



How can implementing the VTEP strategy improve turnaround planning?

MAJOR PROJECT – PSDM6019
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Acknowledgments

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Summary

The following paper has been used to discuss the research that has been carried out with regards to turnaround planning within the petrochemical industry. The aim and objective of the paper is to identify “How can implementing the VTEP strategy improve turnaround planning?”.

The VTEP (Valero Turnaround Excellence Program) is a corporate driven planning tool used by the Valero corporation. With the Valero corporation being such a large organisation operating 15 petrochemical refineries, it was key to the business to develop a tool that would make their turnarounds competitive against rival companies. VTEP was first introduced into the Valero organisation in 2010 and the Pembroke Refinery was bought by Valero in 2011. VTEP has gone through many developments over the years and has now evolved into a full turnaround planning and execution tool.

The operational strategy and management of VTEP is broken down into 5 phases, alignment, definition, detailed planning, pre-turnaround & execution and finally, post turnaround. Each of these individual phases have their own milestones that must be achieved to make the turnaround planning a success.

A case study has been used as a research project and trial of the VTEP tool in preparation for its first major turnaround event that is being planned for the £140MM Cracking and Olefins 2021 TAR. The trial event selected was the £1MM HTU-2 catalyst change TAR that is classed as a relatively small event. In order to ensure that the event was a success, even if the VTEP tool failed, a strategy was selected to double up on the planning effort and continue to plan the event in the same way as it has always been done using the sites V-Drive data base for planning file storage.

In conclusion of the paper, the VTEP tool has been deemed successful in planning and delivering a relatively small and simple catalyst change TAR. Although it has been successful for the HTU-2 event there have been recommendations made to improve the tool ready for the C&O event. In addition to the trial event, another success factor for VTEP has been the report produced by AP Networks identifying Valero as above industry standard for their readiness in TAR preparations, resulting from using the VTEP planning tool.

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Nomenclature

TAR	Turnaround
TAM	Turnaround Maintenance
FCCU	Fluid Catalytic Cracking Unit
HTU	Hydra Treater Unit
C & O	Cracking and Olefins
VTEP	Valero Turnaround Excellence Program
AP	Asset Performance
TINC	Turnaround Industry Network Conference
RBWS	Risk Based Work Selection
WSE	Written Schemes of Examination
PSSR	Pressure Systems Safety Regulations
CTEMS	Commitment to Excellence management System
SAP	System Applications and Products
SME	Subject Matter Expert
LPG	Liquefied Petroleum Gas
SAHQ	San Antonio Head Quarters
IT	Information Technology
PDEP	Project Development Excellence Program
COMAH	Control of Major Accident Hazards
BCR	Benefit Cost Ratio
iTAP	Integrated Turnaround Assist Program

Introduction

The following paper has been developed from an initial research question, 'does a corporately driven turnaround planning strategy work?' (Shiels, 2019). A literature review and further research has developed the original question into a viable project, to see how the corporate strategy of planning turnarounds using the VTEP tool, could improve turnaround planning.

To begin the paper, an overview of the Valero organisation is provided to give an understanding of the size of the organisation and the fields the business operates in. This overview then leads into an extended literature review gathering background information with regards to turnarounds, performance benchmarking, turnaround strategies and an insight into the operational management of the VTEP tool.

The following section of the paper focuses on the project of introducing the VTEP tool into turnaround planning. The focus of this project is the trial introduction of the tool into the HTU-2 plant during the February 2020 maintenance event. The overall implementation of the VTEP project will be executed leading up to the C&O 2021 turnaround.

Further detailed discussion will be taken into the VTEP planning tool and project plan produced for implementing the tool in the Valero Pembroke refineries turnaround events. Cost estimates and contingency planning are also reviewed, before finally reviewing the planning strategies available and the strategy that has been selected for the turnaround project.

The paper then goes into the detail of the VTEP tool and how the different elements of the tool can aid the improvement of planning turnarounds in this way with a corporately driven strategy. Elements such as scope selection, risk-based work selection, scope freeze, job planning, and the process of additional work requests are all discussed.

Before concluding on the paper, evolution of the HTU-2 event will be discussed to determine the results of trailing the VTEP tool. Following the conclusion of the paper, recommendations will be made for improvements to VTEP ready for the 2021 C&O TAR.

1.0 Valero Energy Corporation

Valero Energy Corporation is one of the leading international manufacturers of transportation fuels and petrochemical products (Corporation, 2019). The company Valero was formed on the 1st of January 1980, which was a result of legal settlement by the Texas Railroad Commission for \$1.6 Billion. This ended a long litigation battle brought by the municipal gas customers in 1978.

The Valero Corporation is a fortune 50 company employing circa 10 thousand employees across its 15 petroleum refineries, 11 ethanol plants, wind farms and fuel stations. With Valero's vast number of refineries, they are capable of a refining throughput of circa 3.1 million barrels of oils per day. This makes the Valero Corporation one of the largest independent refiners in the industry.

Valero's main focus of business lies within the United States of America. They also have strategically placed refineries and fuel terminals situated in Quebec (Canada), Ireland and the UK. The map shown here in figure 1 identifies all of Valero's assets that are controlled from the corporate head office in San Antonio Texas.

Figure 1 – Map of Valero Corporation



(Corporation, 2019)

To market Valero's products, Valero own more than 7500 fuel outlets that carry the Valero, Diamond & Shamrock, Shamrock and beacon brands in the United States and the Caribbean, Ultramar in Canada and the Texaco brand in the United Kingdom and Ireland.

To ensure safe and economically viable operation of Valero's refineries, maintenance TARs occur every 3, 4, 6 or in some cases every 10 years to ensure equipment availability and high-end performance. These TARs can cost the organisation anywhere from \$1,000,000 for a small event, to \$100,000,000 and upwards for the larger scale events. These excessive costs and complexity of work scope can generate significant focus from the corporate head offices.

The Valero Energy Corporation purchased the Pembroke Refinery in 2011, which opened the gateway for Valero to operate in the European refining market (Refinery, 2019). The Pembroke Refinery first opened its gates in 1964 and is now one of the largest and most complex refineries in the whole of Western Europe. The outputs from Pembroke's refining process include products such as, diesel, gasoline, kerosene, ethanol, (LPG) liquefied petroleum gas and other associated petrochemical feedstocks.

Pembroke Refinery Facts (Refinery, 2019)

- *Built in 1964 as a hydro skimmer, with cat-cracking capacity added in 1982*
- *Occupies approximately 450 acres of a 1,275-acre site on the southern shore of the Milford Haven Waterway in Pembrokeshire, Wales*
- *Deep-water port and docks with capacity to handle very large ships, without reliance on third-party terminals or pipelines*
- *Total throughput capacity of 270,000 barrels per day, including 220,000 barrels per day of crude oil, plus 50,000 barrels per day of other feedstocks*
- *Approximately 10.5 million barrels of storage, about half used for feedstocks*
- *Large FCC and alkylation units providing significant volumetric production gains*
- *Nelson complexity rating of 11.6 ranking among the top refineries in Western Europe*
- *Refinery scale, flexibility, location and logistical advantages enhancing Valero's optimization and trading strategy in the Atlantic Basin*
- *50th anniversary of the refinery celebrated in 2014 by a visit from Their Royal Highness The Duke and Duchess of Cambridge*

2.0 Literature Review

The first element to the literature will look at the turnaround maintenance philosophy and the operating strategy taken within manufacturing industries such as the oils and gas sector. Operational strategies are key for any manufacturing business that operates their business on a 24hr cycle. The most important operation strategy to get right is that of maintenance and turnaround maintenance, where work can only be carried out when the equipment or unit is fully out of operation.

Turnaround Maintenance (PD, 2015) is a scheduled and periodic shutdown, that can be a total or partial shutdown of an operating plant during the turnaround maintenance work. The TAM or TAR (Turnaround Maintenance) performs maintenance activities such as cleaning, inspection, repair, and the replacement of damaged or faulty equipment. These maintenance turnarounds take place in continuous processing and production facilities such as refineries, petrochemical plants and power plants. (Al-Turki, 2019) Also refers to turnarounds as shutdowns, maintenance squats, unit outages or swoop downs.

(Wenchi, 2015) Identifies turnarounds (TAR) as significant events that handle inspections and repairs. These events can be depicted by local government legislations to ensure safe and controlled operating practices are maintained through an operating plants life cycle. The TAR events are used for cleansing of process equipment that have been constraining process throughput, to an as new condition and restoring known faults and unreliable equipment that can only be worked upon when the operating plant is fully offline.

At Valero Pembroke Refinery, small to large TAR events are planned through the turnaround team. The TAR team are managed through the manager of turnarounds who takes direction from the corporate executives from the Valero head office in San Antonio. The corporate strategy of planning TAR events at Valero is progressively being managed through the “Valero Turnaround Excellence Programme” (VTEP) across all the facilities within the corporation.

2.1 TAR Strategy

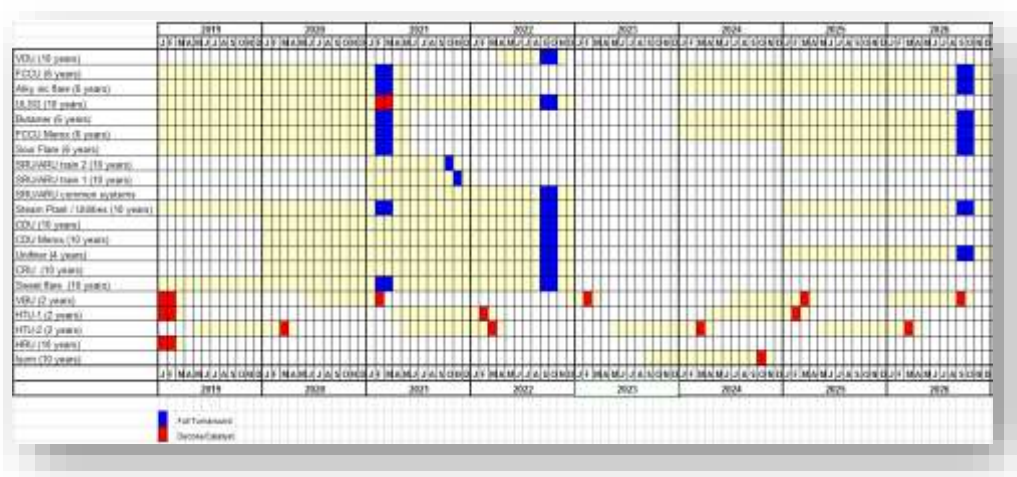
Turnaround strategies can differ across industry, refineries and processing facilities.

However, the focus on a TAR remains one of the most important strategies an organisation can have to ensure that the operating plant is reliable, equipment availability is maximised and also the equipment integrity is maintained (Hameed & Khan, 2014). For any refinery or process facility, the main aim is to keep the unit operating reliably, safely and with high volumes of equipment availability, to maximise production and sales. The strategy in correctly predicting the turnaround intervals, where the unit will be fully offline for maintenance, can be difficult to manage. Therefore, selecting the correct TAR strategy for the business remains a major goal.

2.2 Turnaround Intervals

As with a TAR strategy, TAR intervals also differ across organisation to organisation. Industry research shows that TAR intervals are typically every 4 years for power plants and every 2 years for petrochemical plants and oil refineries, which have been in continuous service (Hameed & Khan, 2014). Contradictorily to industry research, the Valero organisation operate their TAR intervals in a different approach. Large processing units are run on TAR intervals of 6 to 10 years with smaller units being every 2 years if they can be taken offline independently. Smaller catalyst change TAR intervals will take place annually, these events occur when only small elements of the processing unit are taken offline for TAR maintenance. Figure 3 below is a typical TAR strategy plan from Valero Pembroke Refinery.

Figure 2 - Valero Pembroke TAR Interval Strategy



(Bujega, 2019)

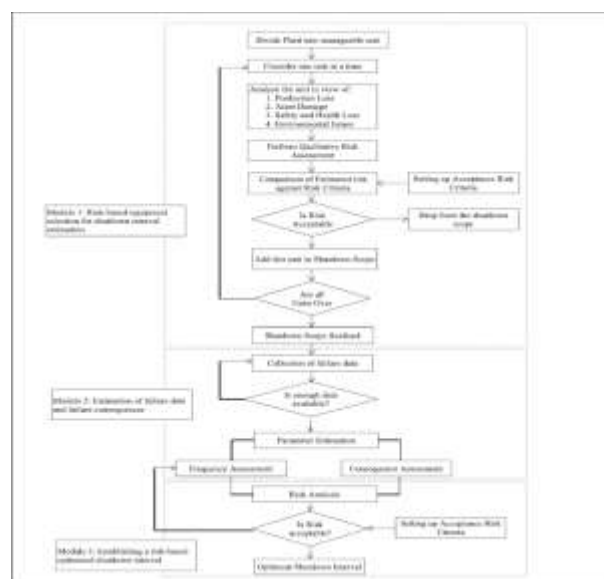
It is vitally important to create the interval settings correctly, as if the incorrect method is selected this can have a major impact of the operational unit or facility. These interval settings can be done in many ways, (Elfeituri, 2007) discusses four different ways to correctly select and predict the turnaround intervals.

1. Review of historical operating conditions and the site run time duty and rate data
2. Experience of subject matter experts (SME) along with the maximum in service intervals as set out by the SMEs
3. Inspection history records of defects associated to specific equipment
4. Risk based inspection methods, where information has been collated at the last turnaround event.

A further method is also used by Valero, where all the refineries within the corporation record process unit information with regards corrosion, run life and failures etc. By recording this information, it allows any refinery in the corporation to see how other units have been performing and identifying the work scope that gets carried out during a turnaround. Doing this gives a good understanding of what the right scope will be and at what interval the equipment or unit should be taken out of service for repair/overhaul.

In addition to the methods discussed above, (Hameed & Khan, 2014) uses a risk-based interval setting model which uses site knowledge and experience. An example of this risk-based interval setting can be seen here in the flow chart in figure 3.

Figure 3 - Risk Based Shutdown Interval



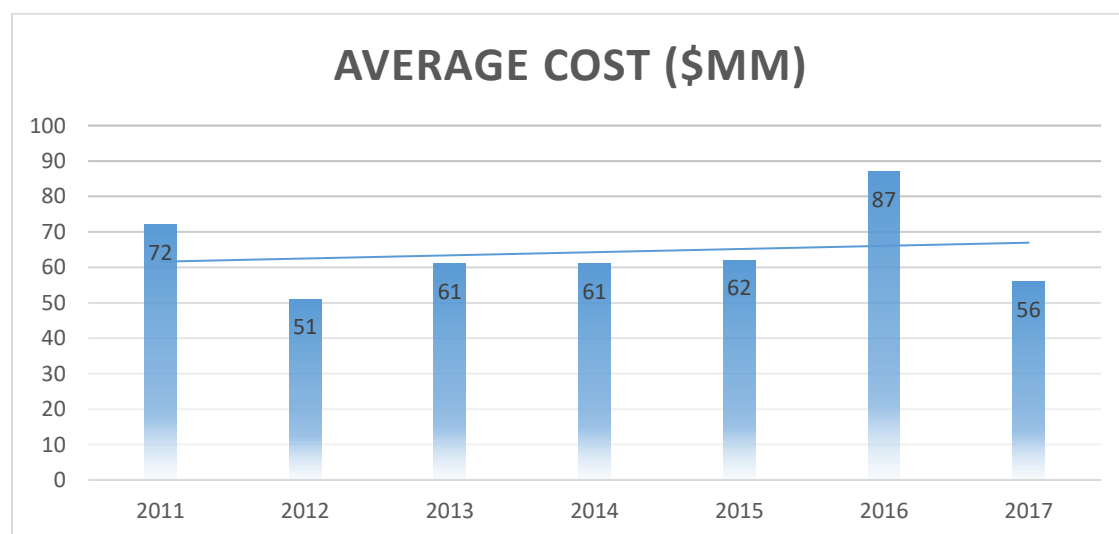
(Hameed & Khan, 2014)

At the Valero Pembroke Refinery, TAR intervals are ultimately split across the two business units, Refining process area and the Cracking and Olefins process area. The Refining process area is typically fully shutdown every ten years where the Cracking and Olefins process area is fully shutdown every six years. These intervals are set using the methods as discussed on the previous page. With the lost profit of a full unit shutdown costing the business approximately \$1,000,000.00 a day, it is critical to the business to ensure the turnaround intervals are set to get the maximum run life out of the equipment and also, when the unit is off line it is for the minimal time only. Valero as a corporation have recognised that turnarounds are an integral part to the business and must be planned and managed correctly. Therefore, over several years the Valero head office team have been developing the Valero Turnaround Excellence Program (VTEP) to ensure all possible factors are considered when selecting TAR intervals and strategy. The VTEP will be discussed in further detail throughout the paper.

2.3 Benchmarking

Benchmarking is a good method for organisations to see how well or how poorly they are performing against their competitors. This will give an organisation a gut feel on how well they are approaching the planning and execution of their turnaround events. However, gathering cost information from competitors is not something that is readily available. As you can see here in figure 4, Valero's average cost of expenditure has been significant since taking over the Pembroke Refinery and is also continuing to climb.

Figure 4 - Valero TAR Cost Profile



(Valero Corporate Office, 2018)

In order to gather the required data to complete the benchmarking process, organisations use industry recognised consultants to use and share their performance in an anonymous way. The consultants use the collated data to build a portfolio of each company using quantitative and qualitative research. The consultants used by Valero and many other refining companies to identify how well or how poorly their organisation is performing in industry is AP Networks. AP Networks is a trusted leader for improving asset and operational performance in petroleum, chemical, and energy companies worldwide (Networks, 2019). AP Network's work closely with their clients to help them achieve safe, competitive and predictable outcomes going into their high-risk events such as turnarounds. To help their clients, AP Networks benchmark each company on their readiness for an event and the cost effectiveness to see how competitive the companies are against their competitors. Figure 5 identifies 23 companies and their cost effectiveness rating; Valero is depicted by company 'J' and can be seen to be almost reaching the top quartile meaning that Valero are operating at a very good standard.

Figure 5 - Industry TAR performance



(AP Networks, 2018)

The graph in figure 5 is showing that company 'EE' is the most competitive when it comes to the cost of their turnarounds, whereas company 'F' is the least competitive. Valero are

reasonably competitive, however there is room for improvement, this is where the VTEP tool could be effective.

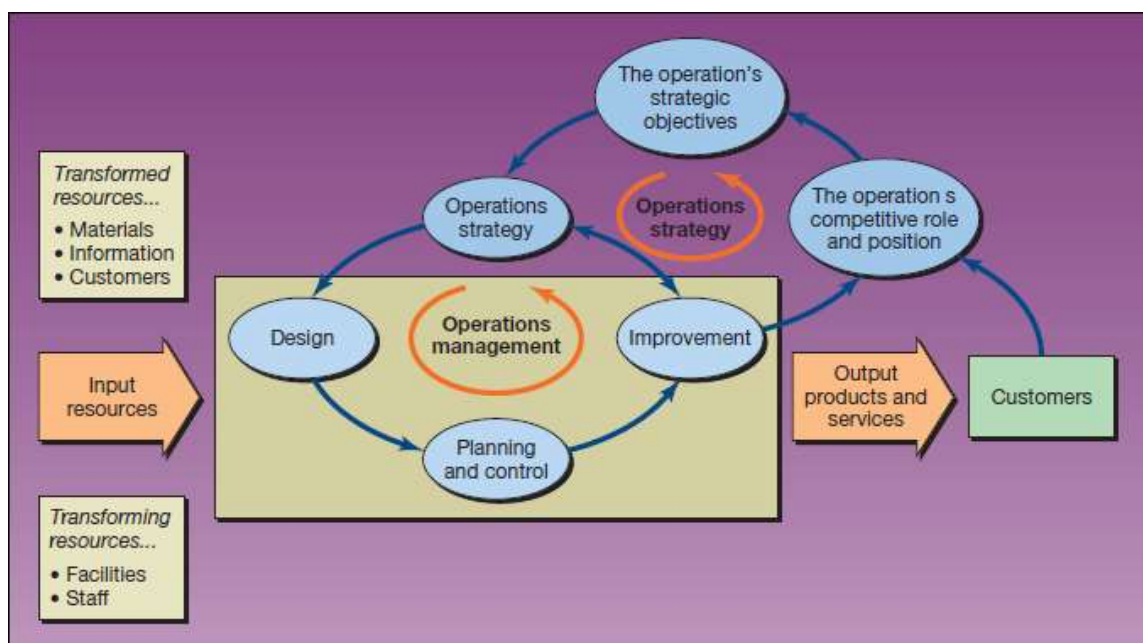
Further tools and consultants are used across industry to try help an organisation lead the way in how they operate their business and turnarounds, to make them leading and profitable marketer. An additional independent company that records further quantitative and qualitative data is the Solomon Index. The Solomon index is also a data gathering tool used across the oil and gas sector. The difference between Solomon and AP Networks is that Solomon investigates more aspects of the business not just turnarounds specifically. The method used by Solomon Index is to collate refinery data and normalise it across the many different operating sites across the globe, which ultimately results in a benchmarking tool to show an organisation their current standing against their peers. (Associates, 2019)

3.0 Operational VTEP Management

The VTEP tool was ultimately designed and introduced by the Valero Corporate office in San Antonio to gain alignment across its many sites with regards their turnaround expectations and objectives. This alignment was used to ensure all key milestones were consistent across the different sites no matter what the turnaround scope or activities were. This allowed the San Antonio headquarters to control turnaround spend more efficiently and also introduce the integration of capitol spend projects into the turnaround scope. Scope introduction into the turnaround also changed with the VTEP tool, where risk-based work selection (RBWS) were used, further information on this element of the VTEP tool will be discussed further in the paper.

Valero Pembroke Refinery use the same corporate driven turnaround strategy as all of the other refineries within the corporation. This strategy (VTEP) is similar to the operational management strategy as depicted by (Nigel Slack, 2004), determining the inputs and outputs required from the process. As shown below, figure 6 clearly identifies two different routes of operational strategy, (1) Operations Management and (2) Operations Strategy.

Figure 6 - Operational Strategy



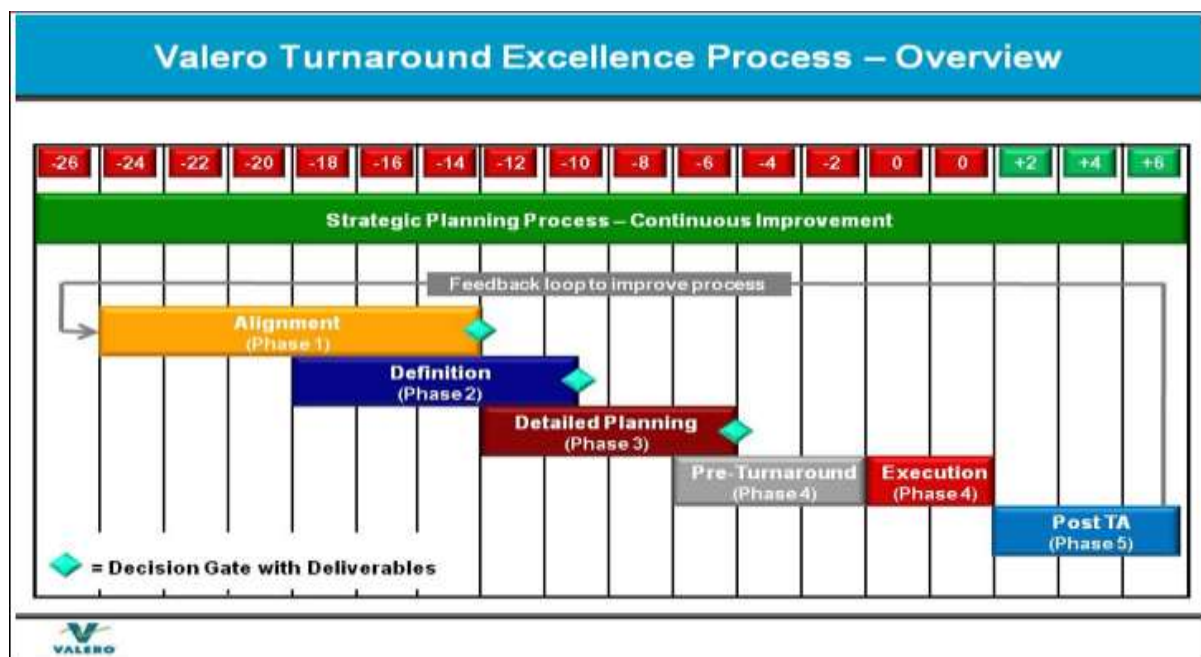
(Nigel Slack, 2004)

The Valero Turnaround Excellence Program (VTEP) is consistent in the way that the operational management strategy is put together. At the input stage Valero uses its own

resources to produce its strategic planning system for turnarounds. This system (VTEP) is heavily reliant on a computer-based system to develop and build the software required. This is not an issue for Valero as there is a large IT infrastructure based in San Antonio to run all its facilities across the globe. Therefore, the Valero staff within SAHQ are used to develop the platform of the design. As shown in figure 6, the “input” is the “resource” element of the strategy. To start the operations strategy, Valero would use the resources from all of the refineries to help in building the platform for the VTEP tool. Turnaround knowledge and experience would be used to determine how the tool should look, feel and work, to ultimately reach the end goal of successfully planning and executing turnarounds within the organisation.

The VTEP process is split into 5 different phases, which define the key objectives/milestones, planning activities and deliverables for each phase during planning a turnaround event. Figure 7 shows the corporate vision of how the different phase align during the process.

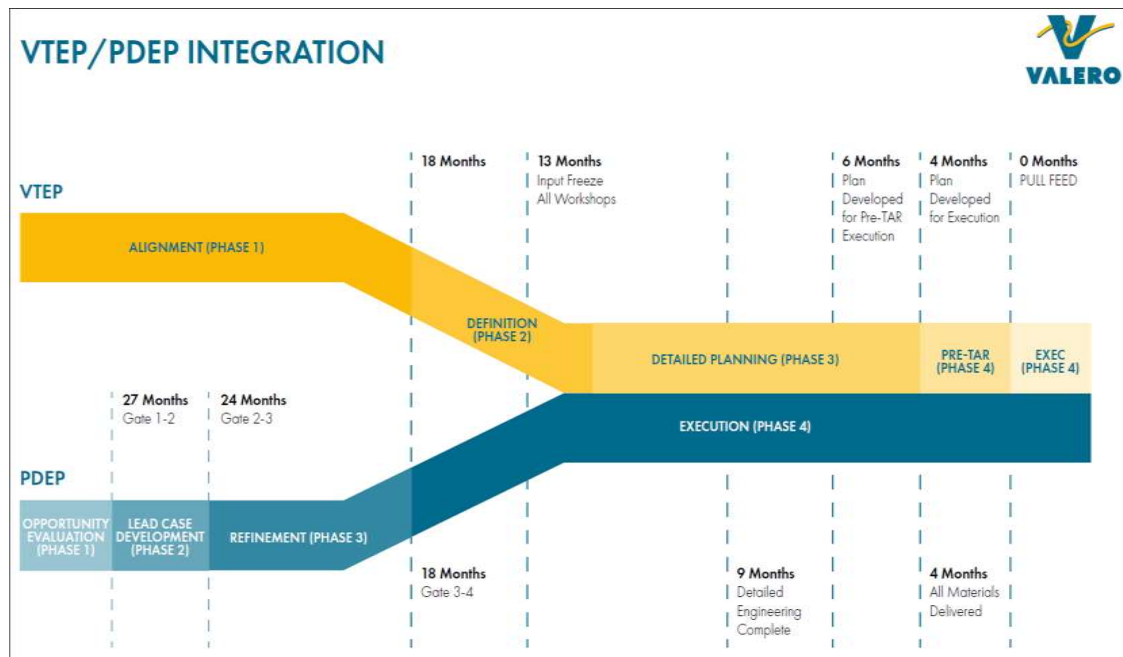
Figure 7 - Valero Turnaround Excellence Program Process



(Valero Energy Corporation, 2018)

To further align turnarounds and projects, the VTEP phases have also been aligned with the Project Development Excellence Program (PDEP) which is used by the capital project engineering group. These phases are both aligned with key milestone dates leading up to the start date of the turnaround event, as shown here in figure 8 and appendix 1.

Figure 8 - VTEP/PDEP Integration



(Valero Corporate Office , 2019)

The following sections, will give the detail on what each phase of the VTEP process is required to successful plan and execute a turnaround.

3.1 Phase 1 – Alignment

The alignment phase of VTEP is where both sides of the business, corporate and site-based personnel discuss the turnaround objectives till all agree. The key personnel include the refinery directors/leadership team and corporate managers from SAHQ. The alignment discussions would be catered around the drivers and the background of the requirement of the turnaround event. To ensure alignment is achieved, the alignment group is usually kept to a small group to ensure refinery objectives and strategy are understood by all involved, in preparation for planning to execute the event.

3.2 Phase 2 – Definition

Within the definition phase, the aim is to establish all of the required scope for the event. This will enable all major scope to be evaluated with the ultimate aim of finally freezing scope development for the event. Within this phase, critical path activities are identified. This enables contractor selection dependant on their experience and knowledge of the critical activities from previous events. The scope developed from the definition phase must be strictly interrogated by the turnaround team. This is to ensure that the scope added to the event is strictly turnaround related and not just nice to have, which could ultimately be carried out during routine on the run plant maintenance. The reason why the turnaround interrogation must take place, is because each discipline such as Health and Safety, Operations, Process, Inspection, Reliability and Maintenance all carry out a discipline review and pull together a list of work they would like executing in the event. The output from the discipline reviews also include regulatory items from the Pressure Systems Safety Regulations (PSSR), inspections Written Schemes of Examination (WSE), removal of temporary repairs such as clamps and raps, maintenance repair work orders that can only be carried out when the plant is offline, process vessel and exchanger cleaning to improve throughput and capacity, process catalyst replacement, capitol project integration and finally critical turnaround checks to meet Valero's Commitment to Excellence Management System (CTEMS).

The final list of work from the output of the discipline review is finally reviewed separately by the turnaround team leaders. All items identified applicable to WSE, PSSR or CTEM standards are pushed through into the event for VTEP detailed planning. All remaining items should just be for repair work and cleaning activities. These remaining items will also go into the VTEP event, but will go through a further review stage of Risk Based Work Selection (RBWS). The RBWS is a process to further define, evaluate and justify the scope to be added into the event for planning. Due to the nature of a turnaround being very costly, the RBWS is required to limit the unwanted scope, which can ultimately increase cost and duration of the event. Once all scope definition reviews have been completed the scope will be selected for either, detailed planning, defer to another event, returned to routine maintenance or cancelled.

3.3 Phase 3 – Detailed Planning

The detailed planning phase is where all the approved scope that has been developed through definition is entered into VTEP to allow all job plan packages to be compiled. The VTEP workbench is set up with a job planning section to enable the packages to be created. By using the VTEP workbench, the Valero organisation has ensured uniformity across all of its sites, when developing the job package. All plans should be set out using the same method, which should all for an efficient scheduling approach supported by SAHQ. When job packages/plans are completed, they are then approved for uploading into the Primavera P6 plan giving an overall duration for the event. The duration of the turnaround is a critical part of the planning phase. Initially the scheduled duration will be excessive for industry norm, this is where the P6 planners must schedule the individual plans to be within an acceptable duration. The duration of an event will get better throughout the schedule review and constructability of the scope items will also be considered. An output from the schedule also gives the ability to understand and define the man hours to complete the event during the chosen duration. These man hours are used to build an overall cost of the event, which is then used to generate a composite rate for estimating against man hours and forecasting cost.

3.4 Phase 4 – Pre-Turnaround & Execution

Phase four of VTEP is split into two different phases, pre-turnaround execution and turnaround execution. Within the pre-turnaround element, all job packages must be completed and entered into the schedule. Manning profiles and contracts must be in place for all selected contractors and all pre-turnaround work scope must be executed and completed in the field. For a well scheduled turnaround element to be successful, it is essential that all planned pre-turnaround work be completed prior to the final execution phase starting. Any pre-turnaround work carried into the main turnaround event can be incredibly disruptive generating additional cost and delays causing an overrun to the event, ultimately resulting in a failed turnaround.

Secondly, the turnaround execution. This part of phase four is the penultimate part to the VTEP management tool. In this phase the unit is shut down and equipment prepared for entry and maintenance activities. During the phase many different VTEP tools and reports are used to track progress and report on how well the turnaround is progressing against the

original planned effort. The VTEP tool is also used to forecast to SAHQ and site management on when the turnaround will be complete, and the unit will be back operational again. Once all planned activities have been completed and handed back to operations, documentation will be signed off to allow the unit to return to service.

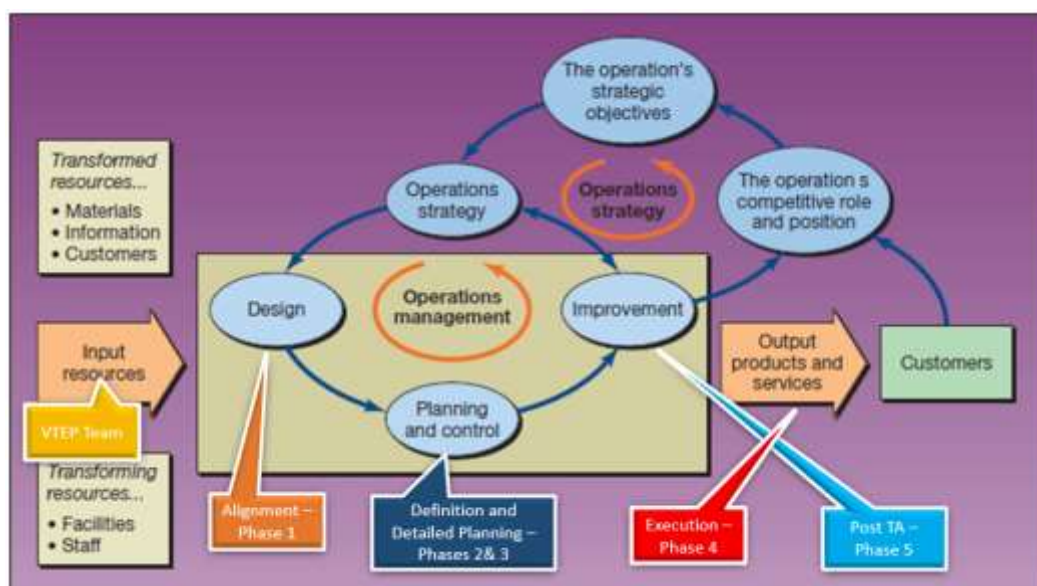
3.5 Phase 5 – Post Turnaround

The final phase of VTEP is the post turnaround. This is used to look back at how the turnaround event went against the original plan, cost, safety and performance expectations. During this phase, lesson learnt meetings are recorded, so that continuous improvements can be implemented ready for the next event.

3.6 VTEP and Operational Strategy Comparison

The operational strategy detailed at the beginning of the section (figure 6) has detailed a very similar model used by Valero in the VTEP process. Each phase of the VTEP tool has been overlapped in figure 9 below to show the comparison between (Nigel Slack, 2004) and the VTEP strategy.

Figure 9 - VTEP/Operational Strategy



(Shiels, 2020)

Each of the VTEP phases is used to manage the resources which are required to produce the turnaround scope, planning and execution that ultimately delivers the completed turnaround (output) to the customer that is Valero.

4.0 Project Specification and Testing Plan – Premise Document

In order to identify the key deliverables from the project of implementing the VTEP planning tool, it must be identified what the specification and testing plan is for the turnaround event. At Valero part of the VTEP process is to compile and produce a premise document (Appendix 2) which will establish the key parameters for planning the event. With the HTU-2 TAR event being relatively small and only a trial for the VTEP project, a premise document has not been compiled. The paper will now discuss the contents of the premise document for the main Cracking and Olefins turnaround as shown here in figure 10.

Figure 10 - Premise Document

Once printed this document becomes UNCONTROLLED. Do not use a hard copy of this document without first verifying that the Issue Status matches that of the electronic file. Obsolete documents should either be destroyed or suitably marked if they are to be kept for reference purposes.			
	<u>Doc Type/Category/Sub Category</u> Standard Title: Turnaround Premise Document – 2021 - Cracking and Olefins		<u>Department/Sub Group/Discipline</u> TAR/Turnaround/All Areas
	Review frequency: 6 Year	Doc No: PP-TAR-STD-0001	Unit: PP – Pembroke Plant
	Issue/Review date: 11 06 2019	CTEMS Element/Expectation: 4.5.1	<u>Content Contact (by Role):</u> Manager Turnaround
	Status: Active Rev: 1.1	Written Incorporating Human factors <u>PP-PEM-JNS-0016</u> applied: N	MOC No: N/A
Purpose			
The purpose of this Standard is to establish key parameters, which are to be used in planning and executing the 2021 Cracking and Olefins Turnaround including goals, conditions/constraints and management expectations.			
Scope			
All work and activities that can only be carried out within the scope of the 2021 Cracking and Olefins Turnaround. All on the run activities are excluded from this document			

(Valero Energy Ltd, 2019)

Both HTU-2 and C&O events follow the same key parameters of the premise document, which are used when planning and executing the TAR.

At the start of planning, considerations and advice are documented with regards to environmental, health, personal and process safety implications of the turnaround. Critical tasks must also be considered in line with the Control of Major Accident Hazards (COMAH). If there are such tasks these must then be further defined and analysed, both HTU-2 and C&O don't have these critical tasks.

4.1 Cost Estimate

The costs associated with the implementation project for VTEP have been taken up in the corporate capital budget from SAHQ (not available). Costs associated with the implementation of VTEP at Pembroke Refinery have been taken up by the refinery overhead expenditure, as it is being implemented by Valero employees and not contract staff. To measure if VTEP has been a cost-effective project is very difficult. The only way to see if VTEP has been a success is to measure whether the event has been a success, resulting from detailed planning. The VTEP tool uses cost tracker to record the turnaround expenditure. Figure 11 (appendix 3) identifies the costs associated to the HTU2 event and these costs will be used to evaluate the success of the event later in the paper.

Figure 11 - Cost Tracker

 Budget Forecast Report by AFE (Full) then Company Pembroke, UK									
30/01/2017 through 31/01/2020 - All Shifts									
All companies									
Group: Q120 HTU2									
AFE: PM20-0346-MM - HTU2 MM Q120									
								Delta	
Company	Authorized Amount	PO Amount	Primavera Estimated Amount	Percent Complete	Amount Earned	Incurred Cost-To-Date	Projected Amount	Incurred To Forecast	Authorized To Forecast
PM20-0346-MM - HTU2 MM Q120									
(None)	140	0	140	0.00%	0	0	140	140	0
*Contingency	54,835	0	54,835	0.00%	0	0	54,835	54,835	0
Ainscough Cranes	9,350	0	9,350	0.00%	0	0	9,350	9,350	0
AIR SEA CONTAINERS LTD	0	219	0	0.00%	0	0	0	0	0
ASHDALE LIFTING SERVICES LTD	0	1,450	0	0.00%	0	0	0	0	0
AUSTWEL LTD	57,750	0	57,750	0.00%	0	38,051	57,750	19,699	0
B&A Contracts LTD	1,200	0	1,200	0.00%	0	0	1,200	1,200	0
Can (Offshore) LTD	18,500	0	18,500	0.00%	0	2,531	18,500	15,969	0
Cape Intermediate Holding Ltd	30,498	170,033	30,498	0.00%	0	33,267	30,498	(2,769)	0
DRUCK LTD	0	22,412	0	0.00%	0	22,412	0	(22,412)	0
E G LEWIS AND COMPANY LIMITED	8,580	5,846	8,580	0.00%	0	1,506	8,580	7,074	0
ELLIOTT GROUP LTD	66,330	0	66,330	0.00%	0	0	66,330	66,330	0
ESS Euresit UK Limited	0	871	0	0.00%	0	0	0	0	0
H S JACKSON & SON (FENCING) LTD	212,062	0	212,062	0.00%	0	0	212,062	212,062	0
Hertel UK LTD	70,090	51,000	70,090	0.00%	0	61,168	70,090	8,922	0
HIRE STATION LTD	18,755	0	18,755	0.00%	0	0	18,755	18,755	0
IRIS NDT UK	2,976	0	2,976	0.00%	0	0	2,976	2,976	0
Jenkins & Davies Techno Engineering	10,890	0	10,890	0.00%	0	10,833	10,890	57	0
MONDDI DIMOND PRESS LTD	0	248	0	0.00%	0	248	0	(248)	0
MRC TRANSMARK LIMITED	0	29,078	0	0.00%	0	28,013	0	(28,013)	0
NORTHGATE PLC	0	935	0	0.00%	0	0	0	0	0
On Line Design	0	0	0	0.00%	0	56	0	(56)	0
QUARTZELEC LTD	0	17,000	0	0.00%	0	0	0	0	0
REFINED TECHNOLOGIES INC	16,711	13,009	16,711	0.00%	0	13,009	16,711	3,702	0
SPRAYING SYSTEMS LTD	0	24,140	0	0.00%	0	0	0	0	0
SSE Contracting Limited	17,738	17,784	17,738	0.00%	0	3,592	17,738	14,145	0
THERCO -SERCK LTD	0	72,579	0	0.00%	0	72,579	0	(72,579)	0
Valero Material Vendors	0	103,523	0	0.00%	0	103,523	0	(103,523)	0
Veolia	0	0	0	0.00%	0	0	0	0	0
VLO Recharges	175,626	0	175,626	0.00%	0	0	175,626	175,626	0
VLO Warehouse	224,785	0	224,785	0.00%	0	2,417	224,785	222,368	0
WIKA INSTRUMENTS LTD	0	29,576	0	0.00%	0	29,576	0	(29,576)	0
	996,816	559,741	996,816	0.00%	0	422,782	996,816	574,034	0

4.2 VTEP Phase 5 – HTU2 Event

Once the HTU-2 event has been complete, final analysis of cost and actual duration against plan will be reviewed. A wash up meeting will be held with all disciplines to identify the good and the bad from the event. Special focus will be given to how the trades found the turnaround plan and VTEP work packs during the execution.

5.0 Project Strategies

In order to make planning the major C&O TAR successful, three strategies were reviewed and evaluated to see what would be suited to Pembroke Refinery.

Option 1 – Continue to plan TAR events as Pembroke have done in the past. Ignore the corporate strategy and implementation of VTEP and use elements of the VTEP tool such as structure but maintain using the network server and available planning tools, storing files and job plans in the site V-Drive.

Option 2 - Adopt the corporate driven VTEP tool in its entirety, allowing Valero headquarters to see every step of the turnaround planning and execution phase. However, there were risks associated with this option, as the Pembroke site had not used the VTEP planning tool before and failure is not an option when it comes to turnarounds.

Option 3 – Implement VTEP to its full potential with the assistance of SAHQ and training key site personnel in the use of the tool, so they become site-based SMEs for VTEP. In addition to the VTEP tool, also use the maintenance strategy as a back up to store planning documentation, in case the VTEP tool doesn't work as expected for Pembroke's turnaround events. This option comes with the risk of increasing workload for planning teams, but also ensures success for the event.

5.1 Selected Strategy

Option 3 – Implement VTEP to its full potential and use the maintenance strategy as back up.

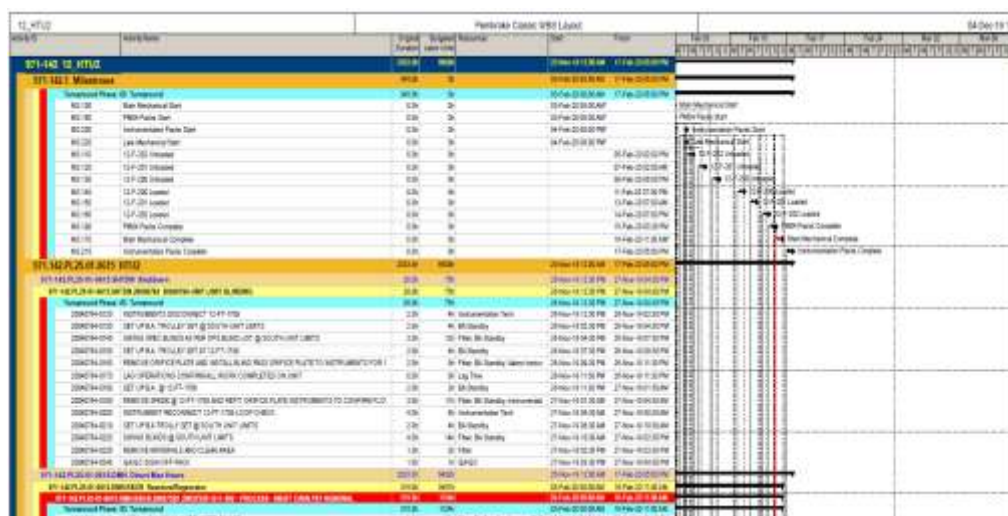
For Valero Pembroke Refinery to feel comfortable with implementing the VTEP tool, the planning strategy selected for the C&O turnaround was to select option three, VTEP and maintenance strategy combined. In addition to the combined strategy it was also deemed necessary to trial the VTEP planning software on a much smaller event such as the HTU-2, which would typically be planned and executed by the maintenance team not TAR team. All elements of the premise document have been incorporated into the HTU-2 event, with the same KPIs being set but on a much smaller scale.

6.0 Project Plan

To collate and schedule the job plans that are associated to the TAR, a P6 project plan is compiled. Once approved, all job plans within the selected event are transferred into the P6 schedule (Appendix 4) where each job plan is scheduled together to give a realistic working plan of the turnaround. Trade disciplines are scheduled within the P6 plan to give an overall labour and cost forecast. The VTEP planning tool prepopulates durations and manning levels ready for the scheduler to build into the plan.

With the HTU-2 event being relatively small in comparison to the 2021 C&O event, the P6 schedule (figure 12) has been planned with float on a number of activities allowing slippage in the schedule if required. This has been allowed to determine if the VTEP planning tool is successful in producing efficient plans. Items that have not been given float are items that are critical path, these items would ultimately extend the duration of the TAR and have been given key completion milestones.

Figure 12 - HTU-2 P6 Plan



(Llewellyn, 2019)

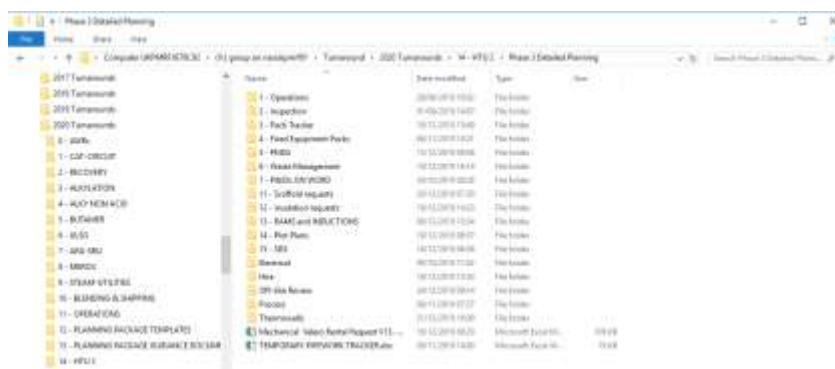
6.1 VTEP Milestones

In the build up to the TAR event, VTEP milestones are set to ensure a time line is put in place so that planning can be completed on time ready for the event to be executed. Appendix 5 details the milestone plan prepared for the HTU2 turnaround.

6.2 Contingency Planning

In addition to the VTEP planning tool, Valero Pembroke Refinery have opted to use a secondary system to store the planning documentation. As the HTU-2 event is a trial for Pembroke using the VTEP tool in its entirety, the V-Drive on the Pembroke server has been used as a backup. This drive is used by all departments for day to day running of the refinery and has also been used in the past for storing files associated to turnarounds in the past. Figure 12 below shows a typical lay out of the file structure for a turnaround planning file. Each turnaround event is split out into its own specific units. The different discipline files are then broken out into a master file.

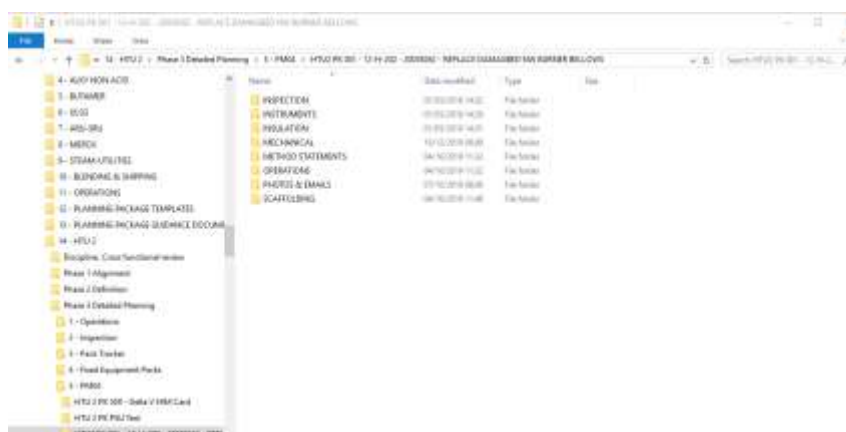
Figure 13 - V-Drive Structure



(Valero Energy Ltd, 2019)

Further into the file structure (figure 13) the different types of planning packs are also split out, such as fixed equipment, repairs/PM04s, inspection and operations. In each folder a job plan will be given a unique identification number, for example HTU 2 PK 001. In this pack the file structure will be broken down again so that each individual discipline can store their planning files and documentation for that planned activity.

Figure 14 - Contingency Planning Packs



(Valero Energy Ltd, 2019)

7.0 VTEP Workbench

The VTEP workbench has been developed and introduced to Valero Pembroke Refinery to implement a step by step planning process of thinking about and organizing the activities required to complete a piece of work that has been identified as a turnaround scope item. Planning involves the creation and update of a job plan for a given scope. A job plan must identify a logical, sequential, detailed job steps to accomplish the given work. For each of the identified job steps, the VTEP plan must also define the following:

1. Identify resource requirements
2. Identify material requirements and long lead items
3. Identify equipment and tool requirements
4. Identify health, safety and environmental aspects
5. Identify key dependencies with other job plans
6. Identify inspection requirements
7. Provide a “basis of estimate” and “basis of schedule”

The VTEP process directs the planning team through its responsibilities for collecting and documenting all information required to effectively complete the work described in the selected scope item. Valero's full VTEP process can be identified in Appendix 6.

7.1 Scope Selection

To select the scope for the event, VTEPs discipline review tool is used. A senior member of each discipline of the refinery must select all of equipment that they want to work on during the event. Once all disciplines have completed their review, a cross functional review will take place to integrate each discipline scope requirements.

Figure 15 - VTEP Scope

[illegible]

(Valero Energy Ltd, n.d.)

In some cases, there are scope items that are not driven by legislation or mechanical failure. These items may be justified by the discipline but will require further support to get them completed during the turnaround. In order to justify these items, VTEP uses the risk-based work selection (RBWS) tool, built into each scope item.

7.2 RBWS

RBWS is a tool to calculate three things. Firstly, whether it is financially viable to complete the work on the run without a significant impact to the business, against the cost of completing the work during the turnaround. Secondly, the consequence of failure if the work was not carried out and the equipment failed while the unit was still online and thirdly, the frequency of failure which will show the unmitigated and mitigated risk (figure 16). Once all fields have been completed a Benefit Cost Ratio (BCR) value will be produced. If the BCR is above 2, this is deemed as too much of a risk and the scope must be completed during the turnaround.

Figure 16 - RBWS Scenario Screen

The screenshot displays the 'Create RBWS Scenario - Inspection - CVI - 25/05/2020 (400041903)' window. It is divided into two main panels: 'Scenario Details' on the left and 'Scenario Details' on the right.

Left Panel (Scenario Details):

- *Title:** Unit Shutdown
- Unit Consequence:** Unit Shutdown
- Damage Mechanism:**
- Consequence of Failure (Business):**
 - Estimated Impact of Failure:**

Production Impact	0	Barrels/Day
Margin	0	\$/Time
Duration	0	Days
Production Impact Cost	0	USD
Repair Cost	0	USD
Fines & Penalties Cost	0	USD
Remediation Cost	0	USD
Total Business Cost (\$)	0	USD
Unmit. Business Risk (\$)	0	USD
 - Estimated Benefits of Mitigation:**

Benefit of Mitigation (\$)	0	USD
Benefit/Cost Ratio (BCR)		

Right Panel (Scenario Details):

- Failure Scenario Description:**
- Risk Assessment Info:**
- Consequence of Failure (H&S, Community & Environmental):**
 - Health and Safety:**
 - IV : Multiple Fatalities across the Site or Public Fatality
 - III : Permanent Disabling Injury to Single or Multiple Fatality within the immediate area or Medical Treatment to Public
 - II : Onsite Recordable or Lost Time Injury or nuisance to Public
 - I : No Onsite Injury to First Aid or No Injury to Public
 - Community:**
 - IV : Public Evacuation or National Media Coverage
 - III : Shelter in Place or State to Regional Media Coverage
 - II : Community Warning or Local Media Coverage
 - I : No to Minor Impact to People or No Media Coverage
 - Environmental:**
 - IV : Agency Intervention or Permanent Environmental Damage
 - III : Reportable quantity with Agency Presence or Prolonged Remediation
 - II : Reportable Quantity with Agency Notification or Short Duration Remediation
 - I : No Reportable Quantity or No Agency Contact or No Response Needed

(Valero Energy Ltd, n.d.)

Figure 17 identifies the frequency of failure tool, this can be used to assess the unmitigated risk against the mitigated risk. A simple check box can also be applied to show that the risk is at its maximum and the equipment is guaranteed to fail.

Figure 17 - RBWS Frequency of Failure Tool

Frequency of Failure

☐ Guaranteed to Fail

Unmitigated	Mitigated
A : Very Unlikely - Not expected to occur at this facility, expected to occur at a refinery somewhere less than once every 10 years	A : Very Unlikely - Not expected to occur at this facility, expected to occur at a refinery somewhere less than once every 10 years
B : Not Likely - Not likely to occur in the life of this facility, expected to occur once per year at a refinery somewhere	B : Not Likely - Not likely to occur in the life of this facility, expected to occur once per year at a refinery somewhere
C : May Occur - May occur once in the life of this facility, expected to occur once per year at a refinery in the USA	C : May Occur - May occur once in the life of this facility, expected to occur once per year at a refinery in the USA
D : Likely - Likely to occur at this facility once every 10 years	D : Likely - Likely to occur at this facility once every 10 years
E : Very Likely - Very likely to occur at this facility	E : Very Likely - Very likely to occur at this facility

Risk Levels

Consequence	Frequency	Total Business Cost				
		IV (Greater than \$10MM)	III (\$1MM to \$10MM)	II (\$100K to \$1MM)	I (Less than \$100K)	
IV (HCE)	L1	L2	L3	L4	L5	
III	AR	L1	L2	L3	L4	
II	AR	AR	L1	L2	L3	
I (B)	AR	AR	AR	AR	AR	
	A	B (U)	C (H)	D	E	

Recommendation Notes

(Valero Energy Ltd, n.d.)

7.3 Scope Freeze

A set VTEP milestone that must be achieved and implemented is that of scope freeze (appendix 7). This milestone is implemented 14 months out from planning complete on a large turnaround. All key stakeholders must sign and agree that all scope has been given to the TAR team ready for planning (figure 17). Following scope additional scope can only be added into the event after going through the VTEP Additional Work Request (AWR) process, which must also be signed off by the event key stakeholders.

Figure 18 - Turnaround Final Work Input Freeze Confirmation

TURNAROUND FINAL WORK INPUT FREEZE CONFIRMATION

TURNAROUND UNIT: 30 PCEU, 34 Alky Acid, 34 Alky Non-Acid, 34 UGDA, 34 Butanol, 34 Ethox, 34 Non-Peroxide & Utilities

TURNAROUND DATE: 01 Feb 2019

INPUT FREEZE DATE: 14th Aug 2019

The Turnaround Additional Work process goes into effect on the work input freeze date. Signing indicates:

- All appropriate recommendations from studies are on the work list.
- All individual jobs have been identified.
- An initial Reliability Threat Risk Priority has been established on all non-compliance work.
- Funding has been confirmed for individual discretionary jobs.

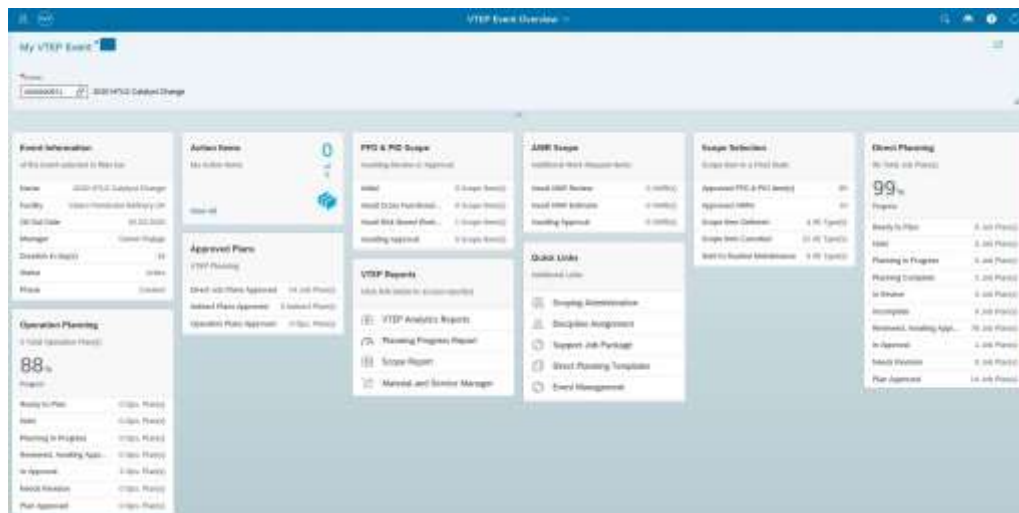
Department	RLT Manager	Tier 2 Leader	Expectations	Signature	Date
HAZOP	RLT Manager Karen Mundt	Andy Stevenson Neil White Kim Woodard	- All HAZOP work items to be included in the TA are identified, justified and passed onto the respective Team Leaders and Planners. - Any projects required to meet air compliance are completed and approved to PCEP phase 1. - Hazardous waste identified and environmental plan started. - Industrial Hygiene plan started. - Modifications to the plant fire system have been reviewed and shutdown work required into the VTEP team i.e. fire man work that can only be done in a turnaround. - RBWS reviewed and complete.	<i>[Signature]</i>	4/8/2019
Operations	Operations Manager Andy Thorpe	Kath Thomas Malcolm White Ben Stewart	- All Operations Dept work items to be included in the TA are identified, justified and passed onto the respective Team Leaders and Planners. - Unit purchasing completed and relevant PHA's issued. - Identify plant defects and submit PMR's. - OMC's to complete Ops package for all PHA's as per the OC work flow model. - In conjunction with Reliability: Process Safety, ensure PHA completed on process units included in the TA and all TA PHA actions included in the workscope. - For non-PCEP projects, Capital Work Request (PP-ENG-FRSH-0033) to be approved with cost estimate and scope of work. - Catchall requirements, exchanger fouling and valves performance reviewed and action items passed onto the TA Team leaders and planners. - Key work on the steam, fuel and electrical systems identified.	<i>[Signature]</i>	4/8/19

(Bujega, 2019)

7.4 Job Planning

The VTEP tool is used to store all event information during planning ready for execution. The event home page, as seen here in figure 19, can be used to access every element of the event such as event management tools, progress reports, material management and job plans.

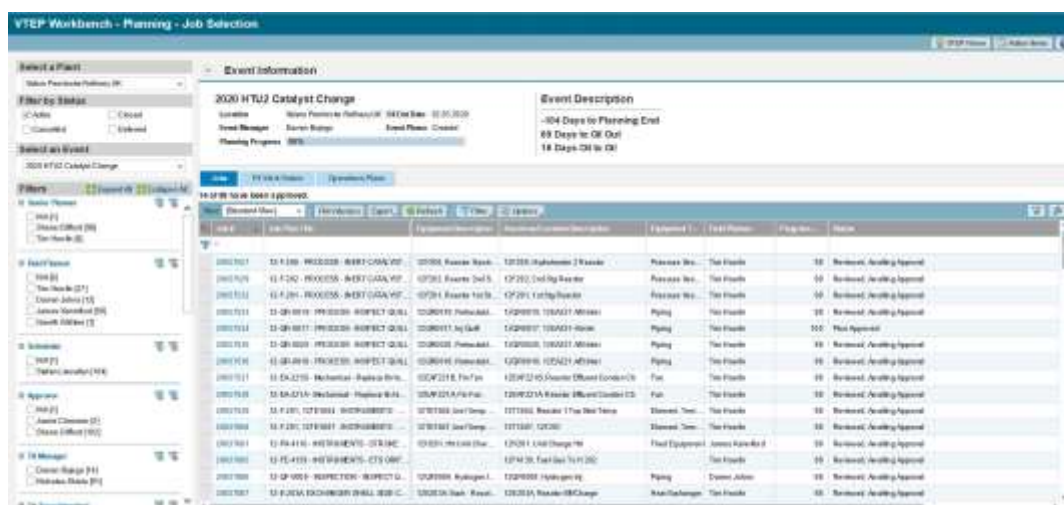
Figure 19 - VTEP Event Page



(Valero Energy Ltd, n.d.)

Behind the direct planning and operations planning screens, the job plans are stored and accessed to carry out the extent of the planning ready for execution. Figure 20 below shows the layout of the job plan selection screen, each job plan will have an individual job plan number that will link the user directly to that job plan.

Figure 20 - VTEP Job Plan Section



(Valero Energy Ltd, n.d.)

The VTEP job plan is used to plan each element associated to the determined scope, such as, materials, activity steps, scaffolding, insulation and painting (figure 21). The general information tab is used to identify to the planner the basic detail, cost information and assigned equipment breakdown. Other useful VTEP tools within the job plan include a document library and action item tool that can be used to automatically send out requests via email. All elements of the job plan are then stored ready for execution and if required can be re used ready for the next event on that piece of equipment.

Figure 21 - VTEP Job Plan Steps

(Valero Energy Ltd, n.d.)

VTEP Material Management ensures control and release of all materials within the event. Keeping materials assigned and released against their respective job plans allows for efficient release of materials against agreed and approved scope.

Figure 22 - VTEP Material Management

Turnaround Event - 971 / Material & Service Manager

2020 HTU2 Catalyst Change

Planning Progress

99%

Plant: Valero Pembroke Refinery UK
Event Manager: Nicholas Shiels

Oil Out Date: Mar 02, 2020
Duration: 16

Phase: Execution
Status: Active

Materials (823) Services (5)

☐ Items ready to release

☐	Job / Plan	Plan Type	Job / Plan Title	Obj. Sort Field	Material WO	Oper #	Oper. / Rlt Description
☐	20037889	Direct	INSTRUMENTS - 12-FE-...	12FE4126A	5707467	0020	INSTALL NEW ORIFICE PLATE & MAKE UP FLAN
☐	20037885	Direct	12-FE-4139 - INSTRUME...		5707463	0020	INSTALL NEW ORIFICE PLATE & MAKE UP FLAN
☐	20037887	Direct	12-E-203A, EXCHANGE...	12E203A	5707465	0050	INSTALL SHELL BLINDS AS PER OPS BLINDS L

(Valero Energy Ltd, n.d.)

To ensure completed job plans are correct and ready for the event it must go through a series of approvals. Figure 23 identifies the steps within the job progress tab that a job plan must go through. Firstly, when the planner completes the plan each plan section is marked as complete. The next step is for the senior planner to review the job plan and mark as complete if everything is correct, there is also an option to recycle an element of the plan if there are any errors or amendments required. The final step is for the plan approver to complete a review and then mark the job plan approved, which will then be flagged for the assigned scheduler to upload the plan into the master P6 schedule.

Figure 23 - VTEP Job Plan Approval

The screenshot displays the 'Planning - Review - (Not Reviewable)' interface. It includes sections for Job Information, Reference Location, Key Milestones, and a table of Actions. The table lists various job plan sections and their approval status, with columns for Completed By, Completed On, Reviewed By, Reviewed On, and Approved By.

Section	Completed By	Completed On	Reviewed By	Reviewed On	Approved By	Approved On
General Information	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Job Vets	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Activities	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Mobilisation	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Inspection	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Structuring	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Laying	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Painting	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Installation	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Refactory	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Additional Requirements	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Permits	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Safety Requirements	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Safety Equipment	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019
Resource Materials	Tim Hovatt	16.06.2019	Shane Clifford	23.11.2019	Nicholas Meeks	23.12.2019

(Valero Energy Ltd, n.d.)

7.5 AWR Process

The AWR process (Additional Work Request) is an enhancement to planning to ensure any scope growth or reduction is captured. The VTEP Additional Work Request must be prepared to propose, obtain authorisation and provide a record of changes to agreed scope. All proposed changes to the original scope of work, as defined by the completed RBWS, shall be controlled using the AWR process and completed within VTEP.

Figure 24 - VTEP AWR Process

The screenshot displays the 'Scoping - AWR Additional Work Request' interface. The top navigation bar includes tabs for 'EQUIPMENT REVIEW', 'DISCIPLINE REVIEW', 'CROSS FUNC. REVIEW', 'RBWS', 'APPROVE SCOPE', and 'AWR'. The 'Event Information' section shows details for event '2021 CRACKING & DISTRI TUBING', including its date, facility, manager, and status. Below this, there are tabs for 'Prepare AWR', 'Review AWR', 'Estimate AWR', and 'Approve AWR'. A table lists equipment items with columns for Equipment, Level, Phase, Functional Location, Complete, Unit, S/Count, Type, and Details. One item is visible: 'Rouline' at 'PGD' level, '12000011 HCU-2 Plant Logic Ctrl' functional location, 'Inching' complete, 'HT02' unit, and '6' S/Count.

Equipment	Level	Phase	Functional Location	Complete	Unit	S/Count	Type	Details
Rouline	PGD		12000011 HCU-2 Plant Logic Ctrl	Inching	HT02	6		

(Valero Energy Ltd, n.d.)

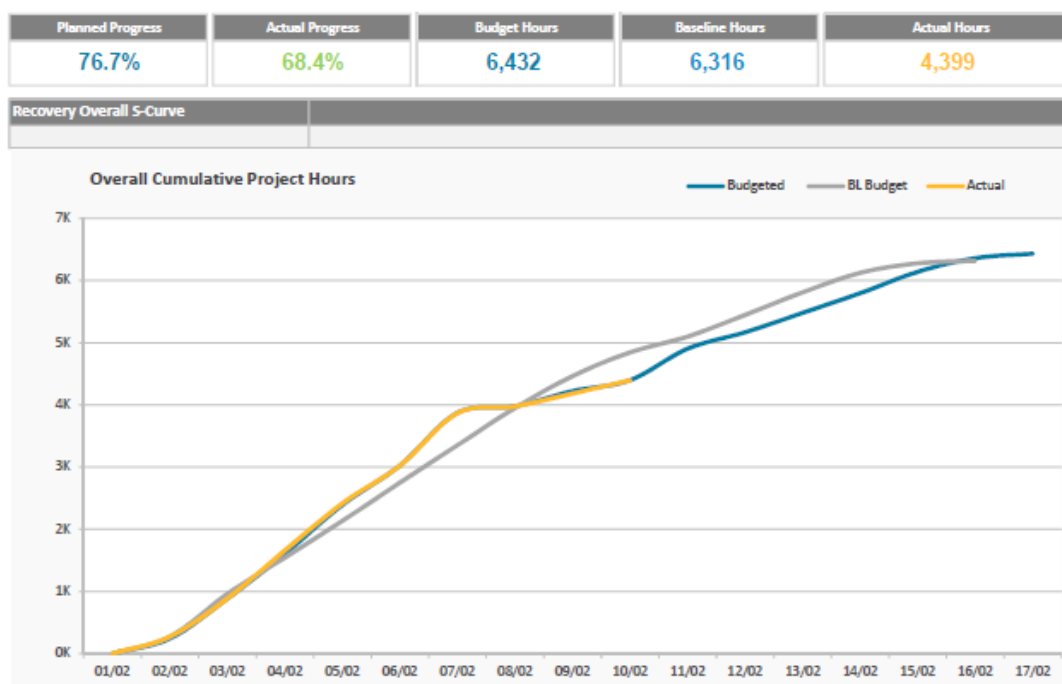
Depending on the stage of planning the event is in, the correct level of AWR must be selected, there are three levels to consider, further detail can be found in appendix 8.

1. AWR-1 between scope freeze and pre full funding
2. AWR-2 between full funding and oil out
3. AWR-3 after oil out

8.0 HTU-2 Execution Phase

During the execution phase of a TAR it is paramount to track progress against plan to see how the TAR is performing. Once all VTEP job plans are approved and entered into the TAR P6 schedule, reports and s-curves are produced. These S-Curves are compiled to show individual progress against equipment type and overall combined progress for the event. Figure 25 identifies the curve for the combined progress.

Figure 25 - Combined Progress Curve



The daily team leaders report (appendix 9) shows the reports that have been gathered to identify the performance of the HTU-2 throughout the event. These reports are used to identify to the refinery leadership team and turnaround team how the turnaround is performing and what the forecast completion date is daily.

In order to carry out the execution phase of VTEP, a large multi discipline team is required. Appendix 10 details the organisational chart used to identify the key positions required for the event. Each disciplines activity planned within VTEP is assigned a coordinator to manage their respective disciplines contractor throughout the event.

To maintain good coordination across all driplines, daily progress meetings take place both morning and night, examples of these meeting minutes can be found in appendix 11.

9.0 HTU-2 VTEP Results & Evaluation

In order to determine the success of VTEP and if the tool has been successful in delivering a well-planned TAR, key deliverables must be met.

Firstly, safety stats must be evaluated. The safety stats can identify if the job plans have been produced correctly in preparation for execution. The safety stats report for the HTU-2 event Appendix 12– Safety Stats have identified a very safely executed event with only minor safety concerns. Therefore, on a safety deliverable VTEP has managed to be a success.

Original cost estimates and forecasts are extracted from VTEP as they are a direct association to the planned man-hours and materials/equipment associated to the event job plans. Target costs are set with a small element of contingency. Throughout the HTU-2 TAR expenditure had been on track with VTEP plans, however costs escalated with additional works managed through the AWR process and overrun due to inclement weather seen from storm Ciara and Dennis. A final cost tracker report from VTEP can be found in appendix 13, showing a slight overrun in costs.

Duration of an event is a key success factor that is measured. As seen here in figure 26, HTU-2 ran over by one day. This has been a success for VTEP as planning was executed timely and would have been ahead of time if it hadn't of been for the inclement weather.

Figure 26 - Final Progress Curve



Overall the VTEP planning tool has worked well for the HTU-2 TAR. The tool has produced well planned packages ready for execution and has also been a good tool to use to identify event information from a single source when required.

The HTU-2 event also met the following targets and expectations set out for the trial project.

- Deliver a safe and injury free event as a result of quality detailed planning
- Deliver an event to the forecasted budget (except additional works)
- Deliver an event within the planned schedule (overrun excepted due to weather)
- VTEP job pans to be executed without the need for additional planning/modifications.

10.0 Conclusion

To conclude on this paper, the Valero Turnaround Excellence Programme has been discussed in much detail identifying the key aspects of the corporate planning tool for turnarounds. With Valero being such a large company operating out of many sites with circa 10,000 employees, it is key to the business to operate maintenance a plant shutdown safely, efficiently and within budget.

There are many tools and metrics within industry that Valero and their competitors use to ensure there's a healthy and competitive market out there for petrochemical marketers to benchmark against. Using the VTEP model ensures a staged approach to planning is used through the preparation of a TAR event, with each phase clearly identifying its aims and objectives to finally completing a turnaround safely, on time and within budget.

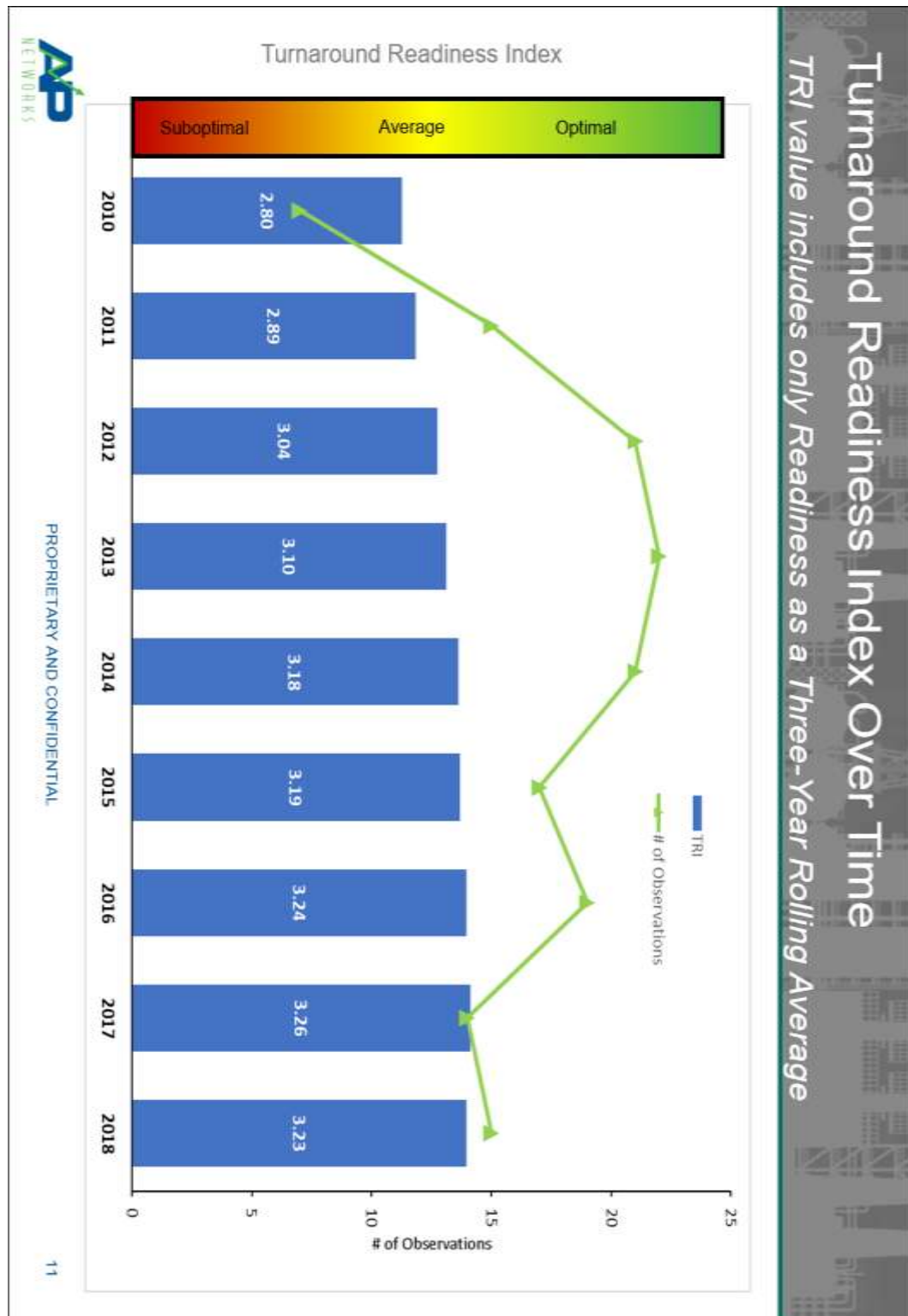
Using a small event such as the HTU-2 catalyst change to trial the VTEP tool has allowed for analysis ready for the major C&O turnaround in 2021. It is clear to see from the performance of the HTU-2 event that the VTEP tool did work and delivered a successful turnaround even though the event did run over schedule due to adverse weather conditions from storms Ciara and Dennis.

In order to answer the paper's initial question "How can implementing the VTEP strategy improve turnaround planning?", the paper has shown all aspects of the planning tool that can improve and structure the way a turnaround planning team would go about planning a major TAR. HTU-2 has proved the process works. However, to fully answer the paper's question an independent company such as AP Networks has been used to identify Valero's readiness factor against industry standard for the 2021 C&O event, this shows if the VTEP strategy really does improve turnaround planning.

AP Networks has been used at Valero sites since 2010 when elements of the VTEP tool were first introduced. Therefore, to finally conclude on the report, the graph on the following page (figure 26) has shown a gradual increase in Valero Pembroke's readiness factor. There are three stages that AP networks assess a company's readiness factor, iTAP-1, iTAP-2 and iTAP-3, which is prior to execution. Valero's C&O 2021 VTEP iTAP-1 results were 2.9 and iTAP-2 were 3.1 with a final forecast of 3.5 at iTAP-3. This high scoring gives a further

indication that implementing the VTEP strategy improves turnaround planning. Further detail on the C&O AP Networks 2019 ITAP-2 report can be found in appendix 14.

Figure 27 - Turnaround Readiness Index



(AP Networks, 2018)

11.0 Recommendations

The aim of the paper was to identify how implementing the VTEP strategy can improve turnaround planning. The VTEP trial on the HTU-2 TAR was a good learning experience for using the corporate driven tool on the much larger turnaround being planned for February 2021. As an outcome from the VTEP trial the following recommendations are being put forward.

- All site-based personnel must be made aware that the TAR is being planned and executed through VTEP, expectations should be that anyone can access the VTEP tool to check details of the event.
- The AWR process must be firmly imbedded and understood by all TAR team members.
- Backup V-drive to be used only if VTEP fails, using both tools will cause confusion and VTEP should be used as the master file.
- Cost control to be fully integrated into VTEP ensuring all cost reports export the right details from the start of the event.
- Detailed VTEP training to be given to all personnel working on the TAR who will actively be involved with job plan packages.

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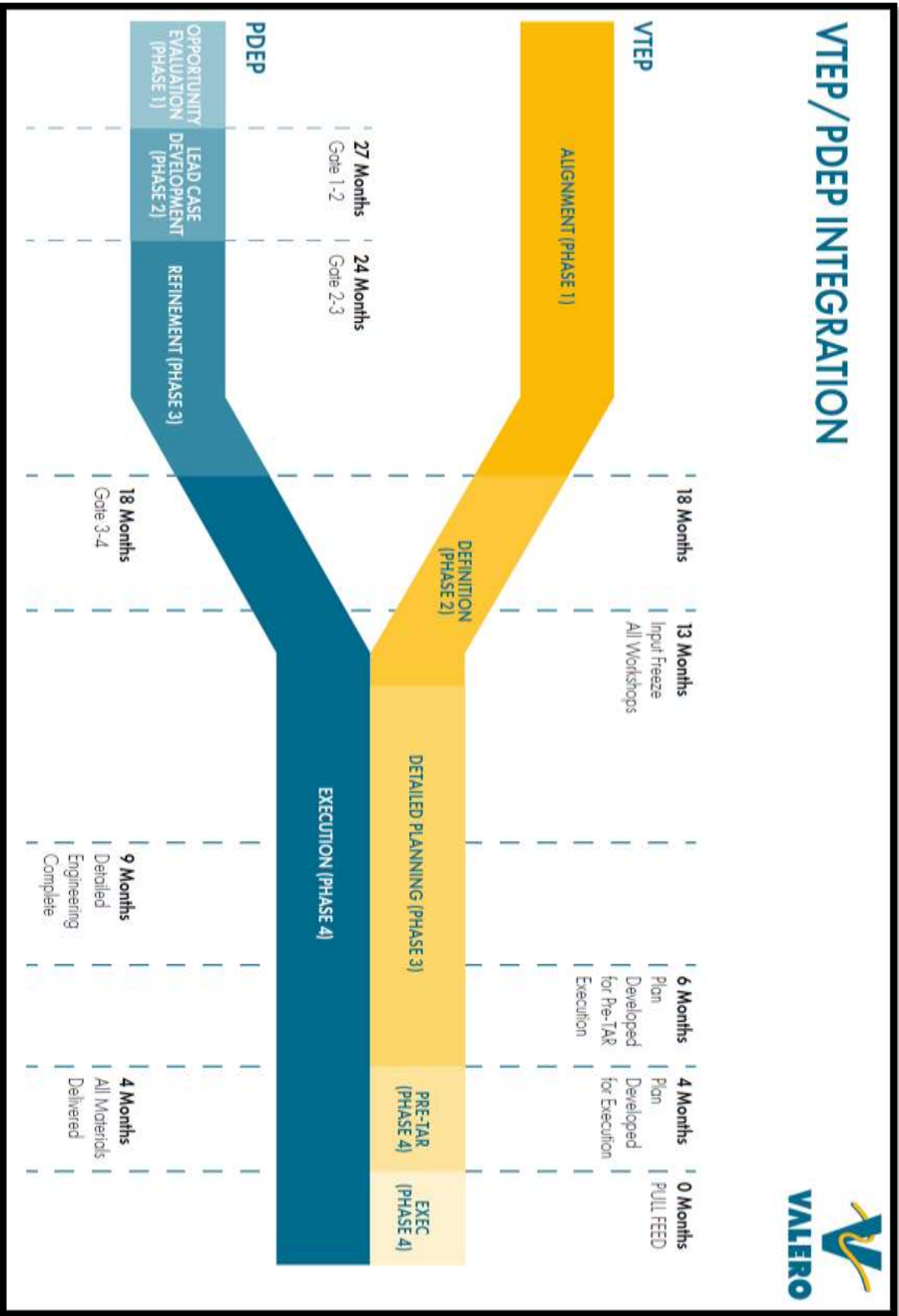
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13.0 Appendices

Appendix 1 – VTEP/PDEP Integration



Appendix 2 – Premise Document



Budget Forecast Report by AFE (Full) then Company

Pembroke, UK

30/01/2017 through 31/01/2020 - All Shifts

All companies

Valero

Group: Q120 HTU2
AFE: PM20-0846-MM - HTU2 MM Q120

Delta

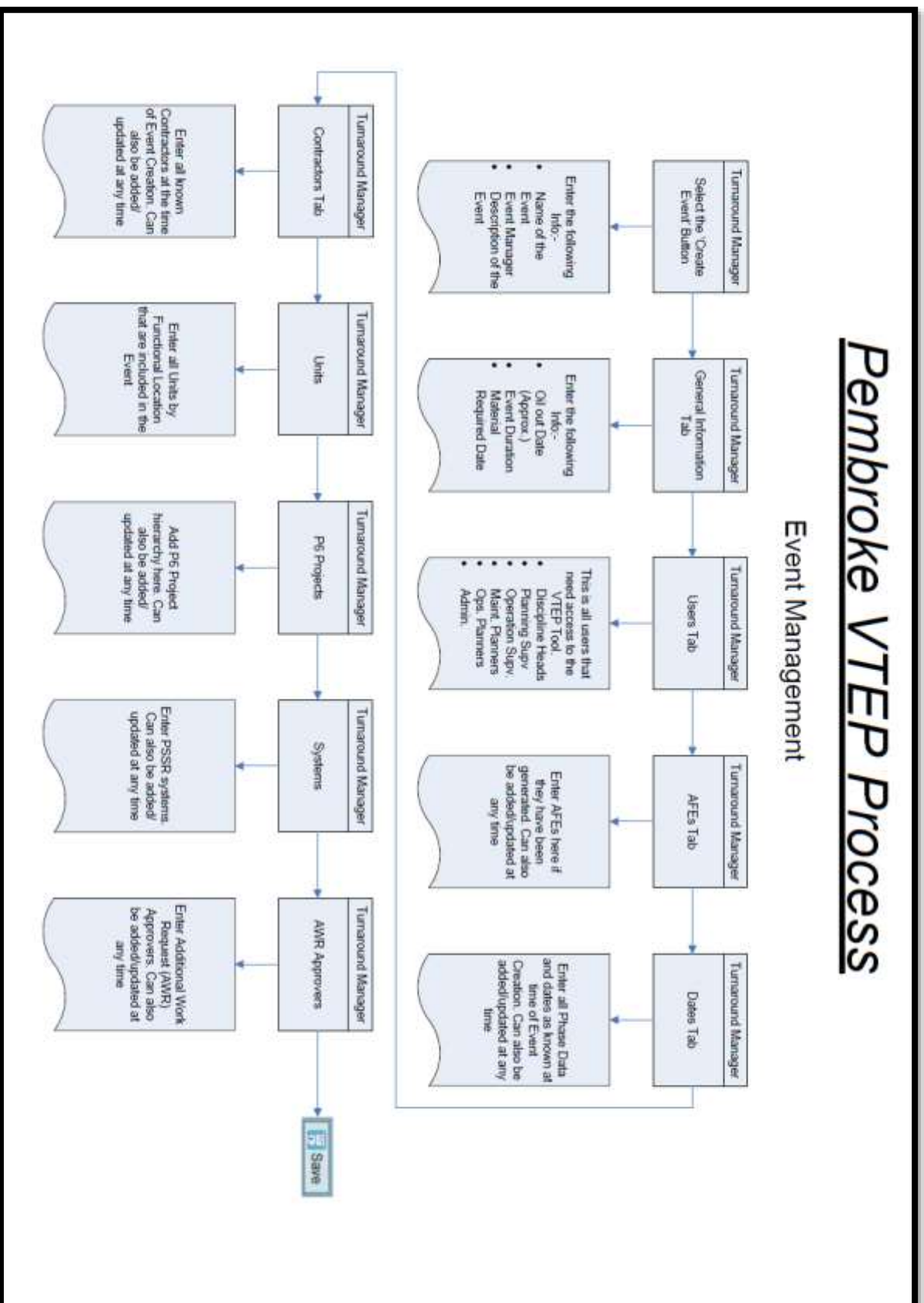
Company	Authorized Amount	PO Amount	Primavera Estimated Amount	Percent Complete	Amount Earned	Incurred Cost-To-Date	Projected Amount	Incurred To Forecast	Authorized To Forecast
PM20-0846-MM - HTU2 MM Q120	140	0	140	0.00%	0	0	140	140	0
(None)									
*Contingency	54,835	0	54,835	0.00%	0	0	54,835	54,835	0
Aircough Cranes	9,350	0	9,350	0.00%	0	0	9,350	9,350	0
AIR SEA CONTAINERS LTD	0	219	0	0.00%	0	0	0	0	0
ASHDALE LIFTING SERVICES LTD	0	1,450	0	0.00%	0	0	0	0	0
AUSTWEL LTD	57,750	0	57,750	0.00%	0	38,051	57,750	19,699	0
B&A Contracts LTD	1,200	0	1,200	0.00%	0	0	1,200	1,200	0
Can (Offshore) LTD	18,500	0	18,500	0.00%	0	2,531	18,500	15,969	0
Cape Intermediate Holding Ltd	30,498	170,033	30,498	0.00%	0	33,267	30,498	(2,769)	0
DRUCK LTD	0	22,412	0	0.00%	0	22,412	0	(22,412)	0
E G LEWIS AND COMPANY LIMITED	8,580	5,846	8,580	0.00%	0	1,506	8,580	7,074	0
ELLIOTT GROUP LTD	66,330	0	66,330	0.00%	0	0	66,330	66,330	0
ESS Eures UK Limited	0	871	0	0.00%	0	0	0	0	0
H S JACKSON & SON (FENCING) LTD	212,062	0	212,062	0.00%	0	0	212,062	212,062	0
Herrel UK LTD	70,090	51,000	70,090	0.00%	0	61,168	70,090	8,922	0
HIRE STATION LTD	18,755	0	18,755	0.00%	0	0	18,755	18,755	0
IRIS NDT UK	2,976	0	2,976	0.00%	0	0	2,976	2,976	0
Jenkins & Davies Techno Engineering	10,890	0	10,890	0.00%	0	10,833	10,890	57	0
MONDDI DIAMOND PRESS LTD	0	248	0	0.00%	0	248	0	(248)	0
MRC TRANSMARK LIMITED	0	29,078	0	0.00%	0	28,013	0	(28,013)	0
NORTHGATE PLC	0	935	0	0.00%	0	0	0	0	0
On Line Design	0	0	0	0.00%	0	56	0	(56)	0
QUARTZTEC LTD	0	17,000	0	0.00%	0	0	0	0	0
REFINED TECHNOLOGIES INC	16,711	13,009	16,711	0.00%	0	13,009	16,711	3,702	0
SPRAYING SYSTEMS LTD	0	24,140	0	0.00%	0	0	0	0	0
SSE Contracting Limited	17,738	17,784	17,738	0.00%	0	3,592	17,738	14,145	0
THERCO -SERICK LTD	0	72,579	0	0.00%	0	72,579	0	(72,579)	0
Valero Material Vendors	0	103,561	0	0.00%	0	103,523	0	(103,523)	0
Veolia	0	0	0	0.00%	0	0	0	0	0
VLO Recharges	175,626	0	175,626	0.00%	0	0	175,626	175,626	0
VLO Warehouse	224,785	0	224,785	0.00%	0	2,417	224,785	222,368	0
WIKIA INSTRUMENTS LTD	0	29,576	0	0.00%	0	29,576	0	(29,576)	0
	996,816	559,741	996,816	0.00%	0	422,782	996,816	574,034	0

Appendix 4 – HTU-2 P6 Execution Plan

Appendix 5 – VTEP Milestone Plan

Pembroke VTEP Process

Event Management



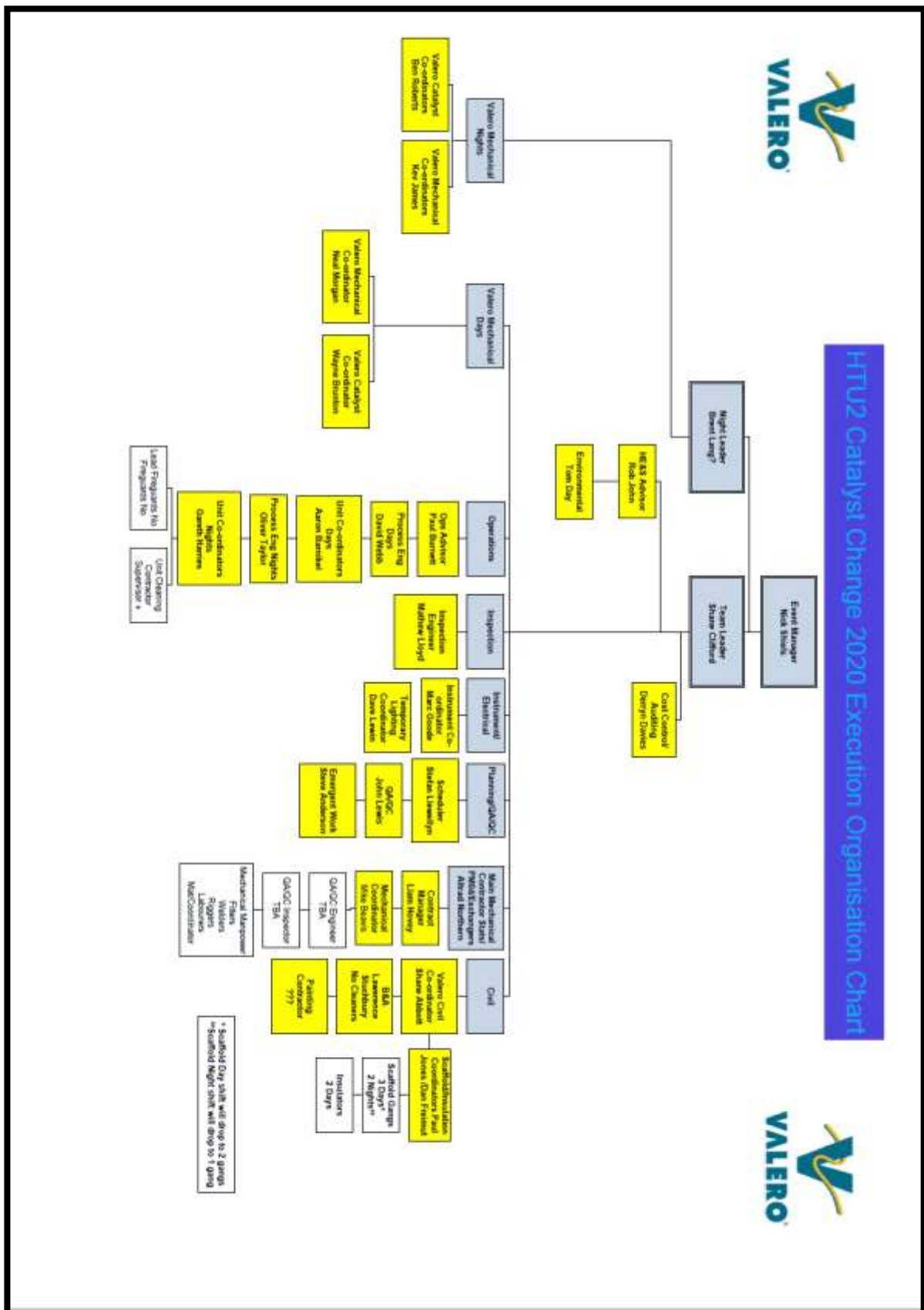
Appendix 7 – Turnaround Final Work Input Freeze Confirmation

TURNAROUND FINAL WORK INPUT FREEZE CONFIRMATION					
TURNAROUND UNIT: 02 FCCU, 04 Alky Acid, 04 Alky Non Acid, 05 ULSG, 06 Butamer, 06 Merox, Misc Flares Offsites & Utilities					
TURNAROUND DATE: 01 Feb 2021					
INPUT FREEZE DATE: 14 th Aug 2019					
The Turnaround Additional Work process goes into effect on the work input freeze date. Signing indicates:					
- All appropriate recommendations from studies are on the work list. - All individual jobs have been identified. - An Initial Reliability Threat Risk Priority has been established on all non-compliance work. - Funding has been confirmed for individual discretionary jobs.					
Department	RLT Manager	Tier 2 Leader	Expectations	Signature	Date
HES Department	HES Manager Karen Muehlbauer	Andy Waterman Noli White Kim Weston	- All HES Department work items to be included in the TA are identified, justified and passed onto the respective Team Leaders and Planners. - Any projects required to meet air compliance are completed and approved to PDEP phase 1. - Hazardous waste identified and environmental plan started. - Industrial Hygiene plan started. - Modifications to the plant fire system have been reviewed and shutdown work inputted into the VTEP team i.e. fire main work that can only be done in a turnaround. - RBWS reviewed and complete.		4/9/2019
Operations	Operations Manager Andy Thorp	Keith Thomas Malcolm White Ben Diment	- All Operations Dept work items to be included in the TA are identified, justified and passed onto the respective Team Leaders and Planners. - Unit punchlisting completed and relevant PM04's raised. - Identify plant defects and submit PM04's - OMC's to complete Ops package for all PM04's as per the OE work flow Model. - In conjunction with Reliability / Process Safety, ensure PHA completed on process units included in the TA and all TA PHA actions included in the workscope. - For non PDEP projects, Capital Work Request (PP-ENG-FRM-0033) to be approved with cost estimate and scope of work. - Catalyst requirements, exchanger fouling and column performance reviewed and action items passed onto the TA Team leaders and planners. - Key work on the steam, fuel and electrical systems identified. - Common lines and tankage work identified in B&S. - RBWS reviewed and complete.		14/8/19
Inspection	Technical Director Joe Muehlbauer	Clive Brown	- All Inspection Department work items to be included in the TA are identified, justified and passed onto the respective Team Leaders and Planners. - All statutory inspection dates set. - All RBI work completed. - All heaters to be pigged identified. - All heaters inspected and workscope defined. - All heat exchanger / fin fan work identified i.e. number of tubes to be removed identified, IRIS work required. - Number and location of Thermowells identified per unit. - All line retreads identified, IANS issued and exact scope of work detailed to the TA team. - All Written schemes completed and all internal inspection requirements identified. - Process lines from unit battery limits to tankage inspected. - All stack work WSE completed. - All equipment templates completed and handed to the TA Team. - All injection points / hot lines identified, reviewed against PCMS/FMEA with Risk Ranking and RBWS then passed onto the TA Team.		3/9/19
Maintenance	Maintenance Director Richard Allen	Neil James Mark Boswell Dan Rochester Chris Lloyd	- All Maintenance Department work items to be included in the TA are identified, justified and passed onto the respective Team Leaders and Planners. - All maintenance work in the operating area on units that are shutdown is identified. - Equipment identified as 'on the run' work to be completed outside of the Turnaround. - MANO backlog reviewed and work submitted to the TA team via the PM04 process. - IAC21's reviewed and work passed onto the TA. - Ensure any Instrument / Electrical upgrades have been identified and inputted as PM04's or detailed projects i.e. an ER with the necessary approval. - Identify any analyser modification / upgrades. - RBWS reviewed and complete.		14-8-19
Reliability	Technical Director Joe Muehlbauer	Clive Brown Jon Cummings	- All Reliability Department work items to be included in the TA to be identified and passed onto the respective Team Leaders and Planners. - In conjunction with Ops ensure PHA studies completed on process units included in the TA and all TA PHA actions included in the workscope. - Ensure previous unit reliability studies have been reviewed / completed and ER's raised for the work. - Ensure all Critical Check Valves (CCV's) are included in the workscope. - Previous significant LPO's have been reviewed and detailed engineering packs produced to rectify problems. - RCM studies completed and passed onto the TA Team. - All Electrical distribution workscope included. - Ensure the RBWS is completed.		3/9/19
Rotating Equipment	Technical Director Joe Muehlbauer	Clive Brown	- All Rotating equipment work items to be included in the TA to be identified and passed onto the respective Team Leaders and Planners. - Identify Machinery Overhaul requirements and detailed plans and pass onto VTEP planners - RBWS reviewed and complete.		3/9/19
PES Projects TPO Projects	Technical Director Joe Muehlbauer	Simon Law	- All projects identified and being resourced to ensure projects are approved, PDEP phase 1 and / or Capital Work Request (PP-ENG-FRM-0033) by 12 months before pulling feed. - Long lead equipment identified and requisitioned by the Project Engineer. - Project TA specific work have been / will be passed onto the TA VTEP planners by 12 months before pulling feed. - RBWS reviewed and complete.		3/9/19
Process Engineering	Technical Director Joe Muehlbauer	Sarah Jellicoe	- In conjunction with Ops / Reliability, ensure PHA studies completed on process units included in the TA. - Process reviews, as per the asset review expectations have been completed and fed into the asset review meetings. - Previous significant LPO's have been reviewed, fed into the unit FMEA's and prioritised as per the CAPEX program. - RBWS reviewed and complete.		3/9/19
Process Control	Technical Director Joe Muehlbauer	Phil Simes	- All process control work items to be included in the TA to be identified and passed onto the respective Team Leaders and Planners. - Identify DCS maintenance requirements - RBWS reviewed and complete. - Identify software upgrades, produce a workscope and pass on plans to the VTEP planners. - Identify hardware upgrades, produce a workscope and pass on plans to the VTEP planners. - Ensure any TA related SIS work is included in the workscope.		3/9/19

Appendix 8 – Additional Work Request (AWR)

Appendix 9 – Team Leaders Report

Appendix 10 - HTU-2 Organisation Chart



Appendix 11 – Minutes of Meetings

Appendix 12 - HTU-2 Safety Report

Appendix 13 – HTU-2 Cost Tracker Report

Appendix 14 – AP Networks i-TAP 2 Assessment

Appendix 15 – Project Proposal