Newsletter

THE INSTITUTION OF ENGINEERS SRI LANKA

Western Australia Chapter

October 2022

IESL WA has conducted many webinars for member professional development as well as for sharing knowledge. This has been very successful due to good participation of many practicing engineers joining these webinars from Australia, New Zealand, Sri Lanka and many other countries. The zoom platform has provided a greater opportunity to join seminars immaterial of their physical location. This year we have already conducted 7 webinars including a discipline group workshop and our last webinar was held on 20th October 2022.

This issue of the newsletter has been dedicated to **Mechanical Engineering** and related areas such as Plant Reliability, Asset Management, Tunnelling with TBM and the Mechanical Engineering related areas of the new **WHS Legislations and Regulations of Western Australia**.

Our culture of sharing knowledge and supporting the growth of our membership will continue through these newsletters, webinars, physical workshops and wherever applicable with discipline group workshops.

The Institution of Engineers Sri Lanka, Western Australia Chapter, 9th Annual General Meeting will be held on 29th October 2022 16^{00} hrs. (4^{00}PM) at Centenary Park pavilion, Wilson.

Why Asset Integrity Management is important?

By Lashan Chandika (BSc. Mechanical Engineering)

Most of the modern-day industrial workplaces operate on 24/7 basis and often owners/operators keep an eye on three main parameters which are very important for sustainable business continuity viz.

- Cost - Mainly cost of production and cost of sustenance (example- Maintenance)
- Risk - Both risk to the people, equipment, environment, and risk to the business.
- Performance - People/Asset performance, Health & Safety Performance, Financial performance.

Obliviously priority outcomes of above parameters would be to:

- Reduce the cost
- Reduce the risk as low as practicable
- Increase performance to get maximum yield.

The most difficult thing is these are three competing priorities, i.e., for example when you try to reduce the cost you may end up increasing the risk, reducing performance or both. The challenge is to find the right balance between the three while not compromising health and safety, process safety and environmental safety.

Catastrophic failures of plant may have following implications:

- Fatalities and Injuries to the workplace personnel and/or community
- Equipment damage and loss of production
- Release of harmful substances to environment.

Consequences of all these major unwanted events affects business negatively, some of the major consequences may be

- Affecting business continuity by revocation of license to operate by regulatory authorities (such as Environmental Protection Authority, Worksafe etc.)
- Heavy fines for business creating bad image among investors, wider community
- Financial losses in the form of compensation, environment clean ups, loss of production
- Loss of goodwill of partners or customers from loss of orders etc.
- Much harsher punishments for Persons Conducting Business and Undertaking (PCBU) as per latest Work Health and Safety Regulations 2022.

FEW EXAMPLES OF CATASTROPHIC FAILURES

A turbine coupling failure

Probable causes:

- Lack of inspection to identify defects.
- Lack of maintenance
- Lack of testing or failure of safety critical devices.

  example: overspeed trip

Structural Reclaimer Failure

Probable causes:

- Inadequate design for fatigue stresses
- Failure of overload protection.
- Lack of Inspection for potential defects
- Lack of maintenance
- Operational mishap such as human factors.

A Tank Failure

Probable causes:

- Inadequate corrosion risk mitigation
- Lack of Inspection for potential defects
- Lack of maintenance and monitoring
- Operational mishap (Human Factors).

Therefore, integrity management of physical assets plays a pivotal role in ensuring the goal of safe workplace.

Asset Integrity Management System (AIMS) ensures people, systems, processes, and resources in place to deliver integrity of assets. key components of an AIMS:

- Responsibility assignment matrix
- Asset and process Data
- Risk Identification and Assessment, risk profiling/ranking
- Risk Mitigation/asset management Plan
- Review and audit plan.

As we want an asset to perform its intended function throughout its lifecycle, it is beneficial to pay attention to AIMS from the beginning of asset's life cycle. In the lifetime, an asset goes through various stages, starting from concept and then moving on to construction, commissioning, operations, maintenance, and de-commissioning. Looking at this life cycle, we can see where we need to focus in terms of integrity.

DESIGN INTEGRITY

A solid design integrity focus will help provide a strong foundation for the AIMS. During this phase confirm that design would not lead to any unacceptable risks. Third party design verification and conformity assessment are some of the tools used to mitigate these risks. Furthermore, owner/operators need to assure that the design complies with all technical and process safety standards and any local government authority regulations. Details about the operation and maintenance routine must be defined and all safety critical devices/elements also need to be identified at this phase.

TECHNICAL INTEGRITY

At the construction and commissioning stage owner/operator need to ensure technical integrity. These could be achieved by project quality management system. Plant owners have primary responsibility and should participate in QA/QC process and audit reviews to assure equipment is manufactured and installed as per applicable codes and standards. Operational readiness/staff training, proper handing over and commissioning is paramount when transitioning from construction to operation phase.

OPERATIONAL INTEGRITY

Most of the assets spend bulk of their lifetime in Operational phase which consists of operation, maintenance, and de-commission stages. After commissioning operational integrity should be ensured by managing operational limits of assets. Some of the strategies include Risk Based Inspections (RBI), Reliability Centered Maintenance (RCM), Safe Integrity Levels (SIL) etc. Planning and scheduling of comprehensive condition monitoring programs, inspection, and testing campaigns are very important to achieve a safe and reliable plant operation.

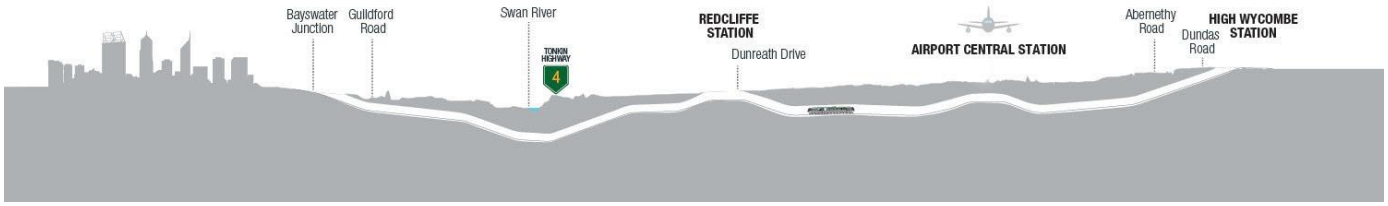
Local regulatory authorities such as Worksafe WA has identified certain types of plants with higher risk in WHS regulation 2022 and require implementation of strict integrity management throughout the lifecycle including registration of design and/or individual plant with them such as:

- Pressure Equipment (Boilers, Pressure Vessels)
- Lifting Equipment (mobile cranes, gantry cranes, vehicle hoists)
- Lifts (passenger lifts, escalators and moving walkways)
- Concrete placing booms
- Elevated work platforms
- Tower cranes
- Amusement Park devices

Hence, above mentioned areas have been sighted with specific regulations to assure their safe operation and integrity to deliver their intended services safely.

*Please refer to WHS Regulation 2022 for definition of PCBU and more details
WALW - Work Health and Safety Act 2020 - Subsidiary legislation

METRONET - Forrestfield-Airport Link



The **$1.86 billion** ***Forrestfield Airport Link*** is jointly funded by the Australian and Western Australian governments and has delivered a new rail service to the eastern suburbs of Perth – with three new stations at ***Redcliffe, Airport Central and High Wycombe.*** The rail link supports part of the ***METRONET*** vision for a well-connected Perth with more transport, housing and employment choices. The Airport Line will spur off the existing Midland Line near Bayswater Station and run to High Wycombe through twin-bored tunnels. In April 2016 the Public Transport Authority awarded the design, construct and maintenance contract to ***Salini Impregilo – NRW Joint Venture***. First trains have started operation on the new Airport Line since 10th October 2022.

TUNNEL BORING MACHINES

Tunnel boring machines (TBMs) are large machines that excavate below the ground surface, while simultaneously installing concrete lining units (segments) to build a tunnel. Two TBMs have been specifically designed for the ***METRONET*** Forrestfield-Airport Link by German company ***Herrenknecht***, the world's leading supplier of TBMs.

Despite their huge electric and hydraulic-powered motor drives, TBMs create little noise at the surface and cause only minor vibrations as they cut through the soil and rock in their path.

There are various types of TBMs to cater for different ground conditions and project requirements. For this project, the TBMs are Mixshield which

use the latest dual-mode technology capable of adapting to variable ground conditions (such as sand, rock and clay) as the machine progresses.

These Tunnel Boring Machines, each costing approximately $20million, will excavate 7m-diameter twin-bored tunnels between Forrestfield and Bayswater (**Figure.1**).

Key components for our TBMs were manufactured in various places around the world before an in-depth nine-month assembly and testing program was conducted in China. Once testing was finished, they were disassembled and shipped to Henderson Port. The TBMs were then transported to site, reassembled and lowered into the dive structure at High Wycombe, where they tunnelled between High Wycombe and Bayswater between July 2017 and April 2020.

Figure 1 TBM used for tunnelling between High Wycombe and Bayswater

During their **8km** journeys the TBMs excavated under Perth Airport and the Swan River, reaching up to **26m depth below the surface**.

TBM Grace began tunnelling in July 2017, and TBM Sandy began in September 2017. Their underground journeys have taken about three years. Their tunnelling lengths have been 7458m and 7456m respectively.

The reinforced tunnelling segments that support the excavation have been specifically designed to withstand external ground pressure. Strain gauges are also installed at each cross passage to monitor the tunnels' stability. The tunnels are designed and built to have **120-year durability** and are constructed to Australian and international standards.

NAMING THE TBMS

Like ships, TBMs are named before they begin work to bring good luck. Traditionally, a TBM cannot start work until it is given a name. TBMs are generally given female names as underground workers look to Saint Barbara for protection.

The first TBM was named ***Grace***, in honour of pre-primary student **Grace McPhee** who was nominated by her classmates at Edney Primary School in High Wycombe. The students said Grace, who is undergoing treatment for leukaemia, was the toughest person they knew – a toughness the TBM would need to bore through the earth. This TBM was decorated with artwork by Year 6 Walliston Primary School student Georgia Fields.

The second TBM was named ***Sandy*** as suggested by High Wycombe Primary School Year 4 student **Sarah Spratt**. Sarah was inspired after finding a ***sandgroper*** in her backyard, as the local insect (*which is also a colloquial name for Western Australians*) is 'excellent at tunnelling, just like the TBM'. This TBM was decorated with artwork by Rossmoyne Primary School Year 5 students **Faith Brand** and **Jood Al Jashammi**.

(Extracted from https://www.forrestfieldairportlink.wa.gov.au/)

Extracts from WHS (Mines) Regulations 2022

Schedule 5 Registration of plant and plant designs

Division 1 - Plant requiring registration of design

1. Items of plant requiring registration of design

(1) Pressure equipment, other than pressure piping, and categorised as hazard level A, B, C or D according to the criteria in Section 2.1 of AS 4343:2014 (Pressure equipment - Hazard levels).
(2) Gas cylinders covered by Section 1 of AS 2030.1:2009 (Gas cylinders - General requirements).
(3) Tower cranes including self-erecting tower cranes.
(4) Lifts and escalators and moving walkways.
(5) Building maintenance units.
(6) Hoists with a platform movement exceeding 2.4 metres, designed to lift people.
(7) Work boxes designed to be suspended from cranes.
(8) [not used]

(8A) Passenger ropeways.

(9) Concrete placing booms.
(10) Prefabricated scaffolding.
(11) Boom-type elevating work platforms.
(12) Gantry cranes with a safe working load greater than 5 tonnes or bridge cranes with a safe working load of greater than 10 tonnes, and any gantry crane or bridge crane which is designed to handle molten metal or dangerous goods.
(13) Vehicle hoists.
(14) Mast climbing work platforms.
(15) Mobile cranes with a rated capacity of greater than 10 tonnes.

2. Exceptions

(1) The items of plant listed in clause 1 do not include -
a) a heritage boiler; or

(ab) any pressure equipment (other than a gas cylinder) excluded

b) from the scope of AS/NZS 1200:2015 (Pressure equipment).

or

Note for this paragraph: See paragraph A3 of Appendix A to AS/NZS 1200:2015.

(b) a crane or hoist that is manually powered; or

(ba) a reach stacker; or

(c) an elevating work platform that is a scissor lift or a vertically moving platform; or

(d) a tow truck.

(2) [not used]

Division 2 -Items of plant requiring registration

3. Items of plant requiring registration

(1) Boilers categorised as hazard level A, B or C according to criteria in Section 2.1 of AS 4343:2014 (Pressure equipment - Hazard levels).
(2) Pressure vessels categorised as hazard level A, B or C according to the criteria in Section 2.1 of AS 4343:2014 (Pressure equipment - Hazard levels), except -
    1) gas cylinders; and
    2) LP Gas fuel vessels for automotive use; and
    3) serially produced vessels.
(3) Tower cranes including self-erecting tower cranes.
(4) Lifts and escalators and moving walkways.
(5) Building maintenance units.
(6) [not used]
(7) Concrete placing booms.
(8) Mobile cranes with a rated capacity of greater than 10 tonnes.

4. Exceptions

(1) The items of plant listed in clause 3 do not include -
(a) any pressure equipment (other than a gas cylinder) excluded from the scope of AS/NZS 1200:2015 (Pressure equipment).

or

Note for this paragraph:

See paragraph A3 of Appendix A to ASINZS 1200:2015.

(b) a crane or hoist that is manually powered; or
(c) a reach stacker.
(2) [not used]

Division 4 - Duties of a person conducting a business or undertaking involving the management or control of plant

Subdivision 1 - Control measures for registered plant

235. Major inspection of registered mobile cranes and tower cranes

(IA) In this regulation -

major inspection means -

(a) an examination of all critical components of the crane, if necessary, by stripping down the crane and removing paint, grease and corrosion to allow a thorough examination of each critical component; and

(b) a check of the effective and safe operation of the crane.

(1B) In this regulation, a competent person is a person who -

(a) complies with both of the following -

(i) has acquired through training, qualification or experience the knowledge and skills to carry out a major inspection of the plant; and

(ii) is eligible for professional engineer membership of Engineers Australia.

or

(b) is determined by the regulator to be a competent person under the Work Health and Safety (General)

Regulations 2022 regulation 235(5) for the purposes of regulation 235(1 B)(b) of those regulations.

(1) This regulation applies to the person with management or control of a registered mobile crane or tower crane at a workplace.

(2) The person must ensure that a major inspection of the crane is carried out by, or under the supervision of, a competent person -

(a) at the end of the design life recommended by the manufacturer for the crane; or

(b) if there are no manufacturer's recommendations - in accordance with the recommendations of a competent person; or

(c) if it is not reasonably practicable to comply with paragraph (a) or (b) - every 10 years from the date that the crane was first commissioned or first registered, whichever occurred first.

Penalty for this sub regulation:

(a) for an individual, a fine of $4 200.

(b) for a body corporate, a fine of $21 000.

(3) A major inspection carried out under and in accordance with an equivalent provision of a corresponding WHS law is taken to be a major inspection for the purposes of this regulation.

236. Lifts

1) The person with management or control of a lift at a workplace (including a person with management or control of maintenance of a lift) must ensure that -
   (a) if there is a risk of a person falling down a lift well -
      (i) secure barriers are provided to prevent access to openings into the lift well by someone other than a person who is performing work in the lift well.
      and

(ii) secure working platforms or equivalent arrangements are provided for a person who is working in the lift well to prevent a fall from height.

and

(2) if there is a risk to a person working in a lift well from objects falling onto that person - a secure barrier is provided to prevent, so far as is reasonably practicable, falling objects from striking the person or otherwise causing a risk.

Penalty for this sub regulation:

(a) for an individual, a fine of $4 200.
(b) for a body corporate, a fine of $21000.

(1) The person must ensure that there is a safe means of entry to and exit from the base of the lift well.

Penalty for this sub regulation:

(a) for an individual, a fine of $4 200.
(b) for a body corporate, a fine of $21000.

3) The person must ensure that there is fixed, in a prominent place in the lift, a sign that states the safe working load specified in the design of the lift.

Penalty for this sub regulation:

(a) for an individual, a fine of $4 200.
(b) for a body corporate, a fine of $21000.

249. Who can apply to register a plant design

(1) A person conducting a business or undertaking that designs an item of plant may apply to the regulator under the Work Health and Safety (General) Regulations 2022 regulation 250 for the registration of the design of that item of plant.
(2) A person with management or control of an item of plant may apply to the regulator under the Work Health and Safety (General) Regulations 2022 regulation 250 for the registration of the design of that item of plant.

The IESL WA ENGINEERS NIGHT has been held on 27 AUGUST 2022 at Serbian Community Centre Kenwick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