



Computerized Fault Tree Analysis Development for Distillation Unit in Refinery Plant

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Nur Suhaili Fitri Bt Ibrahim
Specialist (Fractionation)
Malaysian Refining Company Sdn. Bhd.

Presentation Outline

- 01 Melaka Refinery Overview
- 02 Introduction of Fault Tree Analysis (FTA) in Dynamic Risk Analysis (DRA) software
- 03 FTA Development Timeline
- 04 FTA Workprocess
- 05 Distillation Unit Case Study
- 06 Conclusion





Melaka Refinery
Overview

Welcome to Melaka Refinery
Company Overview

Melaka Refinery Corporate Video



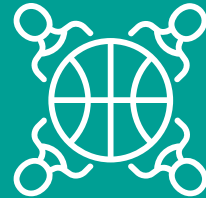
DRA

Dynamic Risk Assessment



Solutions

- **Identifies anomalies or deviations** against normal operation range
- **Providing operators ample time** to act and prevent further escalation



Limitation

DOES NOT diagnose ongoing issues and its probable causes.

FTA

Fault Tree Analysis



Solutions

- **Provide prescriptive insights** on live plant issues.
- **Specific module** embedded in **warning system by DRA**



Advantage

- **Real time** risk assessment
- **Perform diagnostics** function and serve as an **online troubleshooting** for plant operator
- **Better plant trip prediction**

Fault Tree Analysis (FTA) was developed as an enhancement feature to provide insights on the potential implications of anomalies detected by DRA

REACTIVE

PREDICTIVE

PRESCRIPTIVE



Shutdown

Major Event
(e.g equipment
damage, trip,
low yield, ULPO)

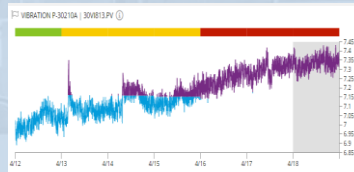
Incident

Alarms

Anomaly in process
data

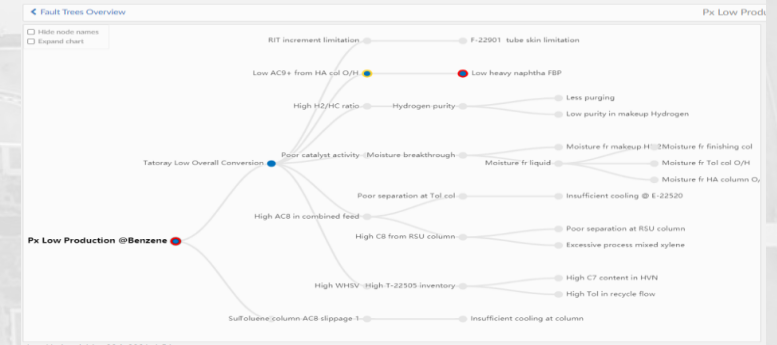
Hidden information and near misses
detected via DRA algorithms

Initiation
Phase



Prescriptive Diagnostics via Fault Tree Analysis

Provide complete overview from root causes to the next potential threats which prompt for immediate intervention before it reaches to a major top event



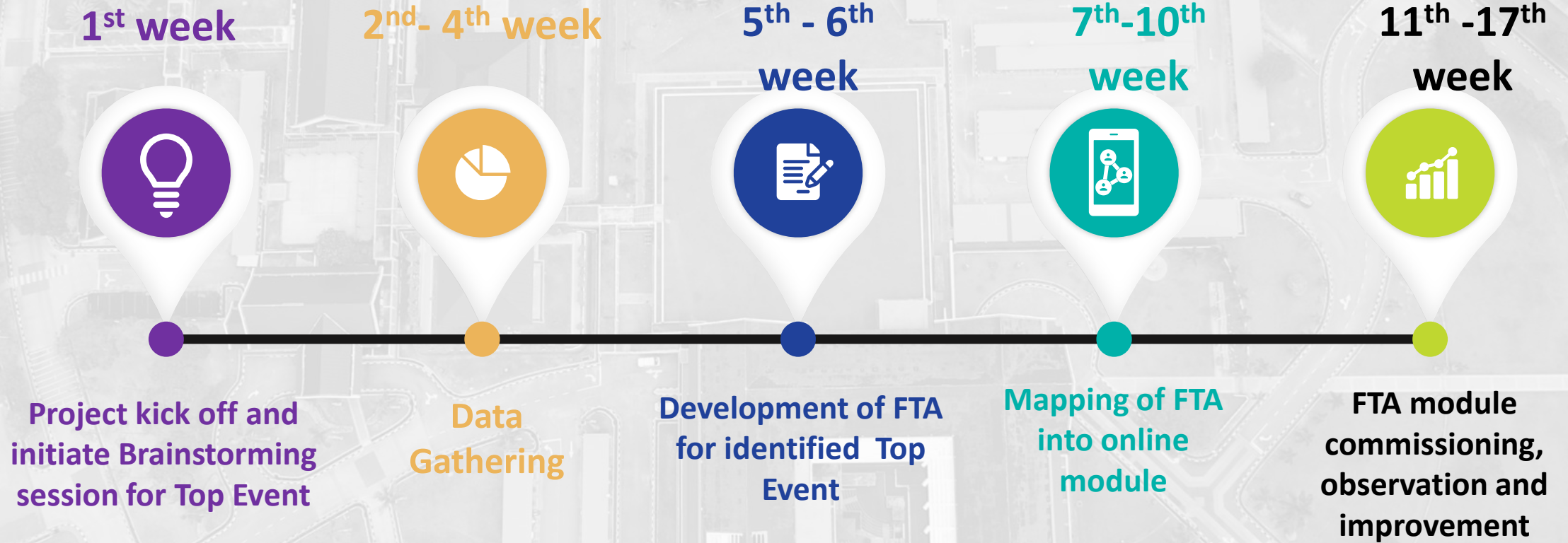
Embedded Fault Tree in DRA



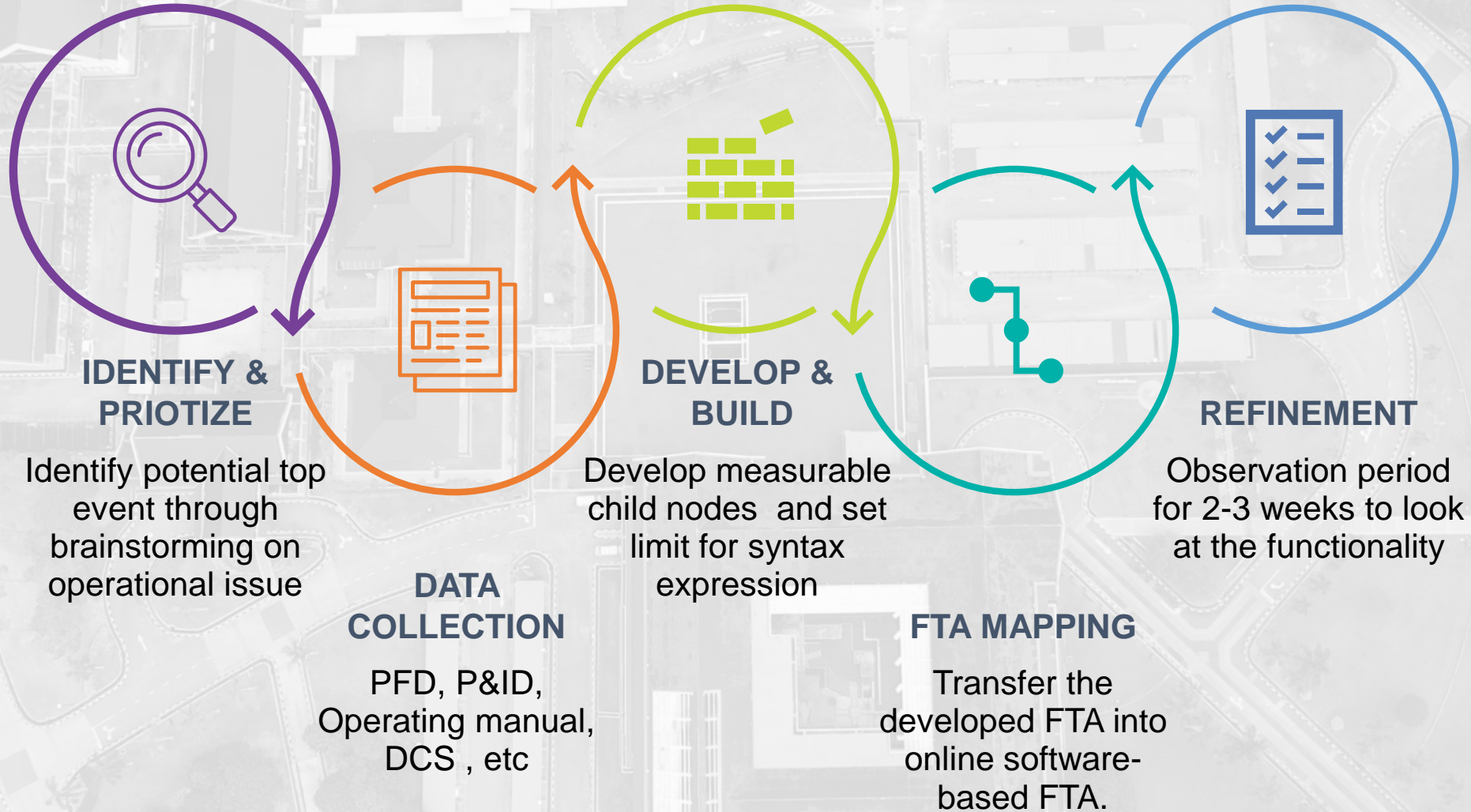
Institutionalise Knowledge

DRA works in predictive mode where it drills down to specific PI tags and identifies the hidden near misses that may lead to top events e.g, equipment damage, unit trips, lower product yield, ULPO, etc.

FTA Development Timeline



FTA Workprocess



Top event risk ranking criterion



Contribute highest Cost of Unreliability (CoUR) or Loss Profit Opportunity (LPO)



Process Related incidents



Issues may jeopardize upstream unit or other downstream units



Process safety related



Repetitive incidents or issues

Top Event	1 Value Creation (Highest CoUR, ULPO)	2 (Process Related incidents)	3 (Jeopardize other unit)	4 (issue Developed by time)	5 (PSM related)	6 (Issues reoccurrence/ repetitive)
.PG Offspec at U26 LTU (C5 C6)	●	●	●	●	●	●
.PG Offspec at U26 LTU (Caustic carryover)	●	●	●	●	●	●
.PG Offspec at U26 LTU (Sulphur)	●	●	●	●	●	●
CDU-2 TPA Integrity Operating Window IOW)	●	●	●	●	●	●
Amine foaming at U24 (C-05)	●	●	●	●	●	●
High RVP in iC5	●	●	●	●	●	●
F-02 & F-52 excess O2*	●	●	●	●	●	●
High salt content in desalted crude	●	●	●	●	●	●

Brainstorm session on potential top events for Distillation

By Equipment

- Pre-heat Train
- Heaters
- Pumparound
- Distillation Columns

By Performance

- Yield
- Energy
- Product Specification

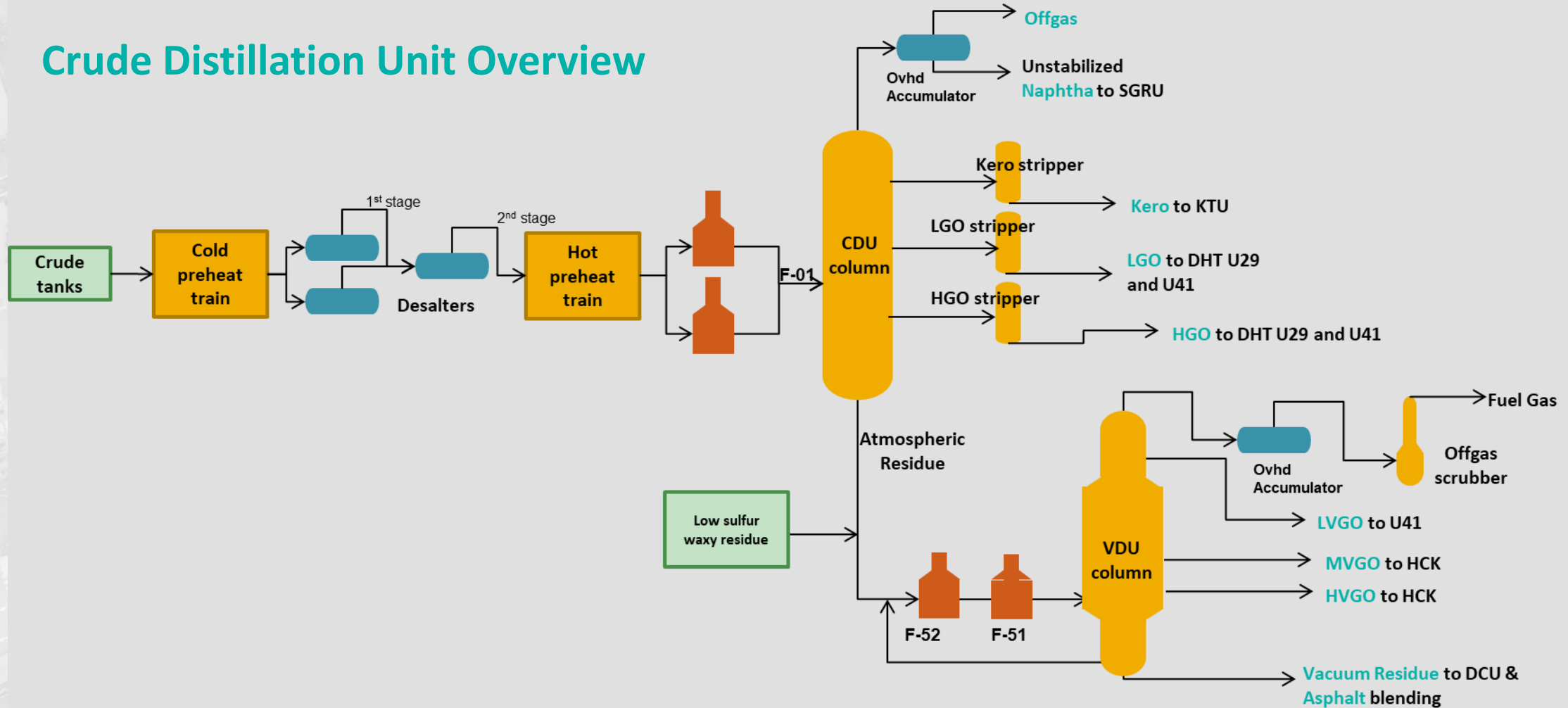
By Issues

- Corrosion / fouling / foaming
- Hot spots

The Top Events Brainstorming Session essentially requires strong collaboration between the SMEs, i.e. Technical Professionals, Operation Engineer, Operation Specialist, and Panelman.



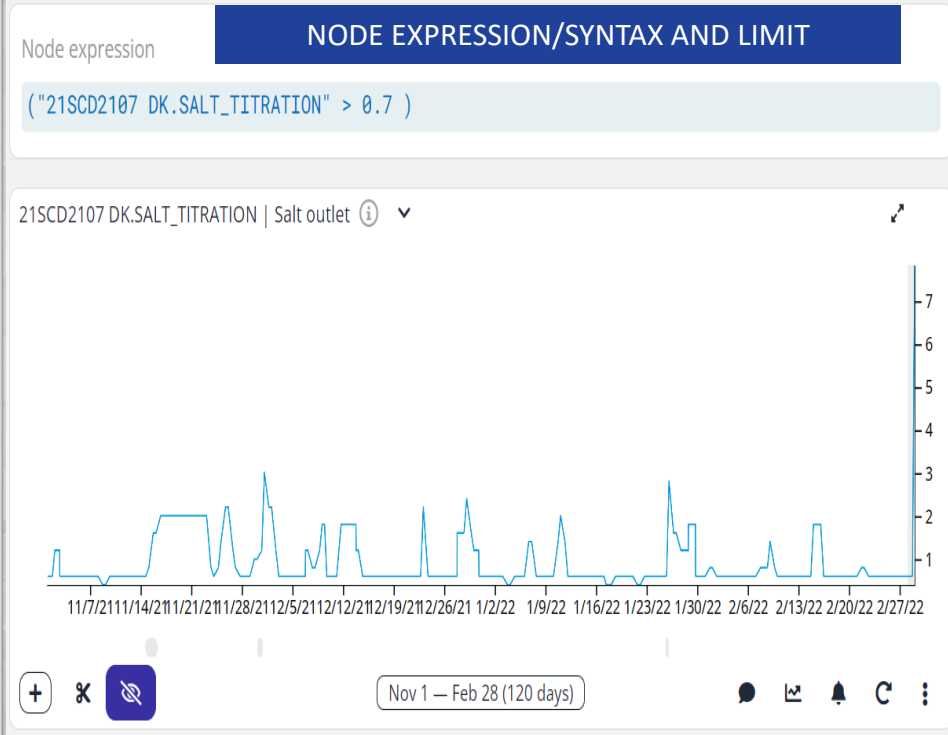
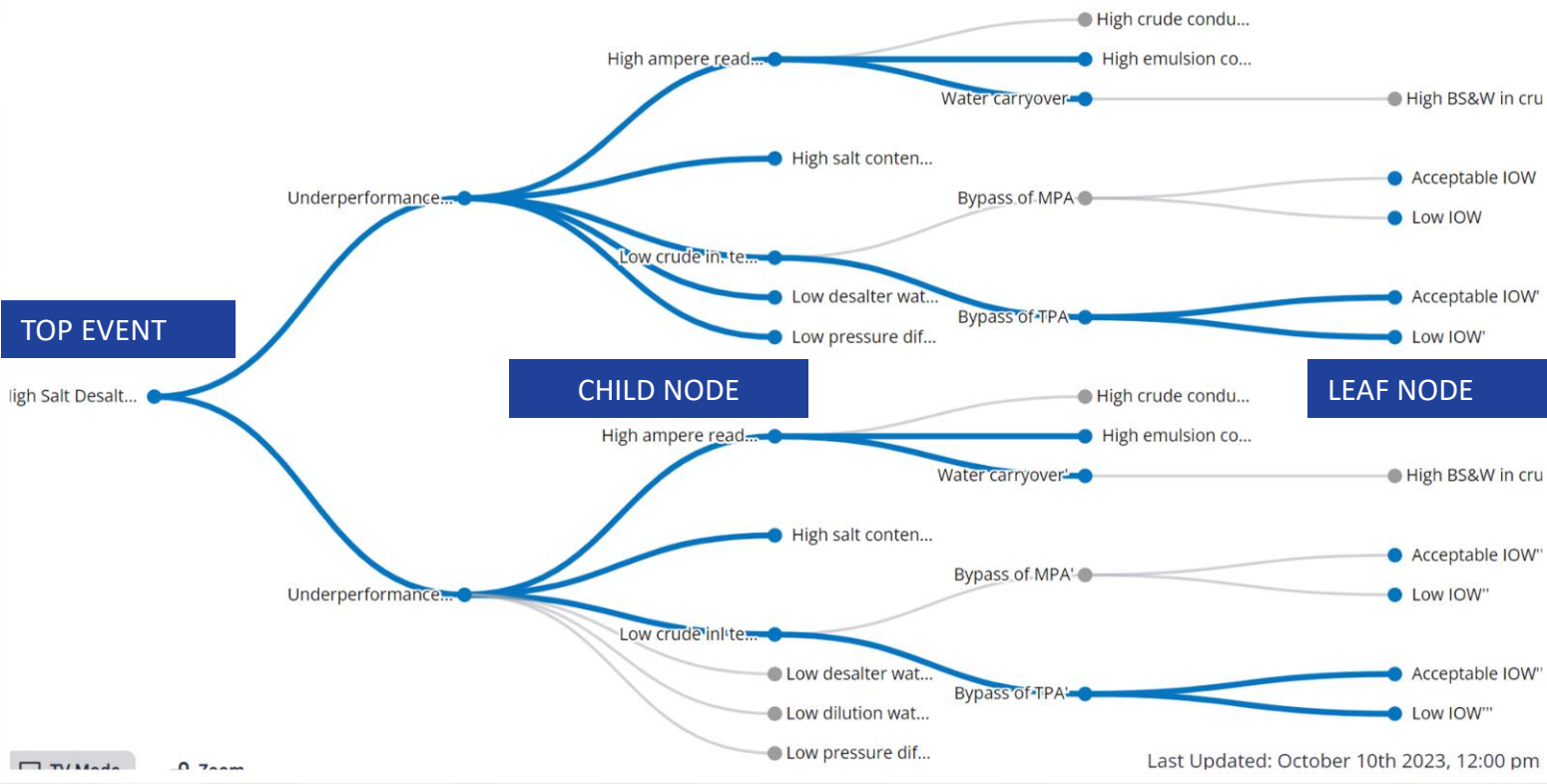
Crude Distillation Unit Overview



SUCCESS STORY – FTA detected occurrence high salt in desalted crude with identified potential causes via nodes activation and anomaly detection

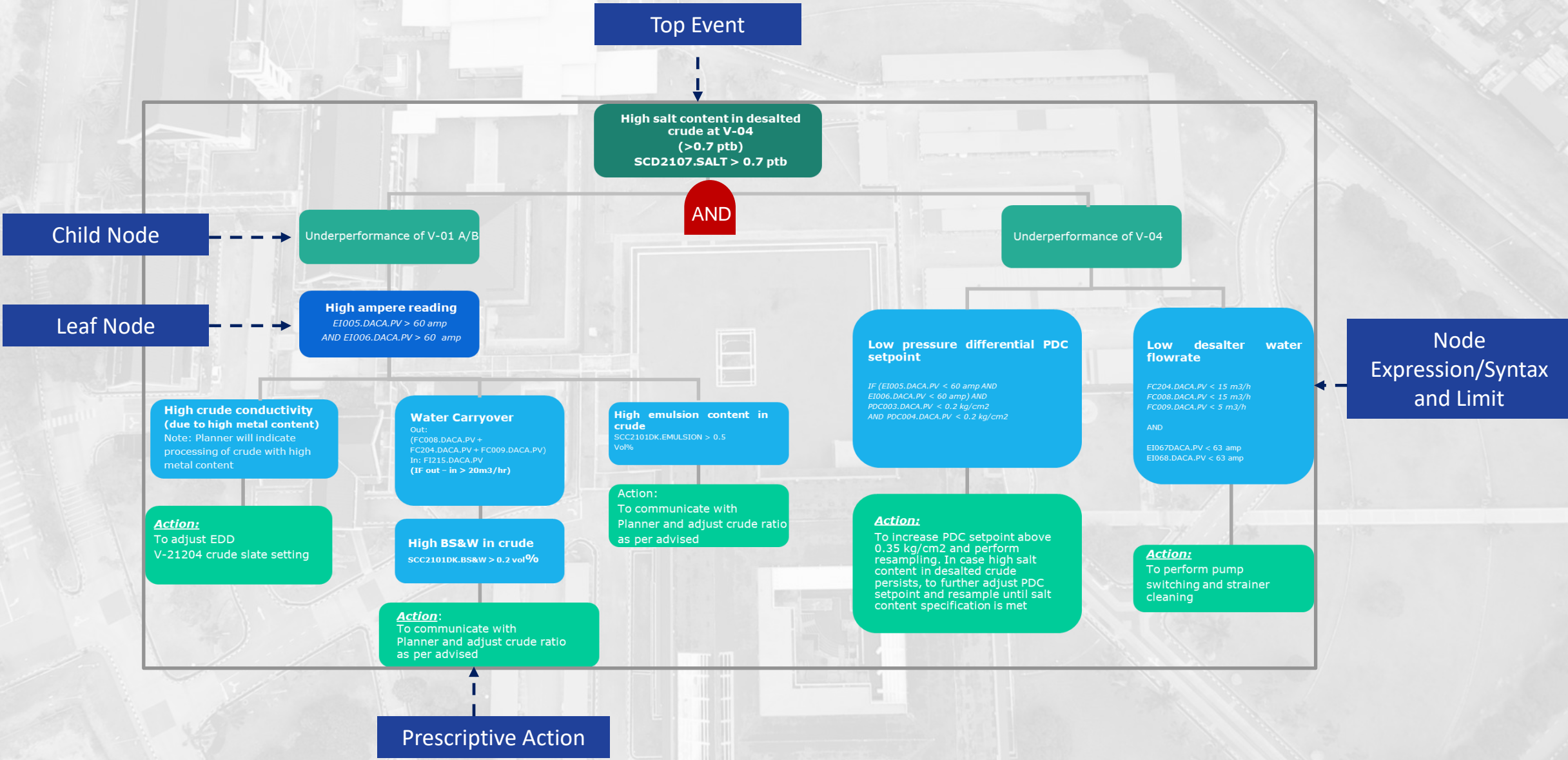
Top Event #1: High salt outlet Desalter V-04

TE#2 High Salt Desalted Crude



- **High salt content** in desalted crude at V-04 **triggered**
- **Activation of leaf nodes** has shown the link of how the **issues escalated further to upper child nodes** and ultimately **triggered the top event of 'High Salt content in desalted crude at V-04'**

Fault Tree Analysis of Top Event #1



Fault Tree Analysis Refinement Process



1. **Modified** from 'OR' to 'AND' to reflect the impact of both TPA and MPA bypass opening which result in lower desalter temperature
2. The **prescribed action is changed** to meet the above condition 1.

Daily Shift Handover meeting is a platform where Shift Operator, Panel Man and Operation Specialist discussed on the prescribed action in the event of FTA occurrence.



Shift operator and Operation Specialist receive notification on anomaly detection of Top Event



Daily shift meeting is used as a platform to discuss on the Top Event Occurrence



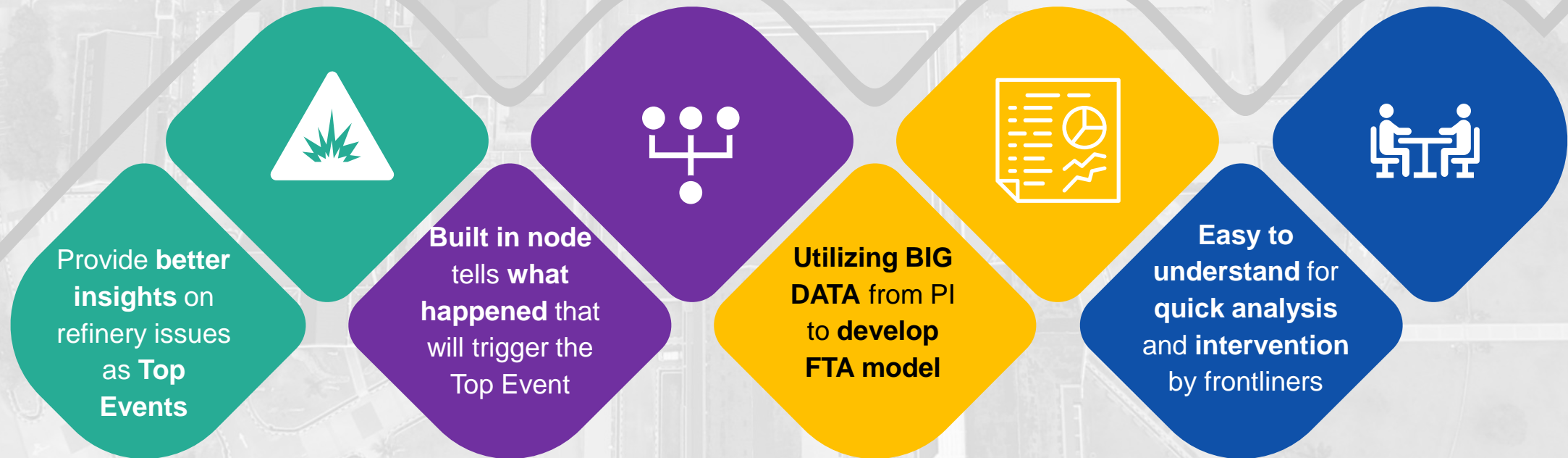
FTA module in DRA is referred specifically on the selected Top Event and review the triggered child/leaf node



Panelman will act accordingly to bring down the risk of top event exposure as prescribed in the FTA

Conclusion

Moving from predictive to Prescriptive mode utilizing FTA is a new direction for Melaka Refinery to reduce Cost of Unreliability (CoUR) and Loss Profit Opportunity (LPO)



An aerial photograph of a university campus, showing various buildings, parking lots, and green spaces. The image is rendered in a light, monochromatic style. Overlaid in the center is the text "THANK YOU" in a bold, teal-colored font.

THANK YOU