



Lost Radioactive Source Capsule January 2023

Presentation to ARPS 2023

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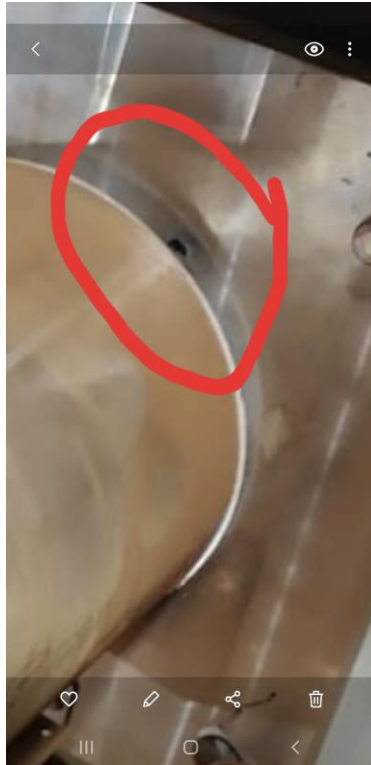
June 2023

The Incident(s)

- On the 12th December 2022, it was observed that the gauge's top plate had come off and the shielding material (with the source capsule intact within) had fallen out of the gauge outer housing
- In the process of falling the shutter mechanism lever and the source rod holder bolt had been sheared off with the top plate
- Regulatory authorities were informed and the gauge, shield and source safely moved to a radiation storage area
- An experienced and licenced firm were contracted to reassemble the gauge and package the gauge in an overpack for transport to Perth and this was performed on the 10-11 January 2023
- The gauge was transported From Site to the contractors location in Perth over the period 12-15 January 2023
- On the 25th January the contractor informed the Regulatory Authorities and Rio Tinto that the gauge was damaged and the source was missing
- The rest is history

Checking other gauges

- Rio Tinto placed freeze on all gauge transportation until investigated
- Examination of all gauges within Rio Tinto Iron Ore
- Examination of all gauges of similar design (WA Radiological Council directive)
- Communication with other State Agencies recommending similar examination (WA Radiological Council)



Key Contributing Factors

Gauge design

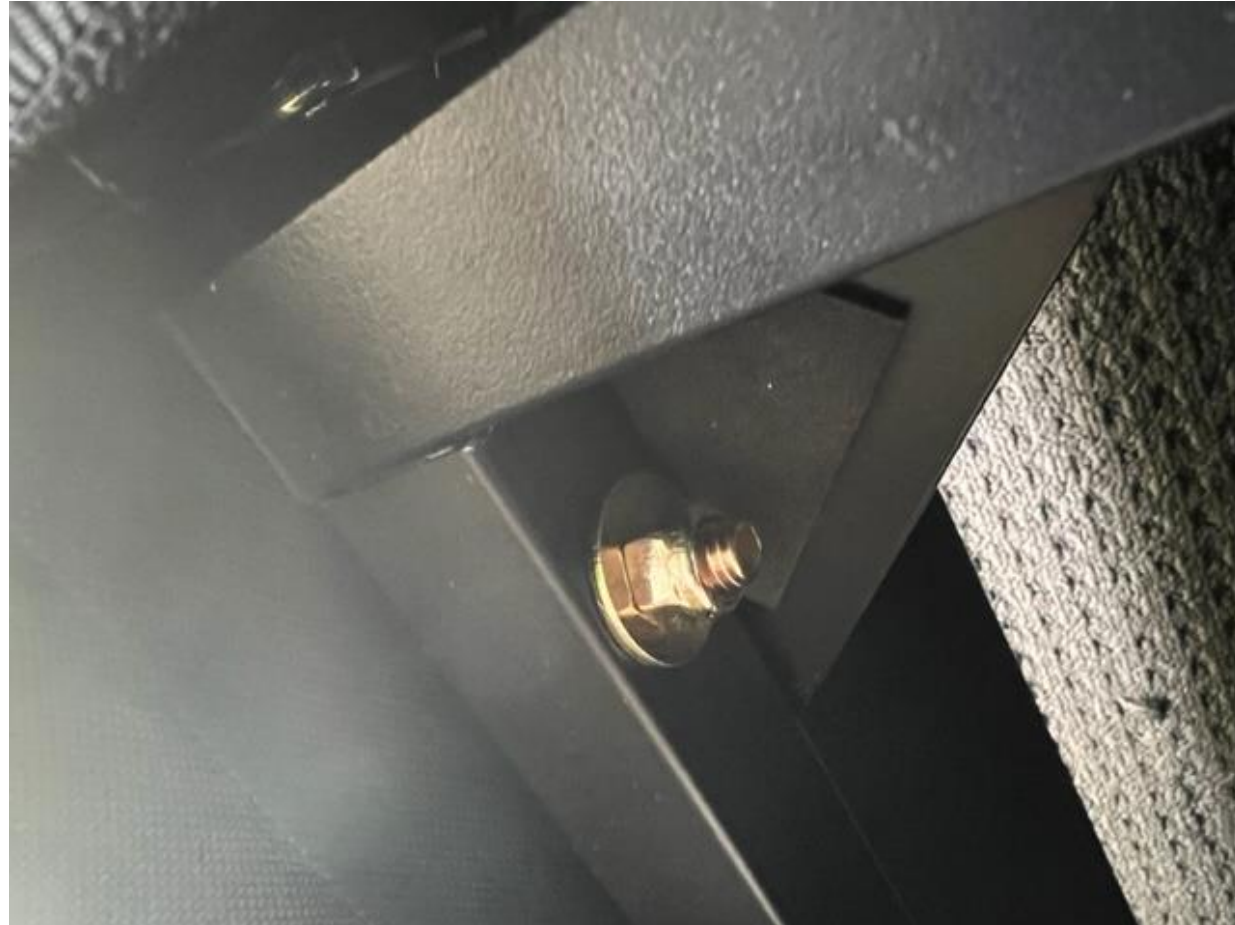
Gauge designation and testing

Packaging

Delay in reporting

Vibration!!!!!!

- Vibration is a well known potential cause of failure in mechanical components where screws or bolts are used
- Even common items which may be exposed to vibration are protected



Gauge Design

- The “new” gauge designed moved from the historic cast construction to an engineered structure with the outer casing consisting of a cylinder attached to a front and back end plate
- The structure is held together by 12 M5*15mm bolts (6 at the front and six at the back)



First Incident

- The top plate had totally separated from the rest of the housing. Bolts were NOT sheared off and appeared to have just come undone
- Shield housing still contained the source capsule and was found approximately 2m below



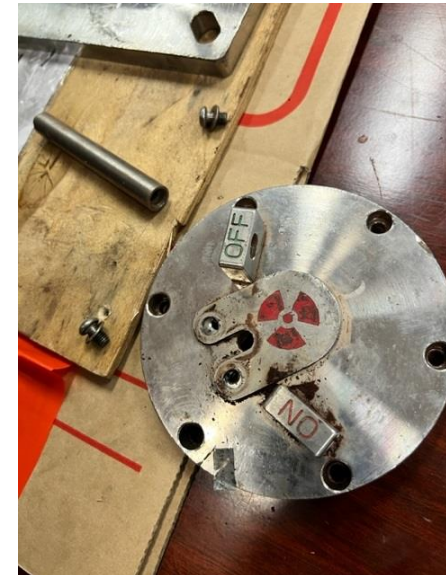
Second Incident

- The gauge basically shook itself into its component pieces in the overpack
- One of the two mounting bolts vibrated loose, enlarged its hole and left this enlarged hole as a overpack penetration
- Even the locking bolt at the end of the source rod holder was unscrewed and missing



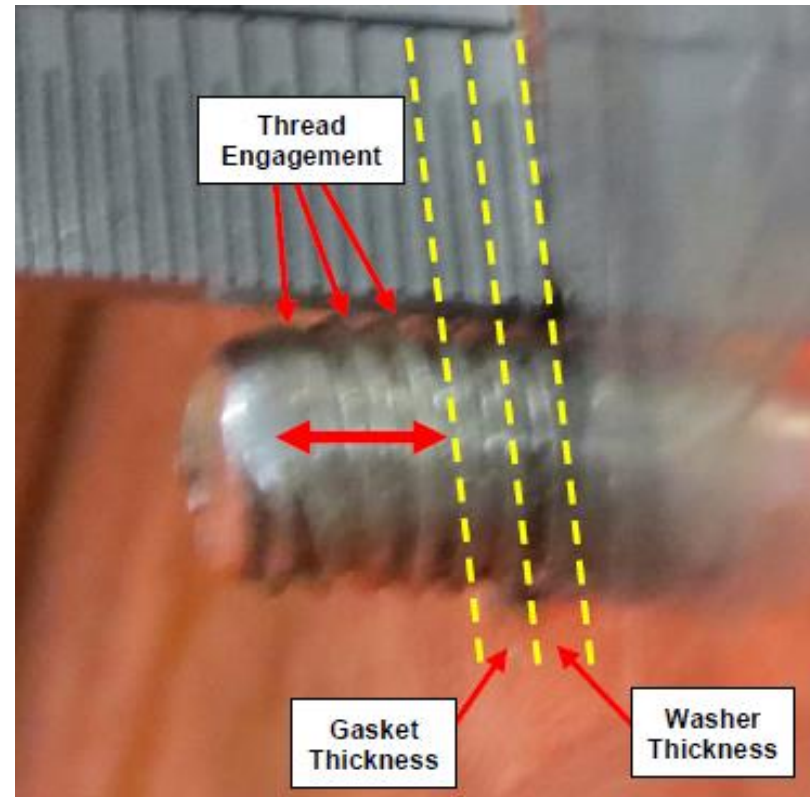
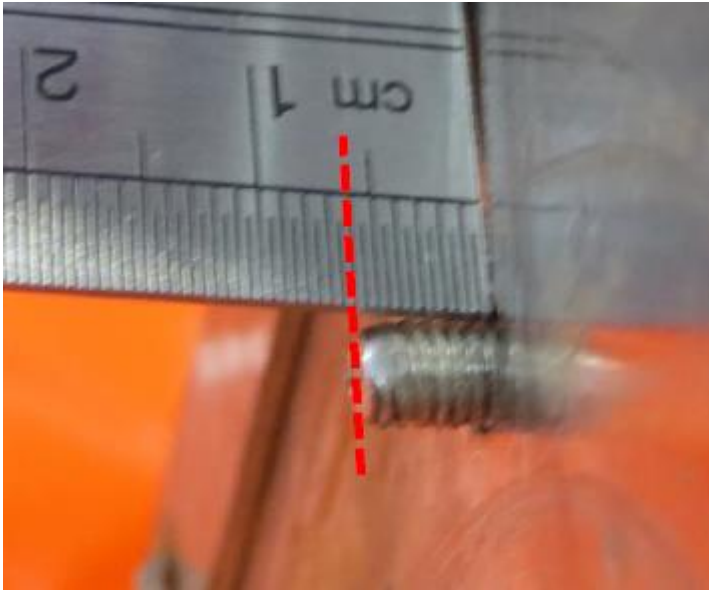
Bolts and attachment

- Only one bolt remained attached for either the top or bottom plate and it was sheared off (a case of last man standing)
- Other bolts found show damaged threads
- Only remaining bolts in the source cover on the top plate were so loose they could be undone by hand



On a short thread

- The bolts utilised for the structural integrity of the gauge relied on only a few turns of thread
- The only design component for vibration was the use of spring washers (no nylon lock nut, Loctite, epoxy resin, etc.)
- Recommended tightening torque obtained from manufacturer during reassemble very low (3 Nm)



Gauge Designation and Testing

- The gauge was purchased on the basis that it was tested and approved
- As part of the investigation it was found that the gauge was incorrectly labelled as DG01 the “old gauge design
- The initial approval for the “new” gauge was for a DG02(L) gauge (the L indicates lead shielding)
- However, due to the source activity the gauge used tungsten alloy as its shielding DG02(T)
- Due to the difference in density there would have to be a significant difference in weight (~6-8kg) based on density though the specifications do not reflect this
- Unsure if vibration was part of the testing and whether the tungsten version was tested

Packaging

- Rio Tinto contracted a licensed and experienced firm to reassemble the gauge and package it for transport
- The gauge was attached to the base of the overpack using two bolts (in a similar way to how new gauges are sent from the manufacturer)
- No additional packaging or precautions were taken despite the gauge being previously damaged with the exception of some additional steel plates at the base (for additional shielding due to shutter being broken)
- The overpack was placed at the rear of the rear trailer of a B Double truck



Reporting

- In the event of any incident involving damage to a gauge the regulatory authority must be informed (generally within 24 hours of discovery)
- There was a significant delay (16th – 25th January) between the delivery of the gauge to its destination at the contractors site and when the gauge was determined to be damaged and the source capsule missing
- This delay had the potential to substantially increase the potential public exposure and also increased the public concerns around the lost source capsule

Changes for transport and gauge testing regulations and recommendations

As part of the learnings from the incident it appears that there are areas for improvement in State, Commonwealth and international guidance and regulations

Transport

- More consideration of vibration as a potential cause for loss of containment needs to be added
- The status and integrity of a damaged gauge or source container need to be considered and if the original package type rating is still maintained
- Solid and robust
- Examine a requirement for checking the source is in place (such as comparing the pre and post Transport Index) upon receipt of an item which is not part of routine transport or where there is any damage either before or during transport

Gauge Design and Approval

- More rigorous and comprehensive mechanical design and manufacturing consideration of vibration
- Testing of gauges for vibration as the current guide is a bit uncertain on whether the gauge as a whole or just the source capsule needs vibration testing

Conclusion

- The loss of a source capsule from an industrial radiation gauge is EXTREMELY unusual and the loss during transport is even more uncommon
- The loss of the source capsule in January 2023 created significant public, media and Government concern
- Due to excellent cooperation between State and Commonwealth agencies the source was found
- Radiological exposure to all individuals was extremely low and well below the public dose limit and the source encapsulation was intact ensuring no distribution of radioactivity to the environment
- Vibration was a major contributor to the failure of the gauge and allowed the source capsule to escape from the overpack during transport
- A number of key learnings arise from the incident and these are or have been implemented
- There are deeper learnings for the regulations for radioactive transport and gauge design
- Rio Tinto has been investigated by the appropriate regulatory authority and deemed to have performed appropriately throughout the incident (no Breaches)