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# An investigation into the cause of loss of containment from the supply of mini-bulk lubricants

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ABSTRACT

An Intermediate Bulk Container (IBC) was punctured during its handling, releasing oil onto soil at an environmentally-sensitive region of Australia. The telehandler did not pierce the plastic of the IBC directly (as was expected) but rather one of the tynes had caught on the underside of the metal base plate, despite numerous controls being in place at time of spill, revealing a previously unreported mechanism for a fluid spill from handling of petroleum hydrocarbons. The diverse investigation team used a root cause analysis (RCA) technique to identify the underlying cause: the inspection process was inadequate with contributing factors of not using a spotter and design of IBC did not anticipate conditions. Engineering controls were put in place as part of the change management process to help prevent spills from occurring from piercing from telehandler tynes on the current project site.



## 1. Introduction

Leaks and spills of petroleum hydrocarbon are a major concern in the upstream oil industry, from both a construction [1] and operational perspective [2–4]. The petroleum industry is greatly concerned about safety and is one which has a strong safety culture with product spills being no exception. Construction in remote locations requires a flexible and yet secure logistics system for delivery of fuel, oil and chemicals. Intermediate Bulk Containers (IBC) units are used to hold various types of liquids including oils, acids and concrete accelerants (Table 1). IBCs are ideally suited for such applications because of their flexibility for handling and scalability as the construction work front changes.

Despite the industry's best endeavors, loss of containment may occur and we need to understand the root causes, consequences and implications of such events. One of the tools commonly used to investigate these losses of containment, root cause analysis (or RCA), will lead investigators to take both short-term immediate corrective actions, as well as finding the underlying root causes (latent failures) hidden in the way work is done that will help avert similar incidents or spills in the future [5].

The project's hazard identification process (or HAZID) did not identify handling of IBCs as posing a risk to the project, but rather accepted the risk to deploy these as an improved approach to other options. Given there is an underlying requirement in all professionally-managed construction projects to ensure the design stage of the project identifies and considers the potential risks [6–10] including those from transport and storage of chemicals, the current resource construction project decided to use IBCs as an enhanced and preferred method to procuring 205 L (or 44 gal) drums strapped to pallets, or to purchase vessels larger than IBCs, such as ISO containers or other large transportable tanks.

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**Table 1**
Examples of chemicals commonly transported to and stored at resource construction and mining sites.

| | | |
|---|---|---|
| Engine lubricants | Greases | Brake fluid |
| Gear lubricants | Detergents | Sealants |
| Coolants | Solvents | Acetone |
| Sodium hydroxide | Hydrochloric acid | Bleach |

## 2. Purpose

The current study used RCA methodology, in a practical context, to investigate the cause(s) and contributing factors that led to an oil spill from a commonly used bulk handling container or Intermediate Bulk Container (IBC) on a large construction project in a remote and environmentally-sensitive area.

## 3. Method

### *3.1. Description of IBCs*

An Intermediate Bulk Container (IBC) or IBC Tote or Pallet Tank, was the type of vessel from which loss of containment occurred in the spill event in the current study. It is a single-use container designed for the transport and storage of bulk liquid and granulate substances (e.g. oil, chemicals, food ingredients, solvents, pharmaceuticals, etc.).

### *3.2. Description of operation and location*

The contractor company that was operating the IBC handling equipment when the spill occurred was the primary earthworks contractor engaged to supply services to the oil and gas company that had land tenure on the island on which the resources construction project was being built. The contractor organization was operating up to 370 plant items including forklifts and tele-handlers used for handling IBCs. The site was an LNG construction site located offshore Western Australia on a remote island classified as a Class A Nature Reserve. The site where the spill occurred was located approximately 2 km from the ocean in the center of the construction works where the LNG plant was being built. The topography where the spill occurred was flat and well trafficked by personnel on the project.

### *3.3. Management systems descriptions*

The contractor operated under a management regime that was comprised of an integrated health, safety, quality and environmental management system. Each component of the system was certified to the relevant ISO standard including ISO 9001 and 14001. To ensure alignment of the contractor's system with that of the oil and gas operator, this integrated system was audited externally by the operator every 6 months.

### *3.4. Root cause analysis methodology*

The team conducted the investigation for this incident in accordance with a fishbone, cause and effect (or Ishikawa) root cause analysis (RCA) process [11]. The steps of this process were: 1. Formation of the investigation team; 2. Collection of incident data including machine handler (operator's) background; 3. Development of the sequence of events; 4. Undertake a protective systems analysis; 5. Perform RCA analysis using the cause and effect (fishbone) model (method) as a team exercise linking verification data to each decision made by the team during analysis; and 6. Development of appropriate corrective actions. Table 2 lists the proforma options for possible root causes that were used in the RCA process. An RCA investigation team was assembled with a range of complementary skills. These were the Company Construction Director, The Company Area Construction Manager, 2x Company Environmental Coordinators, Contractor Environmental Engineer, Company Environmental Superintendent, The Operator, The Health and Safety Representative (for the Operator), The Contractor HSE Manager, The Contractor Project Director, The Contractor's National Construction General Manager, and the Company Incident Investigation Manager.

### *3.5. Collection of incident data*

Data collection included one-on-one interviews, review of project and procedural documentation, employee training records, photographs from the incidents, and procurement manifests and related documents. It also included the goods manifests, discussion with suppliers of the IBC, and licenses.