Our Ref: 18AWE02.4:NvD/LH/MSR
DoP ref: SSD 9741
NSW RFS ref: D18/8341

16 October 2019

A W Edwards Pty Ltd
Level 1, 131 Sailors Bay Road
Northbridge NSW 2063

Attention: Mr D DiPaolo

Dear Dino

Re: Response to NSW RFS - Lane Cove Data Centre
1 Sirius Road, Lane Cove West

Travers bushfire & ecology (TBE) has been requested to provide a response to the NSW Rural Fire Service (RFS) request for additional information in relation to the proposed location of the generators and the associated diesel fuel tanks.

By way of background the fuel tanks were originally located at the basement ground level of the data centre. However following referral responses from Lane Cove Council a revised scheme was developed to ultimately reduce the extent of tree removal on site. This revised scheme resulted in a consolidation of the development footprint and an increase in building height from 4 storey to 5 storeys and use of the basement level of data centre use.

As a result the generators and diesel fuel tanks have been relocated to the three (3) platforms located between 2 - 6m from the eastern, northern and western building facades of the data centre.

The attached document prepared by Parratech depicts the proposed generator layout. The double walled tanks will be located on the lower level of a pair of generators and will hold 28,240L of fuel each. The tanks will be located on a reinforced concrete slab and designed for 48 hr operation of both generators enclosed in steel containers.

These diesel tanks are not a standard construction tank. They have been specifically engineered for this project to consider the additional thermal integrity required to mitigate any bush risk associated with the proximity of the bushland. The tanks will be constructed as follows;

- The diesel tank is a bunded double walled tank with the tank interstice being continually monitored and alarmed. The outer wall will be insulated with concrete to provide a barrier to the radiant heat and flame contact.
- There shall be over fill protection devices fitted to each tank to prevent any tank being filled above the safe fill level.
- Content level of each tank shall be monitored 24/7 by ultra-sonic level transmitters. These levels shall be continually monitored and alarmed by the building management system.

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ABN 85 624 419 870
PO Box 7138
Kariong NSW 2250

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Mt Penang Parklands
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- All connections to the tank shall be via the top of the tank – there shall be no connections that allow for gravity feed from the tank. Any supply from the tank to the Generator shall be from an electric driven pump only.

With this in mind *Travers bushfire & ecology* together with the expertise of *Parratech* have provided the following response to the NSW RFS requires for further information:

RFS Response (Item 1) – The proposed fuel storage tanks in their current locations are considered to have the potential to generate or accelerate bush fire risk to adjacent buildings on and off site and to emergency personnel when defending the property during bush fire events. Additional bush fire protection measures (either with PBP, Australian Standard 3959-2009 Construction of buildings in bushfire prone areas or Building Code of Australia), such as constructional standards and design provisions, to support the location and suitability of the proposed diesel fuel tanks need to be provided given these are possible ignition points and fuel sources.

Travers bushfire & ecology have undertaken a further detailed assessment of the bushfire risk posed to the diesel fuel storage tanks to ascertain the level of radiant heat impact and flame temperature exposure on the diesel fuel tanks.

This information has been calculated using either Method 2 (AS3959) or the short fire run methodology as detailed in Schedule 1 attached and Table 1 below. This information has been provided to Parratech to inform them on developing an engineered solution to address the bushfire risk in support the location of the fuel tanks.

Table 1 – Bushfire attack assessment

Aspect	Vegetation formation within 140m of development	Effective slope of land	Calculated flame length	Setback provided (metres)	Radiant heat results (kW/m2) (refer Attachment 2 for calculation sheets)
Generator Platform 1					
West	Sydney Coastal Dry Sclerophyll Forest (21.3/27.3 t/ha)	8^{0D}	32.12 flame length	36	23.72kW/m^2 (method 2 AS 3959)
North-west	Northern Hinterland Wet Sclerophyll Forest (20/33.10 t/ha)	9^{0D}	Flame height 20.586	32	9.09kW/m2 (Short fire run 1)
North-east			Flame height 20.586	**30**	13.94kW/m2 (Short fire run 2)
Generator Platform 2					
North-west	Northern Hinterland Wet Sclerophyll Forest (20/33.10 t/ha)	10^{0D}	**Flame height 21.639**	**13**	**49.44kW/m2 (Short fire run 3)**
North	Northern Hinterland Wet Sclerophyll Forest (20/33.10 t/ha)	4^{0D}	34.1m flame length	16.041	25.88 kW/m2 (Short fire run 4)
	Short heath	$0\text{-}5^{0D}$	9.07 flame length	16	18.08kW/m2 (method 2 AS 3959)

Aspect	Vegetation formation within 140m of development	Effective slope of land	Calculated flame length	Setback provided (metres)	Radiant heat results (kW/m2) (refer Attachment 2 for calculation sheets)
East	Remnant / exotic vegetation	4^{0D}	**11.86 flame length**	10	**39.53kW/m^2 (method 2 AS3959)**
Generator Platform 3					
North	Remnant / exotic vegetation (10/13.2 t/ha)	4.5^{0D}	**12.22 flame length**	**10**	**40.77kW/m^2 (method 2 AS3959)**
East	Sydney Coastal Dry Sclerophyll Forest (21.3/27.3 t/ha)	$0\text{-}5^{0D}$ Cross slope	**26.73m flame length**	**25**	**32.01kW/m^2 (method 2 AS3959)**

Based on the table above Generator Platform 3 will be exposed to the greatest radiant heat impact - 49.44kW/m^2. The resonance period of bushfire attack that Generator Platform 3 will be exposed to is based on 3:10 (min;sec) being the 'time duration' the tanks would be subject to the longest period of flame temperature affection being 1090 degrees Kelvin.

Parratech have prepared the attached 'Generator Insulated Base Fuel Tank Thermal Study' dated 14/10/19. Their design is based on the worst case scenario – 49.44kW/m^2 of radiant heat flux for a period of up to 3.10 minutes.

The *Parratech* report has concluded that the insulated diesel tanks sees little influence from the fire event that runs for a period of 3.10 minutes. The temperature of the diesel mass is nowhere near the auto-ignition temperature of 215 degrees Celsius or the flag point of 55-90 degrees Celsius for diesel.

The risk posed is further mitigated by the provision of multiple tanks with each tank having a smaller storage capability as opposed to one large tank with a significant fuel storage capability. These factors coupled with the construction materials of the data centre being BAL Flame zone on the exposed sides offers a total protection solution.

Item 2 – Additional information to address safe access to the proposed buildings, with regard to the location of part of the proposed vehicular access on the south western elevations of the Data Centres in the form of an elevated driveway, needs to be provided. This driveway is partially located above Generator Platform No. 1 (diesel fuel tanks located below) which in the course of a bush fire event might impact adversely on the safety of fire fighters either fighting the fire or accessing or egressing the site.

The overhead vehicle ramp is provided with a vertical separation of approximately 6m from the exhaust and over 10m from the diesel tanks (refer Figure 1).

The vehicle ramp will be a concrete road with concrete supporting footings and is therefore a stable engineered roadway suitable for purpose.

As outlined in response to Item 1 above Generator Platform 1 is exposed to a radiant heat flux of less than 23.72kW/m^2. This should be considered in light of the proposed engineered design of the fuel tanks with two (2) stainless steel outer skins (6mm) which will provide an

engineered solution to guard against bushfire impact in order that the tanks do not rupture in order to create a possible ignition point or provide an available fuel source.

As a result the diesel fuel tank design will not adversely impact on the safety of fire fighters accessing or egressing the site.

Firefighting access can also be gained onto the roof of the data centre and via the pedestrian access stairs on each façade of the building.

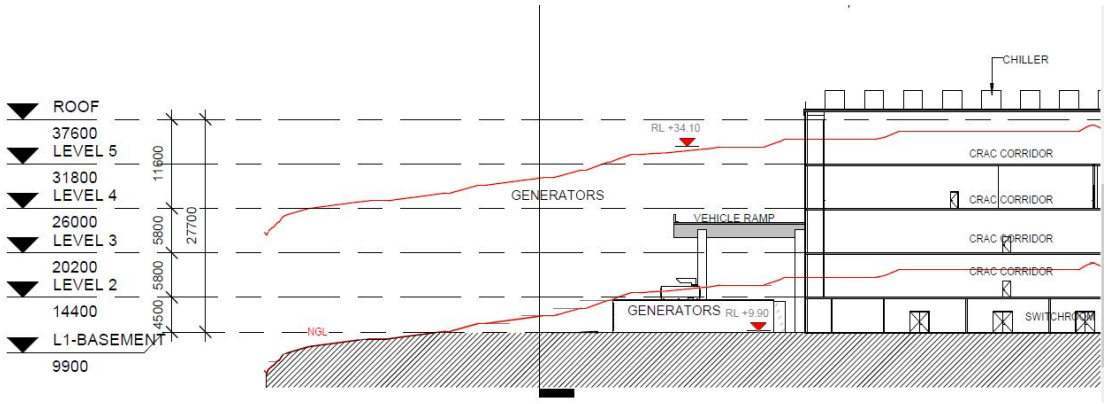

Figure 1 – Elevation plan / vehicle ramp

Should you require further assistance please contact the undersigned on 02 4340 5331 or at info@traversecology.com.au.

Yours faithfully

John Travers
BA Sc. / Ass Dip / Grad Dip / BPAD-Level 3-15195 (FPA)
Principle bushfire consultant – ***Travers bushfire & ecology***

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

Attachment 1 – Schedule 1 Bushfire Protection Measures
Attachment 2 – Calculation results
Attachment 3 – Generator Insulated Base Fuel Tank Thermal Study, prepared by Peretech

LANE COVE RIVER

SFR1 67m
SFR2 109m
SFR3 88m
SFR4 90m

32m
80m
13m
20m
16m
16m
18m
10m
25m
36m

Generator 1
Generator 2
Generator 3

PROPOSED DEVELOPMENT

APOLLO ROAD
ORION ROAD
SIRIUS ROAD

DISCLAIMER: ARC_0104-LEVEL 5 FLOOR PLAN_RL31.8_DWG_[8]-1.0.dwg is not georeferenced. It has been aligned to other, georeferencedCAD linework relating to this project. Verification by a registered surveyor is required prior to finalisation.

Legend

- Subject site (source: CAD)
- Contour (1m) (source: LiDAR)
- Unformed road/ access to easement

Proposed Infrastructure

- Data hall
- Generator platform
- Substation
- GIS
- Oil spill tank
- Firetrail
- Access driveway

- Asset Protection Zone (APZ)

Bushfire Construction Standards AS3959 (2009)*

- Flame zone (FZ)
- BAL 40
- BAL 29

Sydney MetroArea (2013) VISID 3817 StateClass/PCT

- Coastal Floodplain Wetlands (PCT 1234)
- Coastal Swamp Forests (PCT 923)
- Mangrove Swamps (PCT 920)
- Northern Hinterland Wet Sclerophyll Forests (PCT 1845)
- Saltmarshes (PCT 1126)
- Sydney Coastal Dry Sclerophyll Forests (PCT 1250, 1776, 1778)

Aerial source: Nearmap

0 20 40 m

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

PROJECT & MXD REFERENCE
1 Sirius Road, Lane Cove West
18AWE02_BF002

DATE & ISSUE NUMBER
14/10/2019
Issue 1
AH

SCALE & COORDINATE SYSTEM
1:1,500 @A3
GDA 1994 MGA Zone 56

TITLE

Schedule 1 - Bushfire Protection Measures (Generator/diesel tanks)

Document Path: N:\GIS STORAGE\N Drive\18AWE02_SiriusRd_LaneCoveWest\MXDs\18AWE02_BF002.mxd

Travers bushfire & ecology
www.traversecology.com.au

GENERATOR PLATFORM 1

Calculated October 14, 2019, 11:39 am (BALc v.4.8)

Generator 1 (WEST)

Bushfire Attack Level calculator - AS3959-2009 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	4.43 km/h
Vegetation classification	Forest	Flame length	32.12 m
Surface fuel load	21.3 t/ha	Flame angle	70 °
Overall fuel load	27.3 t/ha	Panel height	30.19 m
Vegetation height	n/a	Elevation of receiver	8.09 m
Effective slope	8 °	Fire intensity	62,612 kW/m
Site slope	11 °	Transmissivity	0.803
Distance to vegetation	36 m	Viewfactor	0.3882
Flame width	100 m	Radiant heat flux	23.72 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-29
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics	Generator 1 (north-west)

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Northern Hinterland Wet Sclerophyll Forests - 20 & 33.10 - Low - 0m - < 0.9m				
Surface & Elevated Fuel Load	20	tph	Overall fuel load	33.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	1.4	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	32	Metres	Target elevation of receiver	2	Metres
ffective slope	9	Degrees	Ambient temperature	308	Kelvin
Site slope	5	Degrees	SFR fire run length	67	Metres
FDF nominal head width	100	Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	16.500	Metres	Default elevation of receiver	10.293	Metres
FDF Flame Angle	56	Degrees	SFR Flame Angle	60	Degrees
FDF Flame Length	33.00	Metres	SFR Flame Height	20.586	Metres
FDF Intensity	76374	kW/m	SFR Intensity	461.48	kW/m
FDF FROS	4.4659	kph	SFR FROS	4.4659	kph
FDF Flame transmissivity	0.8232	kW/m	SFR Flame transmissivity	0.8124	kW/m
FDF View Factor	0.4145		SFR View Factor	0.1471	
			Calculated SFR Head Width	24.524	Metres
			SFR fire run length	67	Metres
			Approx. SFR travel time	15:00	min/sec
FDF Radiant Heat	25.94	kW/m^2	**SFR Radiant Heat**	9.09	kW/m^2

Input cells

Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare
kW/m = Kilowatts per metre
kW/m2 = Kilowatts per metre squared
HFD = Horizontal Flame Depth
LRV - Low Risk Vegetation

m/h = metres per hour
FROS = Forward rate of Spread
kph = kilometres an hour
FF = Flank Fire
SFR = Short Fire Run

K = Kelvin
min = minutes
sec = seconds
min/sec = minutes and seconds

Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics	Generator 1 (north-east) - SFR 2

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Northern Hinterland Wet Sclerophyll Forests - 20 & 33.10 - Low - 0m - < 0.9m				
Surface & Elevated Fuel Load	20	tph	Overall fuel load	33.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	1.4	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	30	Metres	Target elevation of receiver	2	Metres
ffective slope	9	Degrees	Ambient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length	109	Metres
FDF nominal head width	100	Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	16.500	Metres	Default elevation of receiver	10.293	Metres
FDF Flame Angle	48	Degrees	SFR Flame Angle	56	Degrees
FDF Flame Length	33.00	Metres	SFR Flame Height	20.586	Metres
FDF Intensity	76374	kW/m	SFR Intensity	461.48	kW/m
FDF FROS	4.4659	kph	SFR FROS	4.4659	kph
FDF Flame transmissivity	0.8341	kW/m	SFR Flame transmissivity	0.8192	kW/m
FDF View Factor	0.4230		SFR View Factor	0.2238	
			Calculated SFR Head Width	39.898	Metres
			SFR fire run length	109	Metres
			Approx. SFR travel time	0:24	min/sec
FDF Radiant Heat	26.83	kW/m^2	**SFR Radiant Heat**	13.94	kW/m^2

Input cells

Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare
kW/m = Kilowatts per metre
kW/m2 = Kilowatts per metre squared
HFD = Horizontal Flame Depth
LRV - Low Risk Vegetation

m/h = metres per hour
FROS = Forward rate of Spread
kph = kilometres an hour
FF = Flank Fire
SFR = Short Fire Run

K = Kelvin
min = minutes
sec = seconds
min/sec = minutes and seconds

GENERATOR PLATFORM 2

Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics	Generator 2 (north-west) - SFR 3

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Northern Hinterland Wet Sclerophyll Forests - 20 & 33.10 - Low - 0m - < 0.9m				
Surface & Elevated Fuel Load	20	tph	Overall fuel load	33.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	1.4	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	13	Metres	Target elevation of receiver	2	Metres
ffective slope	10	Degrees	Ambient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length	88	Metres
FDF nominal head width	100	Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	17.537	Metres	Default elevation of receiver	10.819	Metres
FDF Flame Angle	42	Degrees	SFR Flame Angle	19	Degrees
FDF Flame Length	35.07	Metres	SFR Flame Height	21.639	Metres
FDF Intensity	81830	kW/m	SFR Intensity	49444	kW/m
FDF FROS	4.7849	kph	SFR FROS	4.7849	kph
FDF Flame transmissivity	0.9051	kW/m	SFR Flame transmissivity	0.8927	kW/m
FDF View Factor	0.9999		SFR View Factor	0.7284	
			Calculated SFR Head Width	32.211	Metres
			SFR fire run length	88	Metres
			Approx. SFR travel time	18:23	min/sec
FDF Radiant Heat	68.82	kW/m^2	**SFR Radiant Heat**	49.44	kW/m^2

Input cells

Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare
kW/m = Kilowatts per metre
kW/m2 = Kilowatts per metre squared
HFD = Horizontal Flame Depth
LRV - Low Risk Vegetation

m/h = metres per hour
FROS = Forward rate of Spread
kph = kilometres an hour
FF = Flank Fire
SFR = Short Fire Run

K = Kelvin
min = minutes
sec = seconds
min/sec = minutes and seconds

Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics	Generator 2 (north) - SFR 4

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Northern Hinterland Wet Sclerophyll Forests - 20 & 33.10 - Low - 0m - < 0.9m				
Surface & Elevated Fuel Load	20	tph	Overall fuel load	33.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
Average elevated fuel height	1.4	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	16	Metres	Target elevation of receiver	2	Metres
ffective slope	4	Degrees	Ambient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length	90	Metres
FDF nominal head width	100	Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	12.265	Metres	Default elevation of receiver	8.021	Metres
FDF Flame Angle	25	Degrees	SFR Flame Angle	47	Degrees
FDF Flame Length	24.53	Metres	SFR Flame Height	16.041	Metres
FDF Intensity	54090	kW/m	SFR Intensity	32683	kW/m
FDF FROS	3.1628	kph	SFR FROS	3.1628	kph
FDF Flame transmissivity	0.8838	kW/m	SFR Flame transmissivity	0.8620	kW/m
FDF View Factor	0.6209		SFR View Factor	0.3949	
			Calculated SFR Head Width	32.943	Metres
			SFR fire run length	90	Metres
			Approx. SFR travel time	4:27	min/sec
FDF Radiant Heat	41.72	kW/m^2	**SFR Radiant Heat**	25.88	kW/m^2

Input cells

Locked output cells

Glossary of abreviations/terms:

tph = tonnes per hectare
kW/m = Kilowatts per metre
kW/m2 = Kilowatts per metre squared
HFD = Horizontal Flame Depth
LRV - Low Risk Vegetation

m/h = metres per hour
FROS = Forward rate of Spread
kph = kilometres an hour
FF = Flank Fire
SFR = Short Fire Run

K = Kelvin
min = minutes
sec = seconds
min/sec = minutes and seconds

Calculated October 14, 2019, 12:08 pm (BALc v.4.8)

Generator 2 (north)

Bushfire Attack Level calculator - AS3959-2009 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	4.04 km/h
Vegetation classification	Shrubland	Flame length	9.07 m
Surface fuel load	15 t/ha	Flame angle	73 °
Overall fuel load	15 t/ha	Panel height	8.67 m
Vegetation height	1.5 m	Elevation of receiver	4.33 m
Effective slope	5 °	Fire intensity	31,357 kW/m
Site slope	0 °	Transmissivity	0.847
Distance to vegetation	16 m	Viewfactor	0.2805
Flame width	100 m	Radiant heat flux	18.08 kW/m²
Windspeed	45 km/h	Bushfire Attack Level	BAL-19
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Catchpole et al. 1998

Flame length - Byram, 1959

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

GENERATOR PLATFORM 3

Calculated October 14, 2019, 9:29 am (BALc v.4.8)

Generator 3 (North)

Bushfire Attack Level calculator - AS3959-2009 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	1.63 km/h
Vegetation classification	Rainforest	Flame length	12.22 m
Surface fuel load	10 t/ha	Flame angle	52 °
Overall fuel load	13.2 t/ha	Panel height	9.630000000000001 m
Vegetation height	n/a	Elevation of receiver	4.81 m
Effective slope	4.5 °	Fire intensity	11,163 kW/m
Site slope	0 °	Transmissivity	0.878
Distance to vegetation	10 m	Viewfactor	0.6105
Flame width	100 m	Radiant heat flux	40.77 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-FZ
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Calculated October 14, 2019, 9:26 am (BALc v.4.8)

Generator Platform 3

Bushfire Attack Level calculator - AS3959-2009 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	3.6 km/h
Vegetation classification	Forest	Flame length	26.73 m
Surface fuel load	21.3 t/ha	Flame angle	61 °
Overall fuel load	27.3 t/ha	Panel height	23.38 m
Vegetation height	n/a	Elevation of receiver	9.5 m
Effective slope	5 °	Fire intensity	50,905 kW/m
Site slope	5 °	Transmissivity	0.835
Distance to vegetation	25 m	Viewfactor	0.504
Flame width	100 m	Radiant heat flux	32.01 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-40
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

PARRATECH

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for Mission Critical Facilities

www.parratech.com.au

GENERATOR INSULATED BASE FUEL TANK THERMAL STUDY

ATSYD2

Doc No: P9223-P-381.01
Revision: C

Document prepared by:

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DOCUMENT CONTROL

Report Title		Generator Insulated Base Fuel Tank Thermal Study			
Document ID		P9223-P-381.01	**Project Number**	P9223	
File Path					
Client		AW Edwards			
Client Contact		Timothy Dekruif	**Client Reference**	-	
Rev	**Date**	**Revision details/status**		**Author**	**Approver**
A	14/10/2019	Initial Issue		JB	JF
B	16/10/2019	Updated Following Review		JB	JF
C	25/10/2019	Updated Following Review		JB	JF

APPROVAL

Author Signature		**Approver Signature**	
Name	John Banks	**Name**	Jason Fooks
Title	Design Engineer	**Title**	Project Director

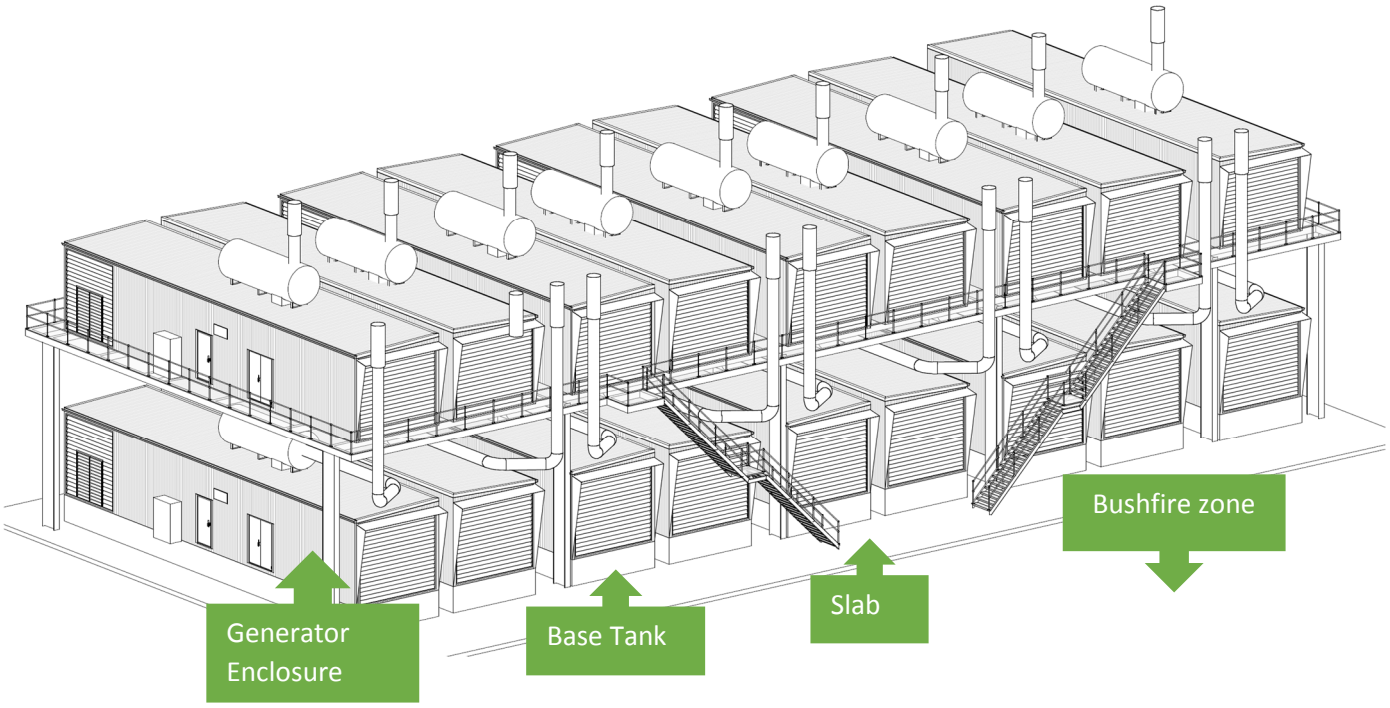
1 Description

The ATSYD2 current design has generator enclosures with diesel fuel base tanks located underneath the enclosure. These base tanks will be positioned on a slab externally to the main building. The location of the enclosures and tanks has a bushfire area close by, for this reason Parratech is proposing an insulated tank design.
The purpose of this report is to review the tank design and the thermal figures provided by the bushfire report to check the feasibility of the proposal.

2 Project Details

2.1 Site Details

The image below provides the typical detail of the enclosure and tank installation on site with an indication of the bush fire area.



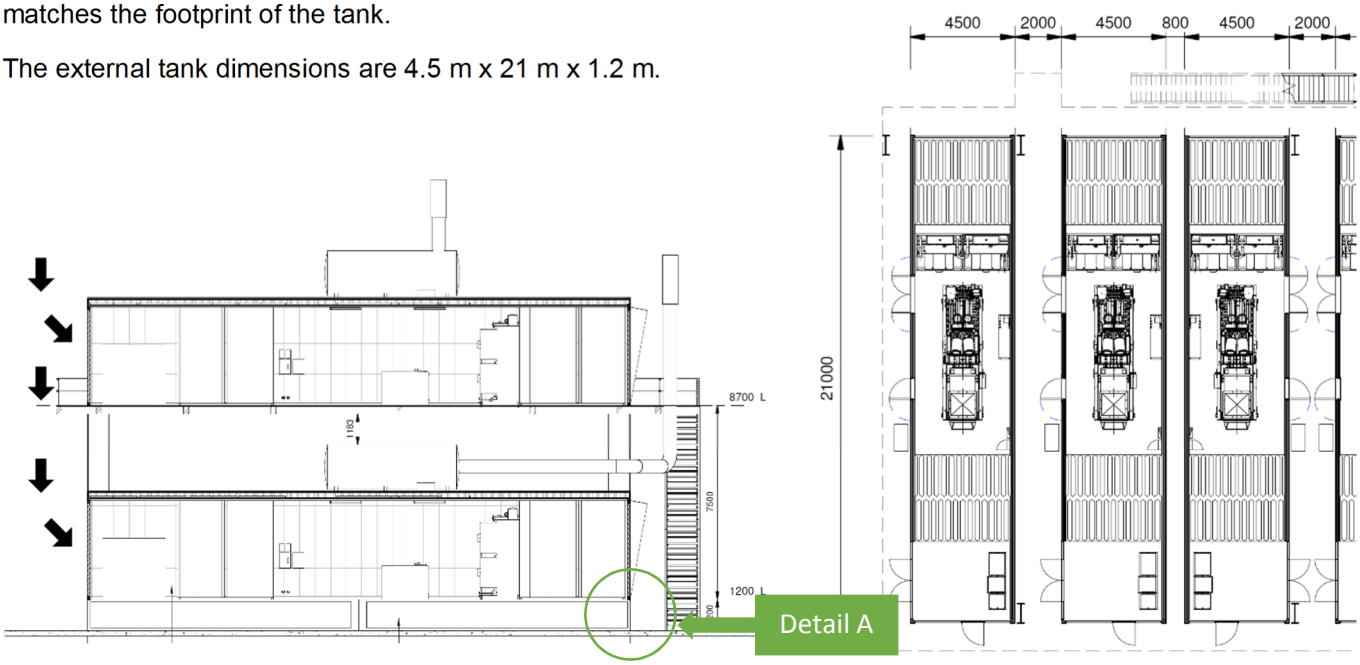
2.2 Enclosure and Tank Details

The image below left shows a cross section of the enclosure and base tank. The tank is installed at ground level (in accordance with AS 1940) the tank supplies fuel to the top and bottom enclosure.

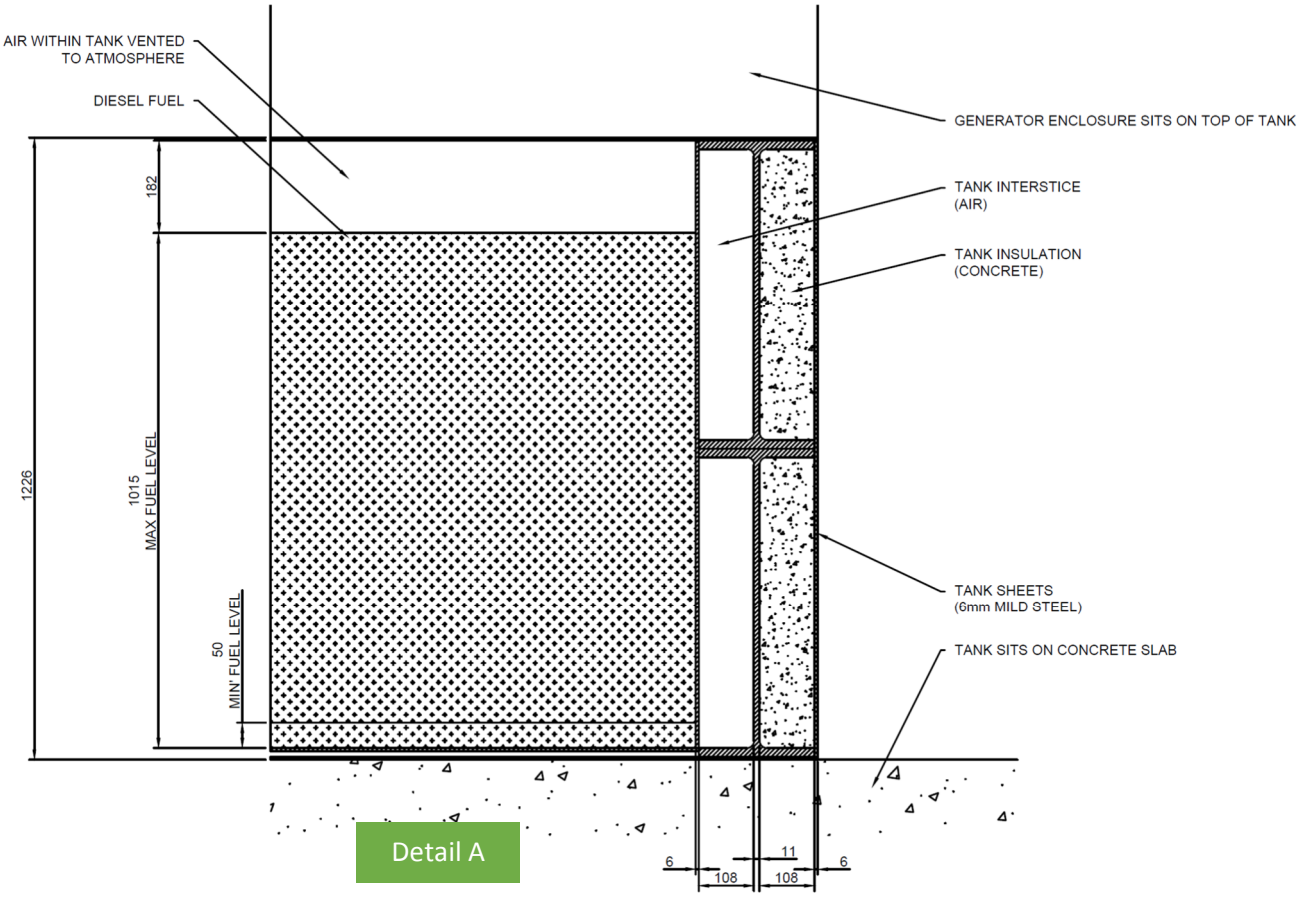
Each tank consists of two compartments each holding 28,240 L of fuel.

The image to the right shows the enclosure footprint which matches the footprint of the tank.

The external tank dimensions are 4.5 m x 21 m x 1.2 m.



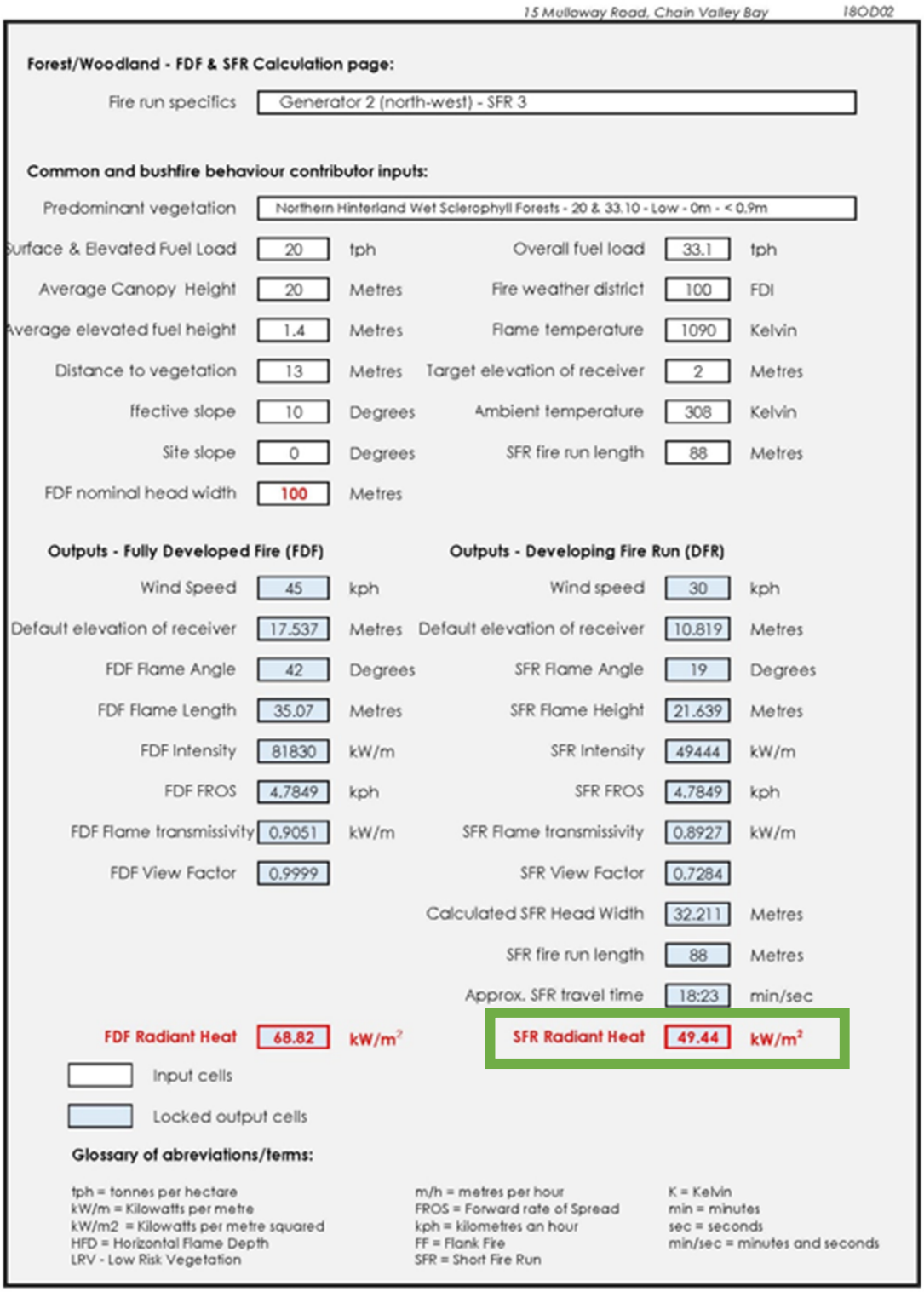
The view below shows a typical cross section through the base tank providing details of materials and thickness's. This detail represents the detail for the complete perimeter of the tank.



2.3 Bushfire Report Details

The image below provides the details of the bushfire thermal energy that the tank may be subjected to in the event of a bushfire. The intensity of the heat exerted onto the tank from the bush fire varies in different locations aroud the facility, for the purposes of this report only the highest temperature will be reviewed.

The radiant heat flux value of **49.44 kW/m^2** highlighted is to be used to review the thermal performace of the tank. This heat intensity may last for **up to 3.1 minutes**. The heat flux provided will be applied directly to the tank and the enclosure.



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Forest/Woodland - FDF & SFR Calculation page:

Fire run specifics	Generator 2 (north-west) - SFR 3

Common and bushfire behaviour contributor inputs:

Predominant vegetation	Northern Hinterland Wet Sclerophyll Forests - 20 & 33.10 - Low - 0m - < 0.9m				
urface & Elevated Fuel Load	20	tph	Overall fuel load	33.1	tph
Average Canopy Height	20	Metres	Fire weather district	100	FDI
verage elevated fuel height	1.4	Metres	Flame temperature	1090	Kelvin
Distance to vegetation	13	Metres	Target elevation of receiver	2	Metres
ffective slope	10	Degrees	Ambient temperature	308	Kelvin
Site slope	0	Degrees	SFR fire run length	88	Metres
FDF nominal head width	100	Metres			

Outputs - Fully Developed Fire (FDF)			Outputs - Developing Fire Run (DFR)		
Wind Speed	45	kph	Wind speed	30	kph
Default elevation of receiver	17.537	Metres	Default elevation of receiver	10.819	Metres
FDF Flame Angle	42	Degrees	SFR Flame Angle	19	Degrees
FDF Flame Length	35.07	Metres	SFR Flame Height	21.639	Metres
FDF Intensity	81830	kW/m	SFR Intensity	49444	kW/m
FDF FROS	4.7849	kph	SFR FROS	4.7849	kph
FDF Flame transmissivity	0.9051	kW/m	SFR Flame transmissivity	0.8927	kW/m
FDF View Factor	0.9999		SFR View Factor	0.7284	
			Calculated SFR Head Width	32.211	Metres
			SFR fire run length	88	Metres
			Approx. SFR travel time	18:23	min/sec
FDF Radiant Heat	68.82	kW/m^2	SFR Radiant Heat	49.44	kW/m^2

Input cells

Locked output cells

Glossary of abreviations/terms:

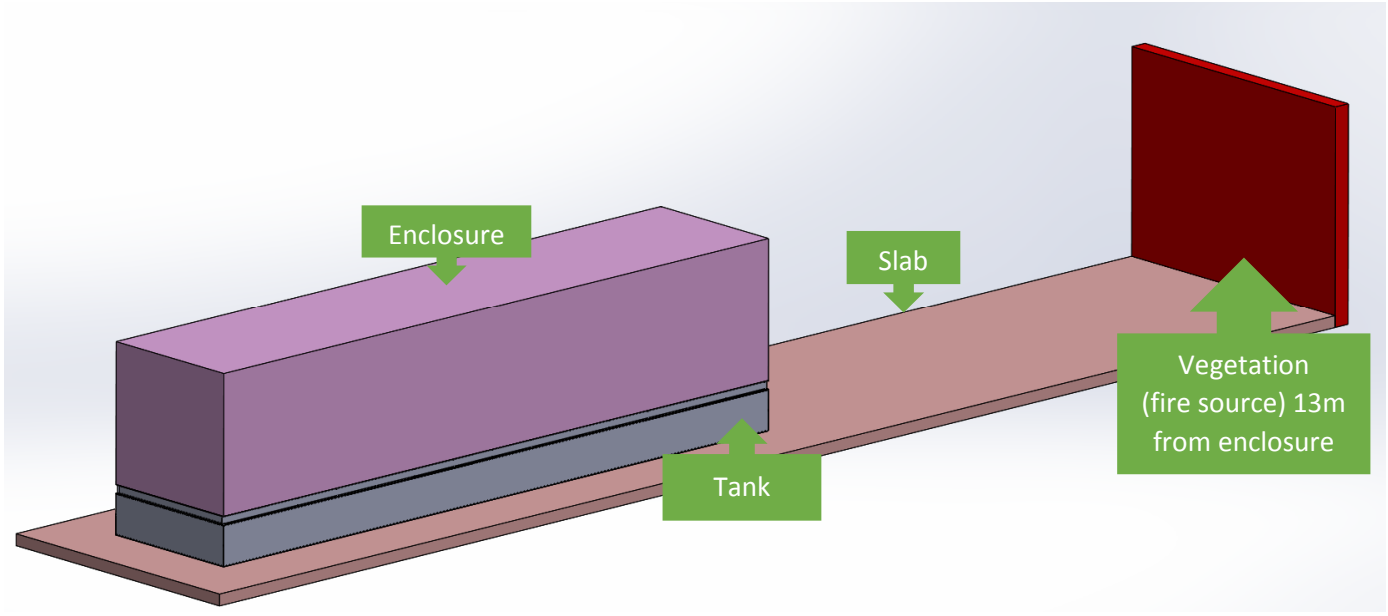
tph = tonnes per hectare
kW/m = Kilowatts per metre
kW/m2 = Kilowatts per metre squared
HFD = Horizontal Flame Depth
LRV - Low Risk Vegetation

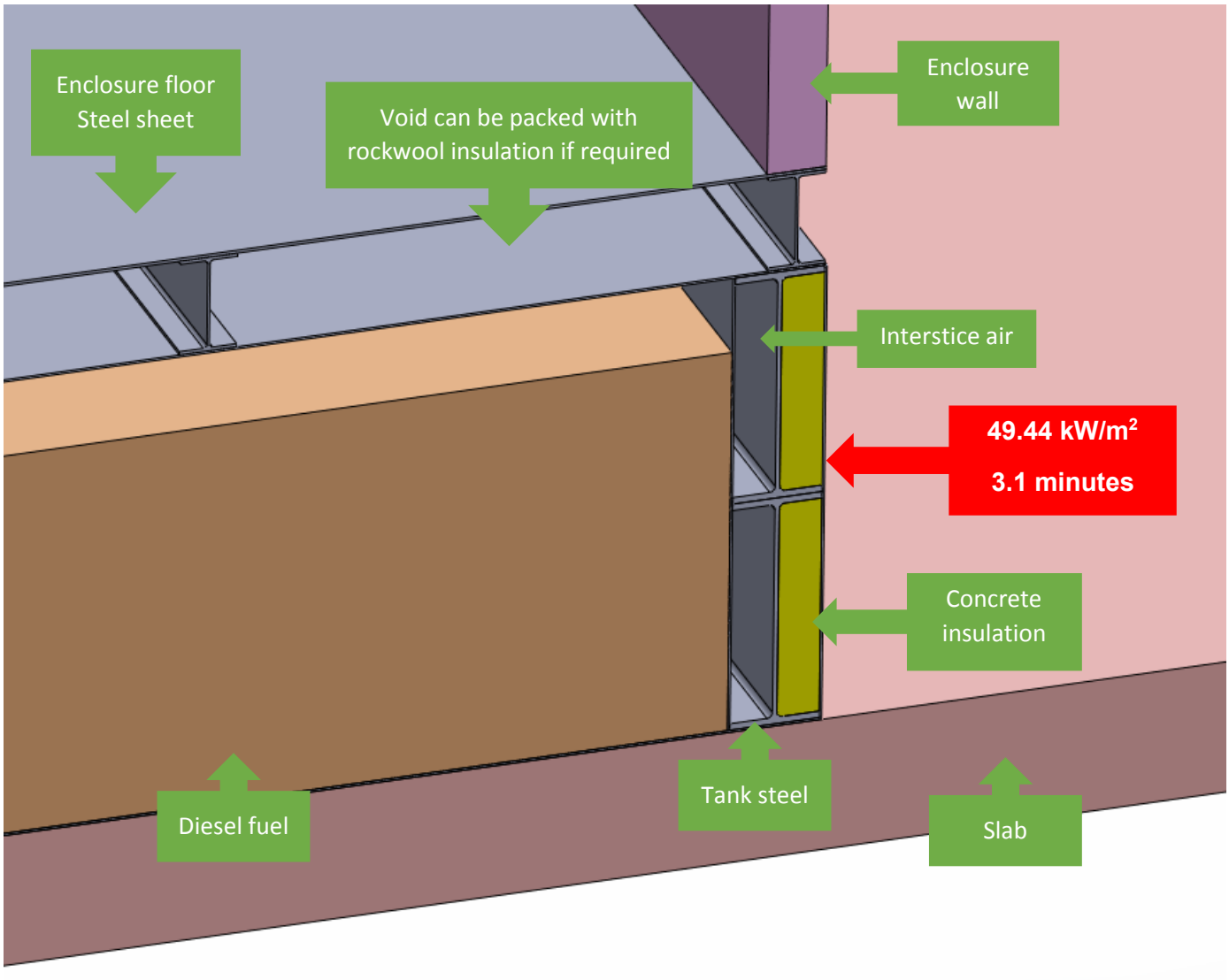
m/h = metres per hour
FROS = Forward rate of Spread
kph = kilometres an hour
FF = Flank Fire
SFR = Short Fire Run

K = Kelvin
min = minutes
sec = seconds
min/sec = minutes and seconds

3 Thermal Study

3.1 Model Details





3.2 Simulation Details and Results

An FEA study was carried out to simulate the heat transfer through the tank to determine the temperature rise on the inside face of the tank which would be in contact with the fuel.

An ambient temperature of 40 degC has been used for the initial conditions inside the tank.

The following images illustrates the model details and the results of the FEA study.

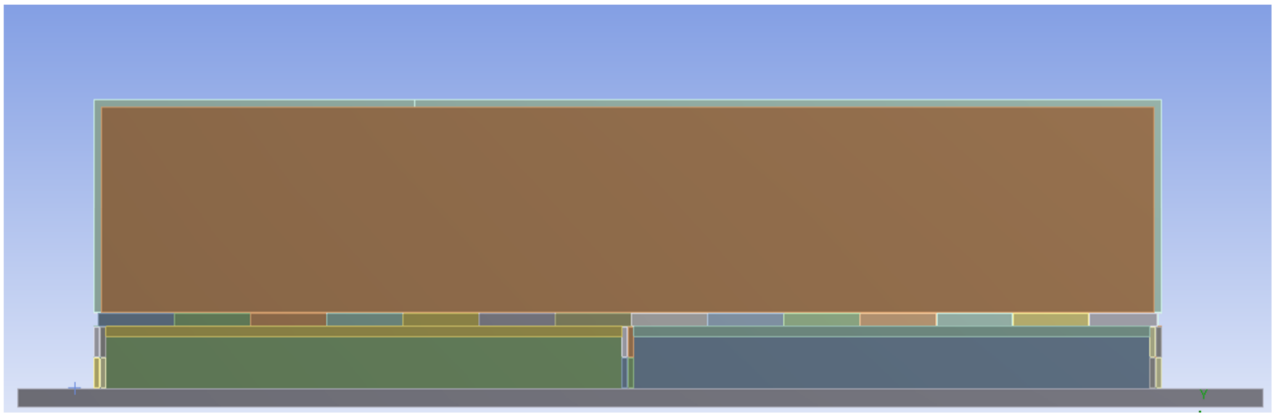


Figure 3.2.1 – Model details

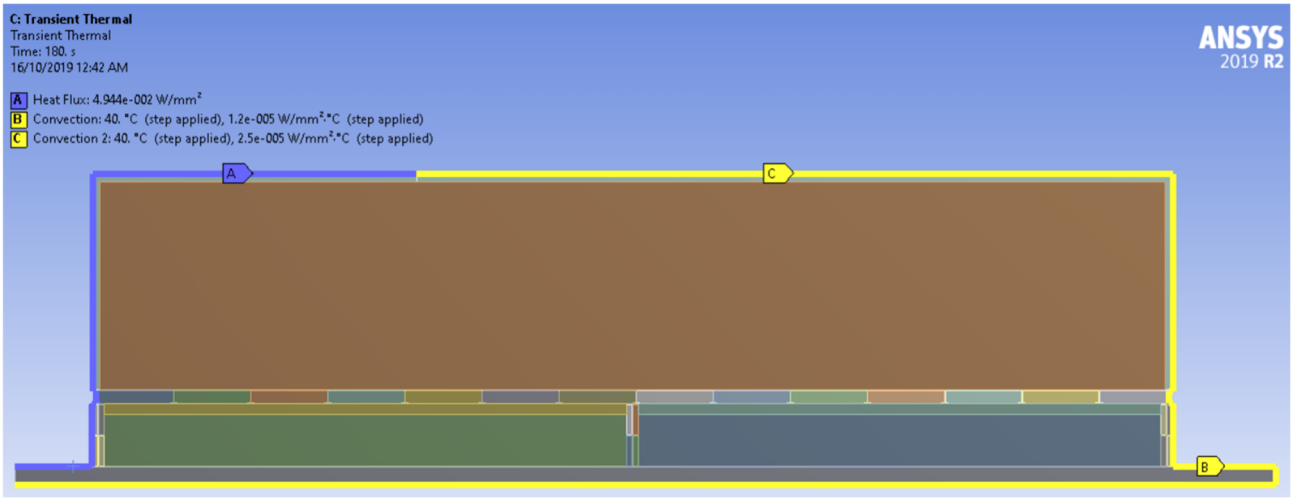


Figure 3.2.2 – Mesh and load details

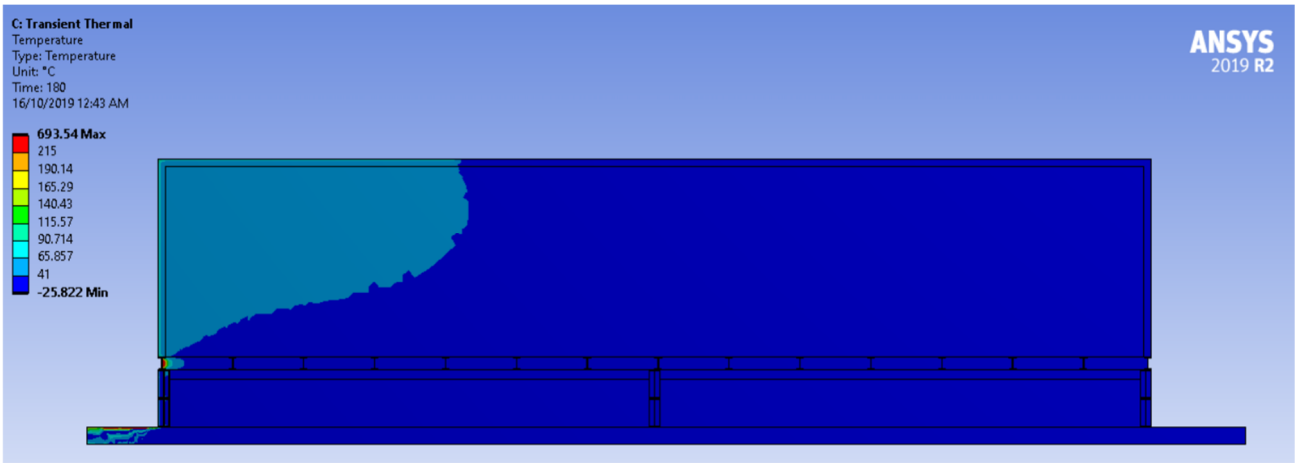


Figure 3.2.3 – Temperature results at 3.1 minutes

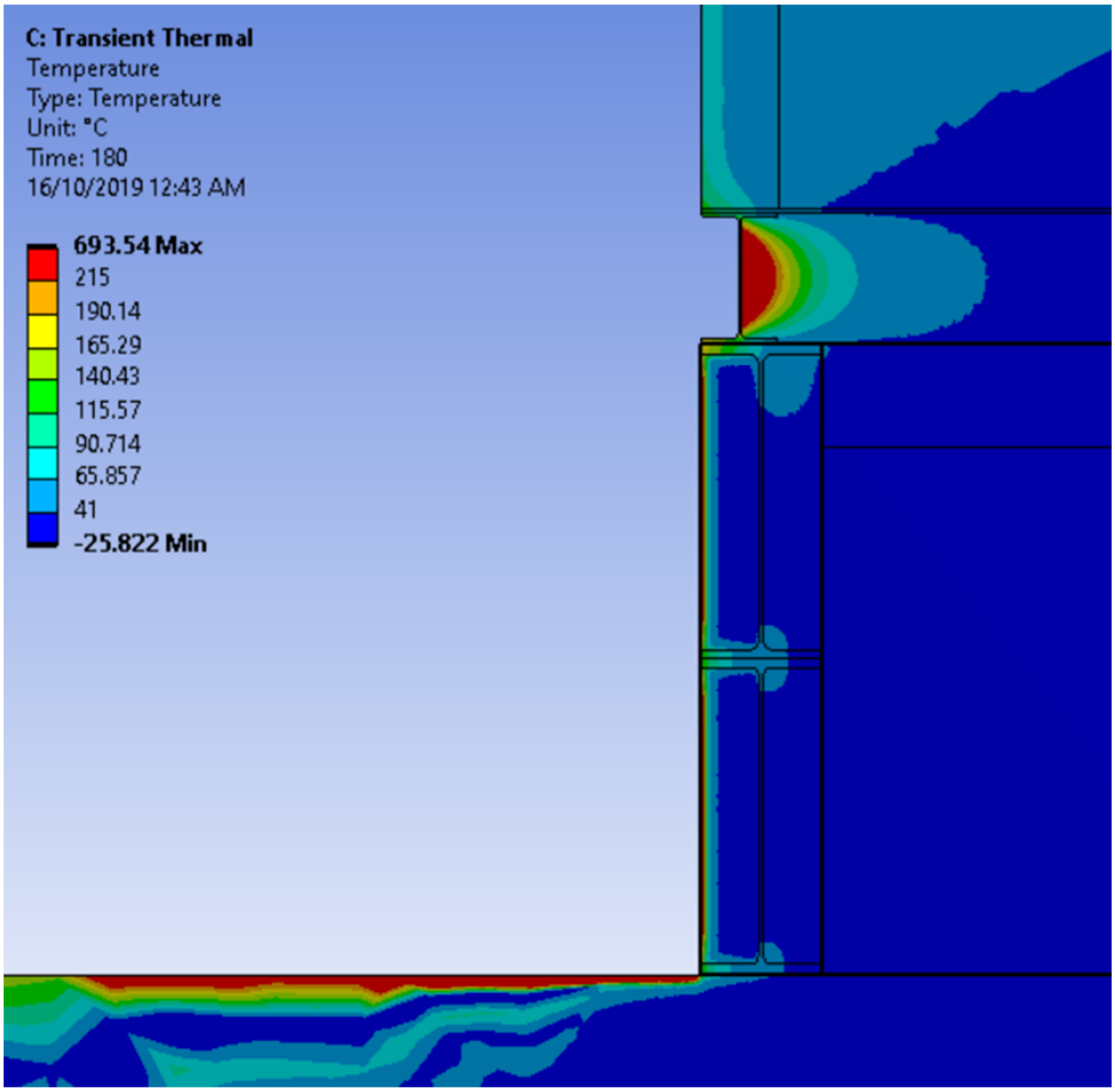


Figure 3.2.3 – Temperature results at 3.1 minutes enlarged detail

4 Conclusion

Based on the review it would appear that the temperatures inside the insulated diesel tank sees little influence from the fire event that runs for a period of 3.1 mins (dark blue on output image represents no change in temperature at the end of the time period). Temperature for the diesel mass are nowhere near the auto-ignition temperature of 215degC or the flash point of 55-90degC for diesel.

The study shows that the tank design is suitable.