures to avoid potential impacts on workforce and community, and general management requirements. The *Contamination Management Plan* would refer to the EPL for the Site, Contaminated Land Management Act 1997 and the NSW (2009) Waste Classification Guidelines and its Regulations (refer to Chapter 9 Soils, Groundwater and Contamination of the SEE). Caltex is committed to following all requirements provided in these documents. Such steps would include preparation of handling procedures and delivery of training programs. Further, the demolition contractor would have an asbestos removal licence (Class A) and their work must comply with AS 2601(*The demolition of structures* (Ref 11)) and *Safe Removal of Asbestos Code of Practice* (Ref 12).

C. Damage to Overhead Power Lines

Work in the right-of-ways would be in close proximity to overhead power lines. If the demolition works within the right of ways are not managed correctly, there is a risk that these power lines maybe damaged. Damage could lead to loss of power to the community, damage to equipment and electrocution of demolition personnel.

The *Work Near Overhead Power Lines Code of Practice* (Ref 13) provides the framework for establishing the controls during these activities. Further, Caltex

has established procedure for work near the overhead power lines, which include PTW, SWMS and the fact that tip-over axle trucks are not allowed on the main refinery/terminal site, land owned by Caltex, the rights-of-way or the Kurnell Wharf.

It is recommended that the requirements for isolation and/or installation of protective barriers at the overhead power lines (in the rights-of-way) be determined in consultation with energy authorities.

4.2.3 Loss of Amenity to Workforce and Community

(Scenarios 16, 17 and 18)

Both the community and the workforce may suffer a temporary reduction in amenity as a result of odour impacts associated with removal and disposal of cooling water intake pipelines from the eastern right of way, or during movement of demolition rubble from the small mercaptan building should it be contaminated with mercaptan. There may also be noise generated from the demolition activities carried out on Site which would be audible at certain residential receptors.

A Traffic Management Plan will be put in place to manage traffic generated during demolition activities. Further, defined laydown and scrap processing areas would be located away from community in the southern part of the Site and demolition works would be scheduled during daylight hours.

Controls to manage offensive odours include the use of SWMS and PTW; following the pipeline shutdown/removal schedule; removing cooling water intake pipework from the right of way in a timely fashion; and removing all mercaptan containing equipment/ canisters well ahead of demolition and the building being emptied and aired.

It is further recommended that chemical cleaning requirements to remove mercaptan contamination (from the mercaptan building) be determined prior to removal.

The risk to the community from the loss of amenity is very low as these events are not considered a major hazard and, as such, are not ranked in the Caltex risk matrix. There is some risk to the workforce from excessive noise and exposure to mercaptan.

Noise and traffic management is further discussed in Chapters 13 and 15 respectively of the SEE.

4.2.4 Other Risk to the Biophysical Environment

A. Incorrect Classification of Waste

(Scenario 19)

Incorrect classification of waste may lead to contamination of trucks and potential delivery of material to the wrong landfill location.

The *Waste Classification Guidelines* (Ref 14) sets the framework for managing potentially contaminated wastes. The key control includes the classification, screening and storage of wastes in designated and signed locations in accordance with these guidelines. Further, inspection and testing programs would be established, prior to disposal in appropriately licensed facilities.

B. Hazardous Interaction Between Public and Demolition Heavy Vehicle Traffic

(Scenarios 9 and 10)

The hazardous interaction of the public and traffic generated by the demolition works on public roads and footpaths may result in vehicle or pedestrian accidents and injury. Controls are well established in Australia and include following traffic rules, the use of licenced drivers and loaders, covering loads and the fact that inappropriate behaviour/activities are penalised (which acts as a deterrent).

Further site-specific controls include the rights of way remaining fenced and gated; the establishment of a *Traffic Management Plan* as part of the *DEMP* which includes traffic controls; and the use of checklist and processes (including load sequencing). In addition, trucks are required to use the weighbridge prior to leaving the Site. Trucks that are overloaded with material are identified at this point and are returned to Site to allow the issue to be rectified.

It is further recommended that the Caltex audit program be implemented to include truck loading activities.

C. Rain Event Re-contaminates Opened Pipework

Rain events may re-contaminate previously opened pipework leading to potential for environmental contamination in the demolition works area. This risk can be prevented by planning work to minimise open pipework, by covering open pipework and by monitoring the weather and managing the works accordingly.

5 RISK ANALYSIS

5.1 QUALITATIVE RISK ANALYSIS

As discussed above, the qualitative risk assessment has been prepared on the basis of the risk matrix and associated consequence and likelihood scoring tables in Section 3.2, and based on the hazardous incident identification exercise summarised in Table 4 above.

The risk profile of the Site during the demolition works is presented in Table 5. In comparison, the risk profile of the terminal is presented in Table 6. Note that, as per the risk matrix, a low number represents a high risk while a high number represents a low risk.

5.1.1 Risk Levels 1 to 5

No scenarios with risk levels 1 to 5 were identified for the operating terminal or for the terminal during the demolition works.

5.1.2 Risk Level 6

According to the risk criteria for risk level 6 scenarios (refer to Chevron's risk matrix criteria detailed in Section 3.3.1): *Risk is tolerable if reasonable safeguards / management systems are confirmed to be in place and consistent with relevant Risk Reduction Procedure and Closure Guidelines.*

The following hazards were ranked as risk level 6 for the terminal during the proposed work:

- Scenario 7: Working at heights
- Scenario 10: Subsidence and collapse/fall into excavation

The hazards associated with Scenarios 7 and 10 are typical for demolition activities and are well known and understood by plant personnel and demolition contractors. The safeguards established for these activities are heavily regulated and proceduralised. Detailed safeguards for each task would be developed in due course to ensure adherence to generally accepted SFAIRP principles for this type of industry and for these types of activities.

5.1.3 Risk Levels 7, 8, 9 and 10

According to the risk criteria for scenarios ranked with risk levels 7, 8, 9, and 10 (refer to Chevron's risk matrix criteria detailed in Section 3.3.1): *No further risk reduction required if risk level is As Low As Reasonably Practicable (ALARP).*

Table 5 – Risk Profile During Demolition

Likelihood	Consequences					
Likely 1	6	5	4	3	2	1
Occasional 2	7	6	5	4	3	2
Seldom 3	8	7 Scenario 18 (workforce) Scenario 20	6	5	4	3
Unlikely 4	9 Scenario 4 Scenario 17 (workforce)	8 Scenario 19	7 Scenario 11	6 Scenario 7 Scenario 10	5	4
Remote 5	10	9	8 Scenario 12 Scenario 15	7 Scenario 1 (tank farm) Scenario 3 Scenario 5 Scenario 6 Scenario 8 Scenario 9 Scenario 13 (workforce) Scenario 14	6	5
Rare 6	10	10	9	8 Scenario 1 (all other areas) Scenario 2 Scenario 13 (community)	7	6
	Incidental 6	Minor 5	Moderate 4	Major 3	Severe 2	Catastrophic 1

Table 6 – Risk Profile of Terminal

Likelihood	Consequences					
Likely 1	6	5	4	3	2	1
Occasional 2	7	6	5	4	3	2
Seldom 3	8	7 Scenario 18 (workforce)	6	5	4	3
Unlikely 4	9 Scenario 4 Scenario 17 (workforce)	8 Scenario 19 Scenario 20	7 Scenario 11	6 Scenario 10	5	4
Remote 5	10	9	8 Scenario 12 Scenario 15	7 Scenario 3 Scenario 5 Scenario 7 Scenario 8 Scenario 9 Scenario 14	6	5
Rare 6	10	10	9	8 Scenario 1 Scenario 2 Scenario 6 Scenario 13 (workforce & community)	7	6
	Incidental 6	Minor 5	Moderate 4	Major 3	Severe 2	Catastrophic 1

The majority of scenarios are ranked as risk levels 7 or 8, both for the operating terminal and for the terminal during the demolition works.

The list below shows the scenarios which are ranked as risk level 7 during the demolition works:

- Scenario 1 (tank farms): Damage to adjacent plant or equipment due to uncontrolled and/or unplanned falling of structure, object or crane collapse (this scenario is ranked as risk level 8 for the operating terminal).
- Scenario 3: Failure to isolate process equipment.
- Scenario 5: Introduction of ignition source in area classified as a Hazardous Area.
- Scenario 6: Crushing or impact injuries (this scenario is ranked as risk level 8 for the operating terminal).
- Scenario 8: Working over water results in drowning.
- Scenario 9: Worker trapped in case of an external incident.
- Scenario 11: Hazardous public and traffic interaction on public roads and footpaths.
- Scenario 13 (workforce): Exposure to hazardous material or dust (this scenario is ranked as risk level 8 for the operating terminal).
- Scenario 14: Damage to overhead power line.
- Scenario 18: Noise generation (no health risk to community).
- Scenario 20: Rain event re-contaminates opened pipework (this scenario is ranked as risk level 8 for the operating terminal).

The following hazards were ranked as risk level 8 during the demolition works:

- Scenario 1 (non-tank farm areas): Damage to adjacent plant or equipment due to uncontrolled and/or unplanned falling of structure, object or crane collapse this scenario is ranked as risk level 8 for the operating terminal).
- Scenario 2: Damage to live pipework during removal or inadvertent cutting into live pipe or pipeline.
- Scenario 12: Loss of material in transit leading to traffic incident.
- Scenario 13 (community): Exposure to hazardous material or dust (this scenario is not considered credible for the operating terminal).
- Scenario 15: Injury during diving operations.
- Scenario 19: Incorrect classification of waste.

The following scenarios were ranked as risk level 9:

- Scenario 4: Damage to underground cables and/or oily water sewer.
- Scenario 17 (workforce): Offensive odour and community complaints from mercaptan (this scenario is not considered credible for the operating terminal as the mercaptan would have been removed from the Site).

No scenarios were ranked as of level 10 as this hazard and risk assessment focussed on high consequence – low likelihood accidents.

Note that **Scenario 16:** *Discomfort from odour associated with removal and disposal of cooling water intake pipelines*, is not considered a major hazard and is not discussed further in this risk assessment.

5.2 QUANTITATIVE RISK ANALYSIS

5.2.1 QRA Conducted for the Operating Terminal

A quantitative risk analysis was conducted as part of the EIS for the new terminal and reported in the PHA, in Appendix C of the EIS (Ref 1).

A. Hazardous Release Scenarios

The PHA developed a number of hazardous LOC scenarios to represent the range of possible failures associated with each isolatable section of the terminal. These failure modes were represented as releases from selected hole sizes. The isolable sections were defined depending on a number of factors including:

- Material;
- Process conditions (e.g. temperature and pressure);
- State (i.e. vapour or liquid);
- Inventory;
- Flow rate; and
- Utilisation (i.e. percentage of the time in use).

B. Consequence Assessment

The hazardous LOC scenarios in the PHA mostly relate to a loss of containment event of flammable or combustible liquids with a subsequent ignition and fire or explosion.

For each hazardous LOC scenario, consequence modelling was conducted as part of the PHA, for a range of hole sizes. The consequence modelling determined the area impacted by each consequence event. The consequence modelling in the PHA was conducted using the software package PHAST-RISK. The consequence impact distances for each effect type was assumed to depend on the following conditions:

- Release conditions (temperature, pressure, hole size and duration);
- Release source (elevation, orientation);
- Chemical properties; and
- Atmospheric conditions (wind speed).

The frequency assessment used available historical failure rate data from a number of public sources, all relevant to an operating industrial site similar to the proposed terminal.

C. Likelihood Estimation

The failure rate data obtained from public sources was used in the QRA without modification. No specific characteristics, such as environmental factors, were identified that would require the failure data to be modified. For example, no

unusually harsh conditions are experienced at the Site that would cause failure modes, such as corrosion, to occur at significantly higher rates than those typical across industry. Additionally, in terminal operations, Caltex will continue to use its established integrity management processes, which are largely-based on industry standards. It is expected that these established processes will serve to maintain integrity management performance at a level that is at least equal to the performance reflected within the failure rate data used in the QRA model. Caltex also has established processes for corporate audits, insurance engineering surveys and external audits.

D. Risk Assessment

The PHA assessed the consequences and likelihoods of each hazardous LOC scenario in turn and then combined the individual scenario risks to generate the risk profile for the operating terminal. Both pool fires and vapour cloud explosions were considered.

The PHA was largely quantitative and determined a risk profile for the Project, using quantitative risk analysis (QRA). The risk profile for the terminal was shown to adhere to all risk criteria, as presented within the NSW Department of Planning's guideline for risk criteria in landuse planning (HIPAP4, Ref 3).

5.2.2 Impact of Demolition Activities on Terminal QRA

A. Hazardous Release Scenarios

The Site operations would, during demolition activities, resemble closely those of the operating terminal. The difference would be the simultaneous demolition activities which have the potential to affect the terminal operation and hence it's associated risk profile.

All of the hazardous LOC scenarios that were determined for the operating terminal, as defined in the PHA, would also be relevant for the Site during demolition phase. No additional LOC scenarios, which could affect the risk profile for the terminal, have been identified during the demolition phase, (note that the scenarios identified during demolition have a potential to trigger a LOC scenario).

B. Consequence Assessment

The consequence of each hazardous LOC scenario would remain unchanged. This is particularly so as the main process safety related controls would also remain active during demolition activities. For example, bunds and other methods of retaining a spill, detection and emergency shutdown systems to minimise the duration of the spill, and emergency response, including fire fighting capabilities, would remain active during the demolition phase as well as during the operation of the terminal.

C. Likelihood Estimation

It is the likelihood of the flammable event that requires further scrutiny, both from a point of view of the demolition activities affecting the likelihood of a LOC event and the probability of an ignition of a flammable or combustible release. A discussion as to the effect on the likelihood of the flammable events is provided below.

The PHA provided a quantitative estimate of the likelihood of a LOC of flammable of combustible material for each scenario, as follows:

- Storage tanks: LOC frequency in the order of 10^{-3} per year per tank (for small leaks), to 10^{-4} per year per tank (for very large leaks) and 10^{-5} per year per tank (for rupture leaks);
- Process piping and transfer pipes (such as the pipelines): LOC frequency in the order of 10^{-5} per meter per year (for small leaks), to 10^{-7} per meter per year (for rupture leaks);
- Pumps: LOC frequency in the order of 10^{-3} to 10^{-5} per year per pump;
- Flanges: LOC frequency in the order of 10^{-5} per year per flange; and
- Valves: LOC frequency in the order of 10^{-5} to 10^{-6} per valve.

The initiating (trigger) events for each type of LOC scenario include impact events (including uncontrolled and/or unplanned falling of structure or object); failure during maintenance or repair (e.g. failure to isolate, or inadvertent cutting into live pipework); corrosion, failure to maintain; operating conditions being exceeded (e.g. overpressure, overflow) etc. The individual frequency of each one of these trigger events makes up the total likelihood for the LOC scenario.

Further, the PHA used a probability of ignition of 1% for small LOCs and up to 8% for very large LOCs. The ignition on an industrial facility such as the terminal could occur from a failure to manage hot work in Hazardous Areas; introduction of un-rated or damaged equipment and instruments into flammable atmospheres etc., and the individual probability of each type of ignition makes up the total probability of ignition assumed in the PHA (Ref 1).

The hazard identification in Section 4 of this Report determined that the following four (4) potentially hazardous scenarios have a potential to impact on the risk profile of the terminal site[1]:

[1] Note that potentially hazardous scenario #4 relates to smaller pipes and would result in underground leaks which are unlikely to contribute to the offsite risk profile, and were hence not included in the PHA for the operating terminal.

- Scenario 1: Damage to adjacent plant or equipment due to uncontrolled and/or unplanned falling of structure, object or crane collapse.

- Scenario 2: Damage to live pipework during removal or inadvertent cutting into live pipe or pipeline.

- Scenario 3: Failure to isolate process equipment.

- Scenario 5: Introduction of ignition source in areas classified as a Hazardous Area.

Scenarios 1, 2 and 3 would potentially affect the likelihood of the initiating event, e.g. a LOC, while scenario 5 would affect the probability of ignition.

Each one of these potentially hazardous scenarios have a potential to affect the hazardous release scenarios identified in the PHA, and provides a potential incremental addition to the failure rate data used in the PHA.

The hazard identification (summarized in Section 4.1 of this Report) determined that the likelihood of tank damage in the tank farm areas may increase during demolition activities due to an uncontrolled and/or unplanned falling of structure/object. None of the other demolition related hazards were deemed to result in an increase in the likelihood of a trigger event.

The incremental increase was estimated to be about one order of magnitude, going from a *Rare* occurrence for an operating terminal to a *Remote* occurrence for the Site during the demolition works.

Interpreting *Rare* and *Remote* as 1 / 1,000,000 years (or 1 x 10^{-6} per year) and 1 / 100,000 years (or 1 x 10^{-5} per year) respectively, it is inferred that the likelihood of a damage of a tank (any tank) in the tank farm areas is increased by approximately 1 x 10^{-5} per year due to demolition works.

With an estimated 43 tanks in operation at the terminal, the additional trigger event frequency relating to demolition activities would be <10^{-6} or about 10^{-7} per tank.

The PHA (Ref 1) estimate that the LOC frequency per tank in the tank farm area (all trigger events) ranges from 10^{-3} to 10^{-5} per year, this incremental increase in LOC frequency is very low and would have very little impact on the overall risk of a flammable event from the Site.

The ignition probabilities assumed in the PHA are relevant for an operating facility where large maintenance crews, often from contracting companies, would periodically access the Site. These crews and their potential to initiate an ignition are not dissimilar to the demolition works crews. Provided the recommendations from this hazard and risk assessment are implemented it is considered that the probability of ignition would remain the same as that assumed in the PHA.

D. Risk Assessment

The small incremental risk of a flammable event in the tank farm has very little to no impact on the overall risk profile of the Site.

6 DISCUSSIONS AND CONCLUSION

6.1 DEMOLITION HAZARDS

The hazard and risk assessment determined that the main hazards associated with the demolition works relate to general health and safety type events, including the hazard associated with working from heights and that associated with subsidence and collapse during excavation.

Five hazards have potential to initiate a process safety incident which could lead to environmental pollution or safety concerns involving personnel from Caltex and/or the demolition contractors. These hazards relate to the potential to damage plant, equipment, pipes and tanks during demolition activities or the potential to introduce ignition sources into classified areas. These hazards will also be relevant for the operating terminal and have been adequately assessed in the PHA prepared for the EIS for the Project (Ref 1).

The hazards identified for the demolition works are all well-known and understood by Caltex staff. The safeguards associated with controlling the hazards have been largely established.

6.2 OVERARCHING CONTROL – UNDERLYING ASSUMPTIONS

Caltex have a commitment to Occupational Health and Safety (*OH&S*) and have numerous policies and procedures to achieve a safe workplace. Specific procedures have been and would continue to be developed to safely manage the future demolition works and protect the local environment. These procedures would build on Caltex's existing measures and would be incorporated into the safety management system.

The demolition activities would comply with current, relevant codes and statutory requirements with respect to work conditions and activities, in particular work would be undertaken by an unrestricted demolition licence holder and in general accordance with Demolition Code of Practice (2013, Ref 10) and relevant Australian Standards.

There would be no changes to existing precautions implemented at the Site (including the right-of-ways and the wharf). In particular, standards and requirements would be maintained for the terminal operation, for the loading and unloading of materials from/to ships and for the storage and transfer of liquids to/from tanks on-site by the operations and maintenance teams. All personnel required to work with these substances are trained in their safe use and handling, and are provided with all the relevant safety equipment.

Emergency procedures have been developed for the terminal operations. These would be aligned to the demolition works and would be reviewed as the demolition works progresses. Emergency procedures during the demolition works would

include responses to emergency evacuation, injury, major operating asset damage or failure, critical failures, spillages, major fire, and threats.

The Demolition Project Manager would have overall responsibility for safety during the demolition works. This individual would be supported by experienced personnel trained in the operation of the plant and associated facilities, including the wharf and berths, during the demolition works.

A PTW system, including Hot Work Permit, is in use at the Site, and the demolition contractor would be required to follow the requirements under these systems.

Injury and incident management is proceduralised and the workforce are trained in how to report incidents. An incident reporting and response mechanism is established and operates 24 hour a day. This system would remain in place during the demolition works.

As discussed above, the shut down, depressurisation, emptying, isolating and cleaning of the plant, equipment and tanks do not form part of the demolition works and is a process that occurs as part of the Turnaround and Inspection (T&I) program on a continuous rotating basis as part of the maintenance program for the Site. Methods used for purging of pipes, vessels and other plant items, including those containing heavier petroleum gas products, are extensively documented in procedures which are used routinely during T&I activities.

Process safety measures would continue to be incorporated into the operation of the Project, many of which would have bearing on risk management during demolition activities, including flammable vapour detectors within the bunds; triple infrared scanners on tank roofs; and CCTV in conjunction with infrared cameras as a confirmation for alarms.

In addition, in the unlikely event of a spill, the Site has significant contingency arrangements, including tertiary containment capacity available within the oily wastewater system, as well as sluice gates in the stormwater system which can be closed, ensuring that a spill is contained within the Site. In the unlikely event of a fire, the Site's firefighting system would continue to operate, complete with fire water ring main, hydrants and monitors, fire water tanks and pumps etc.

Protective systems associated with the operating plant would continue to be tested to ensure they are in a good working order and function reliably when required to do so. This would include scheduled testing of trips, alarms, detectors, relief devices and other protection systems.

Protective systems associated with machinery used during demolition works would also be tested, by the demolition contractors, including by using pre-start checklists for major machinery and vehicles.

All persons involved in the demolition works are provided with appropriate personal protective equipment suitable for use with the specific hazard.

At least one person is trained in first aid at the Site at any one time and a list of persons trained in, and designated as being responsible for the administering of, first aid will be shown on noticeboards across the Site.

6.3 OVERALL CONCLUSION

The activities associated with demolition will be subject to rigorous scrutiny by Caltex and by the demolition contractor, safeguarding delivery and operation of the Project in a manner that minimises the risk to workers, contractors and the community.

The potential for incidents is well understood and the management of demolition activities will minimise the probability of an incident happening and mitigating an incident if it did occur.

The hazard and risk assessment of demolition works has found that the levels of risks to the biophysical environment and to the safety of the public, staff and contractors are reduced to SFAIRP levels following the consideration of the established processes that Caltex have and the contractors would be required to have (including the recommendations in Section 6.4).

The present risk assessment has shown that the overall risk associated with the demolition works is low and does not introduce an excessive additional risk to the surrounding landuse as identified in the PHA for the Project (Ref 1).

6.4 ADDITIONAL RECOMMENDED ACTIONS AND NOTES OF CAUTION

Throughout the course of the analysis, risk reduction measures have been identified in the form of recommendations that would be incorporated into the demolition works plans. These recommendations are as follows:

1. Demolition activities to be coordinated with terminal activities. Where high risk demolition activities are to occur (e.g. where there is a risk of damage to terminal operations), an assessment needs to be completed in conjunction with terminal operations to formulate a hazard control plan specific to the high risk activity. This may include, but not be limited to: a) timing the activity such that alternative product transfer options are available from other tanks / lines; b) changing the work methodology to lower the risk of equipment damage; or c) developing a product supply contingency plan.

2. Demolition works plan to include framework for considering the demolition of individual tanks in shared tank farm areas (sequence activities for max space around in-service tanks).

3. Develop access control plan for the demolition area that reflects demolition operator having limited visibility when using heavy machinery / vehicles.

4. Determine requirements for evacuating buildings and blocking roadways during felling of tall structures.

5. Determine additional requirements for work on interconnecting pipework adjacent to live pipes (e.g. cold cutting and controlled removal; protective barriers).

6. Increase surveillance (use spotters) for work adjacent to (within 1 meters of) live pipes / pipelines.

7. Caltex to check contractor capability for independent verification carried out by contractor (refer Demolition Code of Practice).

8. Investigate additional precautions required for floating roof tanks where pontoons may entrap flammable material which may not be detected during normal gas testing.

9. Review and update Hazardous Area classification drawings for demolition works, particularly in areas where demolition activities are to take place in parallel with an operating terminal. Particular attention should be paid to the fact that demolition contractors may not be well versed with the requirements for control of ignition sources at the Site.

10. Where ever possible, construct ramps away from operational pipework.

11. Minimise the risk of subsidence of the substation and potentially of the nearby residential dwelling both of which are in very close proximity to the pipelines being removed within the right-of-way.

12. Implement Caltex inspection program to include truck loading activities (e.g. use Tipper Truck Loading / Unloading Safety Inspection Checklist FORM 4.00.03.027).

13. Determine the requirements for isolation and/or installation of protective barriers at the overhead power lines (in the rights-of-way), and notify the energy authorities prior to work being undertaken.

14. Determine chemical cleaning requirements to remove contamination prior to removal.

15. Determine waste disposal requirements for mercaptan building rubble.

16. High noise generating demolition works would be confined to less sensitive times of the day and not outside the hours of 7.00 am to 6.00 pm Monday to Saturday.

The HAZDEM workshop recommended that a noise assessment be undertaken in line with relevant NSW guidance to identify and mitigate potential noise impacts on the local community from the demolition works. This noise

assessment has been completed and is provided in Appendix E of the SEE for the demolition works.

7 REFERENCES

1 Dreher L, Proposed Kurnell Product Terminal Preliminary Hazard Analysis (SSD-5544), R4 Risk, 15 May 2013

2 State Environment Planning Policy No 33 – Hazardous and Offensive Development, published in Gazette No 36 of 13/03/1992, p. 1754

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4 Hazardous Industry Planning Advisory Papers Number 6 - Hazard Analysis, Department of Planning, January 2011

5 NSW Work Health and Safety Regulation 2011

6 *CHAIR Safety in Design Tool*, WorkCover New South Wales, 2001

7 ISO31000-2010, *Risk Management – Principles and guidelines*

8 AS/NZS 3931:1998, *Risk analysis of technological systems—Application guide*

9 Nilsson K, *HAZDEM Workshop Results*, Planager Pty Ltd, September 2014

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