Response to various bushfire issues raised by RFS Narrabri Gas Project

Santos Limited

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Template 2.8.1

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1. Background

Bushfire risk assessment has been documented comprehensively as part of the Narrabri Gas Project (NGP) EIS submitted in 2017. Additional bushfire information was provided in the Response to Submissions in 2018 and within the Supplementary Response to Submissions in 2019. Following an email from the RFS, a meeting between DPIE, RFS and Santos representatives was held on 30 July 2019.

The previous documentation forms a critical part of the bushfire risk assessment and the rationale for risk reduction measures. It is essential that this previous information is considered as part of response to the recent specific RFS questions.

The Pilliga bushfire risk (e.g. remoteness, bushfire proneness and fire history) has been assessed in detail and responded to in the development design. The proposal does not exacerbate bushfire proneness of the landscape (see analysis of flare risks) and the likelihood of fire from increased human activity has been assessed within the EIS as remote and is mitigated by the improved fire detection and improved response potential associated with the development.

Further the bushfire ignition risk from all phases of operation are classified as remote within the EIS and the overall bushfire risk has been assessed as MEDIUM.

The risk to firefighters/emergency responders has been evaluated and can be well managed through the multi-agency Bush Fire Management Plan.

2. Low bushfire risk facilities and infrastructure

As described by Santos at the 30 July 2019 meeting, not all NGP facilities and infrastructure are at risk from bushfire. The following low risk elements of the NGP were part of previous assessments but because their negligible/low risk of impact from bushfire the overall facilities are excluded from this response to the latest matters raised by the RFS. Also listed below are the facilities that comply with Planning for Bushfire Protection 2006 and not requiring additional bushfire protection measures.

2.1 Facilities with a low to negligible bushfire risk

Leewood (major facility) infrastructure:

- central water management facility including ponds and water treatment infrastructure;
- optional power generation for the project;
- a safety flare; and
- gas treatment and compression.

Located on farm land to the north of the forest the Leewood property has been cleared historically for cropping and improved pastures. As a major facility the key infrastructure will be behind fenced areas, on hard stand or on concrete. The grassy vegetation on the property is currently, and will continue to be, managed.

Bibblewindi (major facility):

- In field compression
- Safety flare
- Communications tower
- Water tanks
- Staff amenities

Located in the state forest, the size of the existing Bibblewindi site will be expanded to accommodate the proposed new infrastructure. Similar to Leewood these facilities will be behind fences, located on hard stand or concrete, and be appropriately offset from the forest. If required at this cleared site, and to be determined in final design, the wiring and sensitive components of the communications tower will be protected by shielding.

Bibblewindi to Leewood infrastructure corridor

All power lines, water and gas pipelines and communications lines in this corridor are buried and therefore not exposed to damage by bushfire.

Low bushfire risk gas field infrastructure:

- Buried water and gas pipelines
- Access tracks
    - Non combustible
- Fences
    - Low value or non-combustible
- High point vents and low point drains
    - Non-combustible structures or structures requiring no bushfire protection

2.2 Facilities compliant with PBP

Westport workers accommodation

Will be designed and operated in accordance with Special Fire Protection Performance (SFPP) under Planning for Bushfire Protection 2006. It includes an on-site refuge in the event that the workers are unable to evacuate early.

3. Response to RFS issues dated 23.5.18

3.1 APZ and exclusion of flame contact for surface infrastructure

As outlined in **Section 2.1** not all surface infrastructure is located where it is vulnerable to bushfire attack (e.g. Leewood water storage/treatment located on farm) or requires protection from bushfire attack (e.g. roads, low point drains). Extensive APZ equivalent areas either exist or are not required for these facilities.

Of the remaining surface infrastructure (primarily the well heads) the highest predicted Radiant Heat Flux (RHF) and Flame Length was determined using the highest locality-wide inputs for effective slope, predominant vegetation, Generalised Extreme $Value_{50}$ for weather and then assessing this against the smallest permissible APZ for the infrastructure (see **Figure 1**).

This process results in the worst-case bushfire risk and analysis of this (see **Table 1**) and it shows well head infrastructure (apart from roads and fences) are located where the RHF is below 14kW/m^2 and there is no Flame Contact from unmanaged vegetation.

The other surface infrastructure potentially within the flame zone are largely non-combustible (steel, masonry, etc), or easily replaced or pose no risk to life or operations. For infrastructure (outside the well heads) with a higher value and located in the flame zone, strategic shielding will be provided e.g. for electrical cabling and aerials on communication towers (see **Section 3.5**).

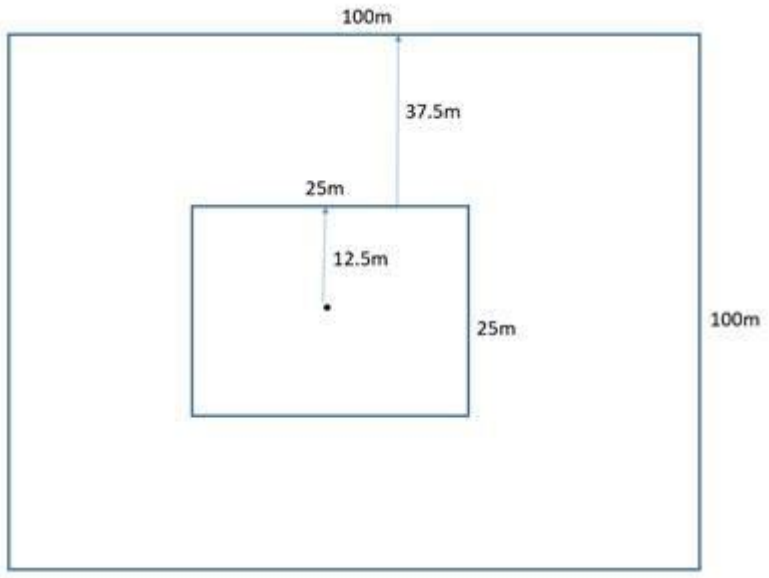

Figure 1: Diagrammatic view of the dimensions of the well pads

It is also noteworthy that the gas at a well head and in the gas gathering network is at a low operating pressure. In the event of a major bush fire threatening project infrastructure the wells would be 'shut in', that is, the valve on the discharge of the well head would close and the well would be isolated from downstream well head equipment.

The infrastructure downstream of the well head, including the gas gathering lines and vents or drains, would be depressurised to the gas compression units or flare system and, as such, the operating pressure in the gas gathering network would rapidly approach atmospheric pressure.

Wells can be 'shut in' remotely using the telemetry control system, however they would also have automated shutdown systems in the event of non-routine operating conditions. All vessels and pipework are protected by pressure safety valves (PSVs) and the pressure increase as a result of radiant heat exposure is considered in selection of the appropriate PSV capacity.

Table 1: Worst-case risk analysis for potential bushfire attack on well head infrastructure

Site	Effective slope	Predominant vegetation and Fuel loads	FFDI (Moree)	Minimum separation from unmanaged vegetation	RHF	Flame Length
Well-head infrastructure	3 degrees downslope	Pilliga Outwash DSF (7 t/ha & 11.05 t/ha)	120	38.5 m	6.53	9.38
	As above	NW Slopes DSF (14 t/ha & 24.7 t/ha)	As above	As above	13.49	19.08
Comment	Project area is predominantly flat. Wells are not permitted adjacent to watercourses where slopes may be greater than 3 degrees.	These are the two major vegetation classes on site. Best available fuel load data has been used for each. i.e. RFS published "Comprehensive vegetation fuel loads V. 8"	Douglas G., PHD Thesis 2017 identified maximum FFDI as 125 and GEV_{50} as 102. Use of FFDI 120 is very conservative	Well-head infrastructure is at least 1 m inside a fenced area, and the fence is located a minimum of 37.5 m from unmanaged vegetation (**Figure 1** illustrates a typical 100 m by 100 m well pad)	NBC Bushfire Attack Assessor V3 used in accord with Method 2 of AS3959 2009 Amt. #1, 2, 3. Flame temperature of 1090K used. Appendix 1 provides the BFAA reports.	As for RHF

Telecommunication towers have protection redundancy measures, as do the proposed wells e.g. shut-in values.

It is not realistic or necessary to have all surface infrastructure located beyond their potential radiant heat exposure. Other bushfire response measures are more pragmatic and effective, these include acceptance that lower value structures may be infrequently damaged by bushfire, effective operational protocols in the total absence of firefighter response and weak-link component shielding.

Infrastructure can be 'certified' by a registered and practicing engineer in conjunction with a BPAD Level 3 accredited bushfire consultant.

3.2 Heat exposure from flares to adjacent hazards

The NGP gas flares have the following structural attributes:

Pilot flare

- Stack height 6m
- Flame height up to 4m
- Safety zone 15m
- Vegetation free zone 40m

Safety flare

- Stack height 50m
- Flame height: 1.5 m from flare stack during normal operations and up to 30 m at design flow rate
- Safety zone 60m
- Vegetation free zone 130m

Radiation contours have been prepared by engineers for these flare types and the maximum radiation levels permissible are shown in **Table 2**. The nearest vegetation of any sort cannot be exposed to greater than 6.31 kW/m^2. Therefore, the following RFS recommended condition is satisfied

- *"Flame length and radiant heat values be modelled for the proposed gas flaring infrastructure. Radiant heat levels on surrounding vegetation shall not exceed 10k/Wm^2 on days of FFDI 120."*

3.9.1 Thermal Radiation Considerations

Radiation contours must be produced for flares. The maximum allowable radiation levels for flare design are listed in the table below and are based on API STD 521.

Location	Maximum Allowable Total Thermal Radiation Level (kW/m^2)(1)
Maximum at grade, typically directly below flame centre	9.46
Sterile area boundary(2)	6.31
Vegetation (grass, trees)	6.31
Flare Knock-Out Drum, Liquid Seal Drum(3)	4.73
Nearest Process Plant Boundary	3.15
Facilities Boundary Without Public Access Within 70 m from Boundary	3.15
Facilities Boundary With Limited Public Access(4) up to Boundary	2.37
Areas where workers or members of the public are continuously exposed(5)	1.58

Notes

(1). Total thermal radiation level **includes** solar radiation equal to 90% of the value tabulated for the typical average spring and autumn day for locations detailed in 1515-010-DSG-0002. This solar radiation level is typically the yearly average radiation level between the hours of 10 AM to 2 PM. For locations not covered by 1515-010-DSG-0002, local solar radiation data for a typical spring and autumn day must be used, or in the absence of local data, a value of 0.8 kW/m^2 must be used.

Table 2: Maximum allowable Thermal Radiation Levels

3.3 Risk of under-ground coal seam fires

It is not possible for underground coal ignition to occur as a result of development of natural gas from coal seams. Gas production and transport infrastructure is in place all around Australia and fire risks and management have been addressed in accordance with industry leading practice.

The project proposes to extract gas from coal seams that are up to 1,200 metres below ground level. The reduction of pressure resulting from the extraction of water from within coal seams allows natural gas to flow to the surface via the gas wells. The gas in the coal seams is almost entirely comprised of methane, carbon dioxide and nitrogen. For a fire to occur in the well casing up to 1,200 metres underground near the coal seam, in addition to the presence of methane (a combustible gas), oxygen must also be present. Given the absence of oxygen at the coal seam, combustion would not be possible.

The maximum concentration of methane that will burn in air is 15 per cent. It is expected that around 90 per cent of the gas extracted from the coal seam (and therefore the gas present in the well casing), will be methane. Therefore, the ignition of methane at the concentration within the coal seam is also not possible.

While the project proposes to extract naturally occurring methane from the coal seam by reducing the groundwater pressure, underground coal gasification is not proposed. The production of natural gas

from coal seams should not be confused with underground coal gasification. Underground coal gasification converts the coal *in situ* to 'syngas' through combustion. The air or oxygen required for this combustion is injected into the coal seam. Unlike underground coal gasification, there is no risk of a fire in the coal seam associated with coal seam gas development.

3.4 Radiant heat modelling from the gas flares

Section 3.2 and **Table 2** identify the engineering specifications of the radiant heat from the proposed gas flares. No vegetation or other infrastructure will be exposed to radiant heat levels capable of causing ignition.

The likelihood of wind-borne combustible material being ignited by the flares is negligible as evidenced by no identifiable record of fires having started from such causes despite thousands of gas flare operation in bushfire prone environments. This is not unexpected as the flare temperature would cause any burning debris to burn to extinction almost immediately or at least within the safety zone. It is also important to note that the stack height of the safety flare is up to 50m.

3.5 Protection of specific infrastructure from bushfire

For communications towers and any other higher value assets beyond the well head, it is proposed that any cabling or electronics exposed to a RHF >13kW/m^2 (the NSW Telco Authority agreed failure RHF for communication towers) will be appropriately shielded in the design and construction phase. Large APZ around communication towers and the like are not feasible nor necessary provided the structures are resilient to the bushfire attack level predicted. Resilience can be achieved by material and structure design.

4. Response to RFS issues dated 6.8.19

The additional issues raised in the RFS email to DPIE dated 6th August 2019 are addressed below:

4.1 Use of a comprehensive and complete risk identification process

4.1.1 All possible risks addressed

The EIS and subsequent responses identified, assessed and where necessary ameliorated all bushfire risks. The five broad categories these risks fall into have been commented upon in this report, the five categories are:

- Negligible or low bushfire risk sites e.g. Leewood (**Section 2.1**);
- Facilities compliant or having the potential to be compliant with Planning for Bushfire Protection 2006 e.g. SFPP at Westport;
- Low risk and low value gas field infrastructure requiring no protection measures e.g. buried pipelines, low point drains (**Section 2.1**);
- Well head facilities, none of which are within the flame zone of unmanaged vegetation or exposed to >14 kW/m^2 (**Section 3.1**);

- Gas flares with large APZ that ensure thermal radiation will not ignite the nearest vegetation (**Section 3.2** and **3.4**); and
- Risk to life (**Section 4.1.4**).

4.1.2 Risk Treatments

4.1.2.1 Bushfire risk from the NGP

The following identifies the specific measures that minimise the risk of bushfire ignition associated with the construction and operation of the facility.

- Inherent in the design of all built components and operational systems of the facility are measures that minimise and potentially eliminate bushfire ignition risk. All potential ignition risks are a high priority management action at well heads and these actions inherently also manage bushfire ignition risks.
- Hot works permits identify requirements to adjust, modify or cease activities which may cause ignitions in response to predicted Fire Danger Ratings. Restricted numbers of hot work permits are issued between October and February. Fire units are assigned at hot work sites during periods of higher Fire Danger Ratings.
- Safety flares at Leewood and Bibblewindi and Pilot Flares are surrounded by large APZ with the maximum thermal radiation at the nearest vegetation permissible 6.31 kW/m^2.
- The potential for windblown debris to pass through safety flares or pilot flares and result in the ignition of a bushfire is negligible.
- The assessment committed the proponent to prepare a Bushfire Management Plan in consultation with the NSW Rural Fire Service and Forestry Corporation of NSW. There is a Bushfire Management Plan currently in place for the exploration and appraisal activities and this would be amended in consultation with NSW Rural Fire Service and Forestry Corporation to reflect the project's activities.
- A Bushfire Management Plan for the project will include a range of measures for staff and contractor safety including policy, operational protocols and training to minimise ignition risk. Construction and operational staff are therefore far less likely than other users of the region to ignite fires by accident or other means. The Bushfire Management Plan is described in further detail in Appendix S of the EIS.
- As occurs currently, the NSW Rural Fire Service would be consulted in the preparation of the Bushfire Management Plan including bushfire season preparedness activities. The plan would be produced in consultation with the NSW Rural Fire Service, Forestry Corporation of NSW and landholders. The assessment committed the proponent to prepare a Bushfire Management Plan in consultation with the NSW Rural Fire Service and Forestry Corporation of NSW. There is a Bushfire Management Plan currently in place for exploration and appraisal activities and this would be amended in consultation with NSW Rural Fire Service and Forestry Corporation to reflect the project activities. The plan would also reflect the proponent's participation in the Resource Industry Fire Management Group.

4.1.2.2 Risk to the facilities and infrastructure

- All occupants of Westport workers' accommodation would be fully briefed on bushfire risks and appropriate bushfire response procedures. An emergency response and evacuation plan will be

prepared to meet the proposed use. In the event that refuge is required on site, it will be provided in the general use buildings of the site and these buildings are/will be constructed to their Bushfire Attack Level appropriate for a refuge building.

- Operational well pads are located within large cleared areas of around one quarter of a hectare.
- Well head infrastructure is surrounded by blue metal, vegetation free or vegetation managed areas as part of their Asset Protection Zone (APZ) and are a considerable distance from unmanaged vegetation.

4.1.3 Risk to firefighters has been addressed

There is no obligation or expectation that firefighters will protect infrastructure, with the potential exception of back burning operations, where if feasible fire retardant may be used to protect facilities prior to the impact of a back burn. If this measure is adopted it will be by agreement and design with fire response agencies.

The proposed Bushfire Management Plan will address all operational aspects associated with firefighter and NGP employee bushfire risks. This Plan is prepared in conjunction with all bushfire response agencies.

Firefighters will not be required to enter fenced areas in the gas field.

Fire detection and response in the Pilliga has been demonstrated to be significantly enhanced by the provision of fire detection cameras by Santos, and the presence of Santos staff and contractors.

4.1.4 Identify the risk assessment process used

Bushfire was assessed in the Hazard and Risk Assessment in Appendix S and summarised in Chapter 25 of the EIS. The assessment was undertaken in accordance with the Secretary's environmental assessment requirements by a suitably qualified bushfire specialist.

4.1.5 Engineer sign off

The design of all NGP infrastructure and facilities will include bushfire expert input and subsequent sign off by an engineer and BPAD Level 3 bushfire consultant. Auditing and QA processes will be undertaken under the Bushfire Management Plan.

5. Conclusion

This report identifies a range of bushfire risks to and from the NGP facilities and infrastructure and groups those with similar risks levels. Some facilities and infrastructure have negligible risk or easily replaced, others will comply with standards/guidelines for building on bushfire prone land and there will be no well heads located within the predicted flame zone of unmanaged vegetation or exposed to >14kW/m^2 with a bushfire attack under an FFDI 120. Any other infrastructure of value potentially exposed to a radiant heat levels beyond the tolerance of its key components will have those components shielded e.g. cabling on communication towers.

The gas flares are designed and located where ignition of vegetation by the flares will not occur and there is no evidence to indicate the ignition of wind-borne material is possible.

All risks to life, whether emergency services, employees, contractors or visitors can be effectively managed through implementation of the required Bushfire Management which will be prepared in conjunction with local fire response agencies.

This report is supplementary to a large amount of other bushfire risk assessment material provided by the EIS and the Response and Supplementary Response to Submissions.

Rod Rose

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FPAA BPAD Level 3 Certified Practitioner No. BPAD1940-L3

Appendix A: Bushfire Attack Assessor Reports on worst-case well head risks

NBC Bushfire Attack Assessment Report V2.1

AS3959 (2009) Appendix B - Detailed Method 2

Printed: 26/08/2019 **Assessment Date:** 26/08/2019

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

Site Street Address: Well-head infrastructure,

Assessor: Mr Admin; admin

Local Government Area: Moree Plains **Alpine Area:** No

Equations Used

Transmissivity: Fuss and Hammins, 2002
Flame Length: RFS PBP, 2001
Rate of Fire Spread: Noble et al., 1980
Radiant Heat: Drysdale, 1985; Sullivan et al., 2003; Tan et al., 2005
Peak Elevation of Receiver: Tan et al., 2005
Peak Flame Angle: Tan et al., 2005

Run Description: NGP NW Slopes DSF

Vegetation Information

Vegetation Type:	Forest	**Vegetation Group:**	Forest and Woodland
Vegetation Slope:	3 Degrees	**Vegetation Slope Type:**	Downslope
Surface Fuel Load(t/ha):	14	**Overall Fuel Load(t/ha):**	24.7

Site Information

Site Slope:	0 Degrees	**Site Slope Type:**	Level
Elevation of Receiver(m):	Default	**APZ/Separation(m):**	38.5

Fire Inputs

Veg./Flame Width(m):	100	**Flame Temp(K)**	1090

Calculation Parameters

Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg)	18600	**Ambient Temp(K):**	308
Moisture Factor:	5	**FDI:**	120

Program Outputs

Category of Attack:	MODERATE	**Peak Elevation of Receiver(m):**	9.07
Level of Construction:	BAL 19	**Fire Intensity(kW/m):**	31644
Radiant Heat(kW/m2):	13.49	**Flame Angle (degrees):**	72
Flame Length(m):	19.08	**Maximum View Factor:**	0.224
Rate Of Spread (km/h):	2.48	**Inner Protection Area(m):**	38
Transmissivity:	0.793	**Outer Protection Area(m):**	0

Run Description:	NGP Pilliga Outwash DSF		
Vegetation Information			
Vegetation Type:	Forest	**Vegetation Group:**	Forest and Woodland
Vegetation Slope:	3 Degrees	**Vegetation Slope Type:**	Downslope
Surface Fuel Load(t/ha):	7	**Overall Fuel Load(t/ha):**	11.05
Site Information			
Site Slope:	0 Degrees	**Site Slope Type:**	Level
Elevation of Receiver(m):	Default	**APZ/Separation(m):**	38.5
Fire Inputs			
Veg./Flame Width(m):	100	**Flame Temp(K)**	1090
Calculation Parameters			
Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg)	18600	**Ambient Temp(K):**	308
Moisture Factor:	5	**FDI:**	120
Program Outputs			
Category of Attack:	LOW	**Peak Elevation of Receiver(m):**	4.63
Level of Construction:	BAL 12.5	**Fire Intensity(kW/m):**	7078
Radiant Heat(kW/m2):	6.53	**Flame Angle (degrees):**	81
Flame Length(m):	9.38	**Maximum View Factor:**	0.109
Rate Of Spread (km/h):	1.24	**Inner Protection Area(m):**	38
Transmissivity:	0.788	**Outer Protection Area(m):**	0

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