NOPSEMA
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INVESTIGATION REPORT

NOPSEMA Investigation – Blacktip P3 B-Annulus Pressure

Investigation details

Well:	Blacktip P3
Titleholder:	Eni Australia B.V. (Eni)
Date investigation commenced:	28/02/2023
Lead Investigator:	[redacted]
Investigation team:	[redacted], [redacted]
Investigation number:	IVT12244

Report distribution

Position	Company
Records management	NOPSEMA
	Eni Australia B.V.

Revision status

Rev	Date	Description	Prepared by	Approved by
A	22/06/2023	Internal draft	[redacted]	[redacted]
B	01/08/2023	Draft for titleholder review	[redacted]	[redacted]
C	05/09/2023	Minor edits, mainly to reflect additional information from Eni provided 4 and 9 August 2023	[redacted]	[redacted]
0	28/09/2023	Final (minor edits arising from meeting on 7 September 2023 highlighted)	[redacted]	[redacted]

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1. Background

On 24 February 2023, anomalous sustained casing pressure (SCP) of 660psi was recorded on the 13-5/8" x 20" annulus of new Blacktip well BT-P3, indicating a breach through the 13-5/8" cement sheath, cemented ~5 weeks earlier. The annulus pressure had previously been recorded at zero, indicating a change during the 5-week period.

Eni notified NOPSEMA about the annulus pressure on 28 February 2023 and provided a 3 day report describing the situation and immediate actions [1]. Soon after identifying the SCP, Eni convened risk assessment sessions and shared the output with NOPSEMA [2,3]. At NOPSEMA's request, Eni also provided data related to the 13-5/8" cement job [4] and later a presentation [5] providing updates on Eni's diagnostic and investigative work. Eni subsequently provided additional information as it became available [6,7].

2. Investigation scope

NOPSEMA initiated an investigation with the following objectives:

- Immediate risks and incident control: Determine if the titleholder has an appropriate plan in place to identify and manage immediate risks
- Determine if the duty holder has an appropriate longer-term plan in place to:
  - Diagnose and manage the annulus pressure
  - Investigate the 13-3/8" cement job and identify improvements for future wells.

3. Conclusions and reasons for those conclusions

1	**Immediate risks and incident control** **Conclusions:** Based on the information gathered and observations made during the investigation, the inspectors concluded that: (a) the titleholder had an appropriate plan in place to identify and manage immediate risks posed by the sustained casing pressure (SCP). (b) the well has been subject to a significant new well integrity risk and a WOMP revision is required. **Reasons for the conclusions:** (a) Eni's actions after identifying the SCP included: recording the annulus pressure bleed off and build-up rate, continuous pressure monitoring, testing wellhead barriers, holding risk assessment sessions, consulting the wellhead OEM regarding additional barriers (subsequently ordered) and reducing the maximum allowable wellhead operating pressure (MAWOP). (b) The SCP indicates failure of the 13-5/8" cement sheath to prevent gas migration. A WOMP revision is required to describe the associated risks and control measures, and how the design and/or construction of future Blacktip wells will be revised to prevent reoccurrence.

2	**Diagnosis and management of SCP** **Conclusions:** Based on the observations made during the investigation, the inspectors concluded that Eni has undertaken diagnostic work indicating that the leak rate into the annulus is within an industry standard threshold of acceptability. Eni is implementing control measures to manage the risks associated with the SCP, such as reducing MAWOP below the WOMP value and ordering additional wellhead barriers and sensors. Based on the information provided, the control measures are consistent with international standards and guidelines for SCP. However, Eni has not yet demonstrated that they have assessed all potential long-term risks associated with the SCP. **Reasons for the conclusions:**
	[redacted]
3	**Investigation of 13-5/8" cement job** Based on the information gathered and observations made during the investigation, the inspectors concur with Eni's findings that there is a leak path through the 13-5/8" cement sheath

extending from the A1 gas zone to the top of cement. The inspectors conclude that the leak path likely involves a microannulus that formed after the setting of the 13-5/8" cement.

Eni has not demonstrated that they have identified the aspects of the design and construction of well BT-P3 that may have contributed to defects in the cement job, nor recommended specific improvements for future Blacktip wells (design, construction, and/or barrier verification). Based on the observations, the inspectors conclude that the pre-defined performance standards and acceptance criteria for the 13-5/8" casing were not adequate. Given the uncertainty regarding the nature and causes of the cement defect, NOPSEMA considers that Eni should consider alternative causes of the cement defect and identify appropriate control measures to prevent gas migration before and after cement setting in future wells.

Reasons for the conclusion:

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[redacted]

NOPSEMA expects Eni to consider these findings and conclusions and undertake sufficient action of their own to both fully understand the issues presented and to take action to reduce the risks and impacts to ALARP and come back into compliance with their duties under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and/or the requirements of the WOMP.

Additional supporting points for the conclusions are provided in the Findings section.

4. Inspectors' recommendations to NOPSEMA

The investigation team recommend that NOPSEMA:

- closes out this investigation,
- monitors compliance at the next well integrity inspection, and
- ensures Eni submits a WOMP revision (as committed to in Eni's response to the planned inspection report [20]).

WOMP Revision

Given the unplanned annulus pressure on BT-P3, the inspectors consider that a WOMP revision is required to demonstrate how risks to well integrity will be reduced to ALARP for existing and future Blacktip wells. Such a WOMP revision should include the following (but not limited to):

- A description of the as-installed well barriers in Blacktip P3 well (and P1 post-workover), including updated well and barrier schematics with similar level of detail to the diagrams in Appendix G of the in-force WOMP.
- A summary of the BT-P3 diagnostic work.
- A description of the annulus pressure management plan for BT-P3, including an ALARP demonstration that considers long-term risks and options for remediating the annulus.
- Consideration of potential alternative scenarios for the 13-5/8" cement defect(s) and identification of control measures or changes to prevent SCP reoccurrence in future Blacktip wells.
- Consideration of long-term risks associated with the flow beneath the 20" shoe, including (but not limited to):
    - a description of all hydrocarbon bearing zones and aquifers in the 17-1/2" and 26" hole sections, endorsed by subsurface personnel. The description should include relevant information (e.g. lateral extent, accumulation points, closure, dip) to indicate where hydrocarbons migrating from a lower zone could accumulate, and consideration of the potential impact on other Blacktip wells.
    - Information about the geology at the 20" shoe, e.g. permeability.
    - Pore pressure gradients for all hydrocarbon bearing zones, with plots showing the pressure associated with full columns of hydrocarbons to surface, similar to the plot in document [2].

5. Findings

The inspectors made the following findings on each of the scope topics, included as further support for the report's conclusions.

Immediate risks and incident control

- The annulus pressure bled off from 660psi to 90psi in 6.5mins. As the annulus pressure bled to the target pressure within the test duration, API RP 90-1 considers it a "small leak", and states *"Because the pressure can be bled to the target pressure, the leak rate and the barrier envelope may be considered adequate after performing a risk assessment"* [14].

- The annulus pressure has been monitored continuously and has remained approximately stable between February and July 2023, indicating no significant change to the risk profile.

Diagnosis and management of SCP

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13-5/8" cement job

The inspectors made the following findings related to the 13-5/8" cement job:

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6. Abbreviations

ALARP	As low as reasonably practicable
BT-P3	Blacktip 3 well
DDR	Daily drilling report
FCP	Final circulating pressure
MAASP	Maximum allowable annulus surface pressure
MAWOP	Maximum allowable wellhead operating pressure (MAASP minus a safety margin)
MODU	Mobile offshore drilling unit
OEUK	Offshore Energy UK
Scf/min	Standard cubic feet / minute
SCP	Sustained casing pressure
TOC	Top of cement
(T)TOC	(Theoretical) top of cement

7. References

1. Blacktip-P3 'B' annulus pressure_3 day report (A917618)
2. Initial BT-P3 Risk Assessment - B Annulus Pressure, 06-03-2023 (A918078)
3. BT-P3 20 x 13 Annulus Pressure updated post RA, 13-3-23 (A921995)
4. Eni data pack – Risk assessment and investigation of 13_58 cement job (A921186)
5. BTP3 - 13 5-8in Casing NOPSEMA presentation June 2nd (A942001)
6. Scanwell results, SCP trends and MAWOP update, 16-06-23 (A948080)
7. Summary of Eni Update - BT-P3 (17 July 2023) (A954405)
8. Eni Drilling Design Procedure STAP-P-1-M-26536 (A955559)
9. Eni Well Barrier Management Report ENI-DRL-RP-025 (A892448)
10. Well Cementing – Second edition, Schlumberger, 2016 (https://www.slb.com/-/media/files/ce/other/well-cementing-book.ashx)
11. Oil and Gas UK Guidelines on Qualification of Materials for the Abandonment of Wells, Issue 2
12. 117 –Norwegian Oil and Gas Recommended Guidelines for Well Integrity
13. NORSOK D-010:2021 Well integrity in drilling and well operations
14. API Recommended Practice (RP) 90-1, Annular Casing Pressure Management for Offshore Wells
15. Blacktip P3 Compositional Analysis Annulus Gas (A955553)
16. Mustafa Al Ramadan et al, 2021, Numerical Modeling of Gas Migration through Cement Sheath and Microannulus (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8697593/)
17. Blacktip BTP3 Acceptance Criteria, 000036_DV_PR.D&C.1172.000_00
18. Mrudhul Raj, Atkins Ltd, 2014, Well Integrity - Christmas Tree Acceptable Leakage Rate and Sustained Casing Pressure (https://www.icheme.org/media/8920/xxiv-paper-26.pdf)
19. Email thread - Eni explanation of pressure test theory (A1000229)
20. Submission - Blacktip Inspection no.2522_Eni Response Letter - 31-08-2023 (A1002940)