PTT ENERGY SOLUTIONS

Your Excellent Solutions

The Esolution+

Newsletter

Issue 1 / Year 2021

WELCOME TO
PTT Energy Solutions

PTT Energy Solutions Company Limited (PTTES), a PTT Group company, was established in 2011. Through our strong background as a technical consultancy firm, we commit to deliver an extensive range of engineering consulting services with multi-discipline expertise, as well as focus on the use of technology and innovation to increase competitiveness for customers' businesses, both within the PTT group and in other industries.

VISION

A trusted consulting company that provides Technical Excellence Solution to promote sustainability for customers in the region by 2022.

MISSIONS

01 Build proficiency to create **Technical Consultancy** services that provides a one-stop-service to customers.

02 Seek and build **proprietary products/ services/ solutions** to enhance client competitiveness using **Integrated Technology & Engineering Solutions.**

03 Strengthen portfolio and capture **New Markets opportunities** beyond PTT Group.

04 **Create supportive process, environment, and culture** that promote individual and team learning & development and that motivate people.

PTTES VALUES : SPIRIT

PTT Group has the value called SPIRIT
with a belief that This SPIRIT value provides
a guideline for the creation of a framework of ideasand
beliefs that will lead to behavior and practices for the management
and all employees to be “Kon Dee” (Responsibility for Society,
Integrity & Ethics,Trust & Respect) and “Kon Keng”
(Synergy, Performance Excellence, Innovation)
of the organization and society.

The way we work together

S — Synergy
สร้างพลังร่วมอันยิ่งใหญ่

P — Performance Excellence
ร่วมมุ่งสู่ความเป็นเลิศ

I — Innovation
ร่วมสร้างนวัตกรรม

R — Responsibility for Society
ร่วมรับผิดชอบต่อสังคม

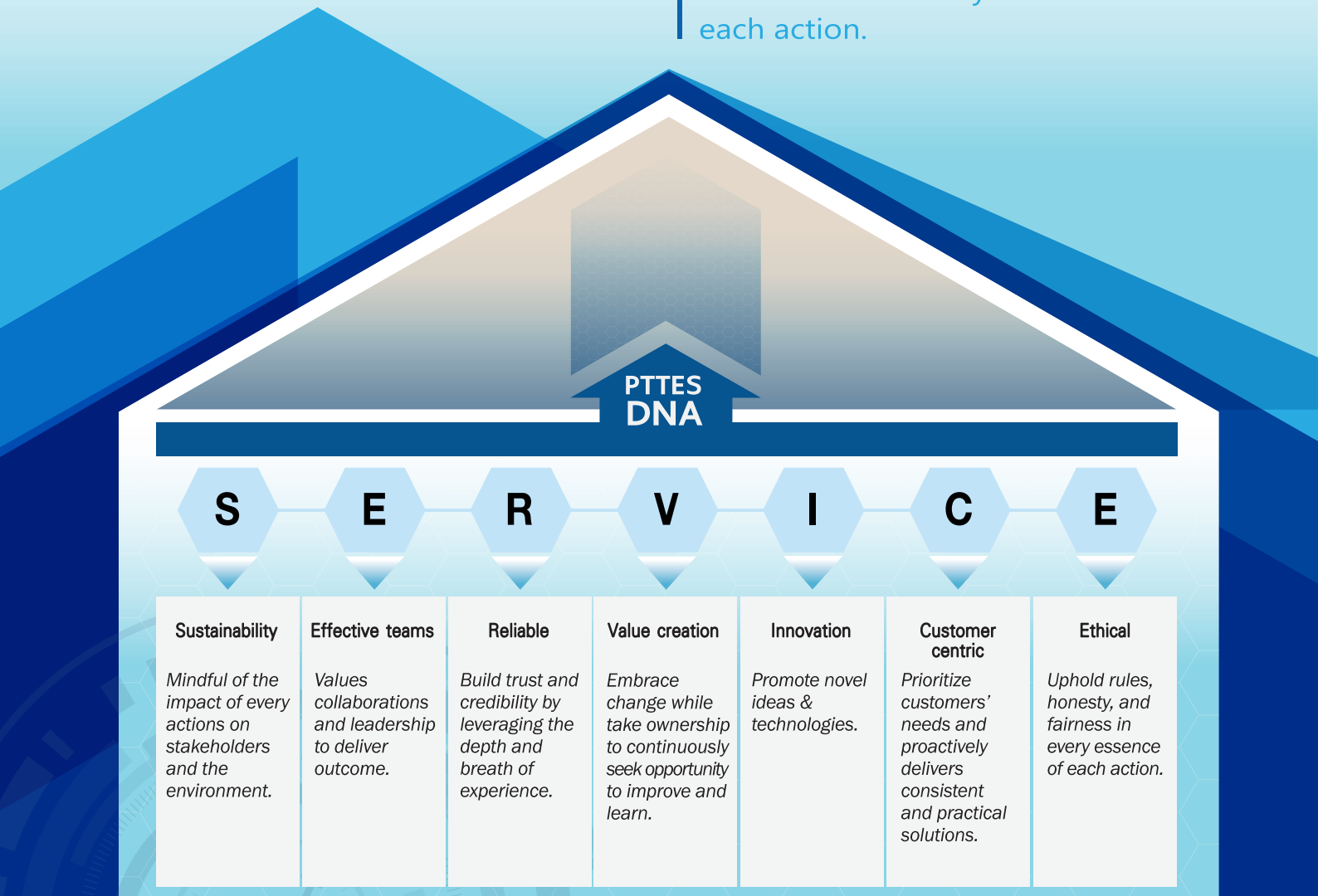
I — Integrity & Ethics
ร่วมสร้างพลังความดี

T — Trust & Respect
ร่วมสร้างความเชื่อมั่น

PTTES DNA : SERVICE

PTTES DNA is derived from core value of aspired players and from PTT Group SPIRIT values. SERVICE are to be the guiding principle of desirable traits and behavior that will drive PTTES to its aspirations.

- **Sustainability :** Mindful of the impact of every actions on stakeholders and the environment.
- **Effective Teams :** Values collaborations and leadership to deliver outcome.
- **Reliability :** Build trust and credibility by leveraging the depth and breath of experience.
- **Value Creation :** Embrace change while take ownership to continuously seek opportunity to improve and learn.
- **Innovation :** Promote novel ideas & technologies.
- **Customer Centric :** Prioritize customers' needs and proactively delivers consistent and practical solutions.
- **Ethical :** Uphold rules, honesty, and fairness in every essence of each action.



Oil Logistics
Network Optimization

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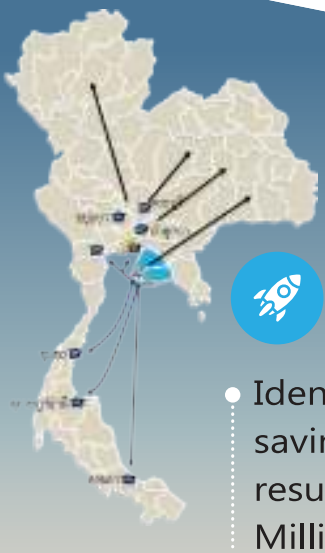
Our client runs an oil retail business, and requested PTTES to study the current domestic oil logistics network and the masterplan for the next 5 years. This study focused on finding the most effective and optimized overall logistics based on cost, as well as comparing options for future facilities investment.

KM Corner

OBJECTIVE :

- To perform an optimization study on the total logistics cost of the overall oil distribution network from refineries to customers.
- To provide Quick-win solutions to improve the current distribution network.
- To simulate savings for the future scenarios and options for future facilities investments.

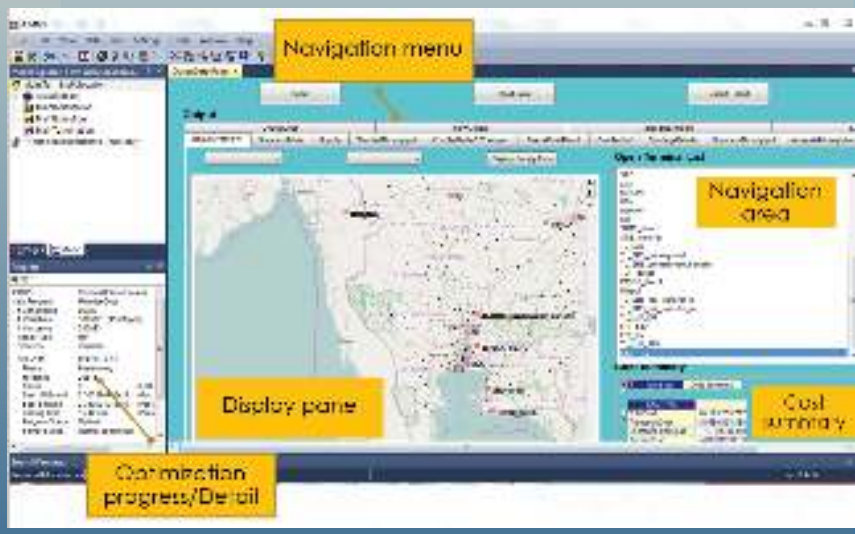


OUTCOME:

- Identified potential savings from Quick-win resulting in about 300 Million Baht per year.
- Proposed the most optimized future scenarios with potential logistics savings of about 1,000 Million Baht per year.
- Enhanced analysis of asset rationalization and debottlenecking of terminals and distribution routes to optimize and maximize effectiveness.

SCOPE OF *STUDY:*

1. Agree on basis, assumption and scenario cases.
2. Build an optimization model from actual provided data and run the model validation by comparing the model and actual results.
3. Run the Quick-win optimization to find improvement opportunities and savings for the current oil distribution network.
4. Build the optimization model for future scenarios and run the optimized results for each of the alternative scenarios.
5. Recommend the most reasonable and optimized options to client, and enablers or investment required to achieve the cost saving options



SMART TERMINAL CONCEPTUAL DESIGN

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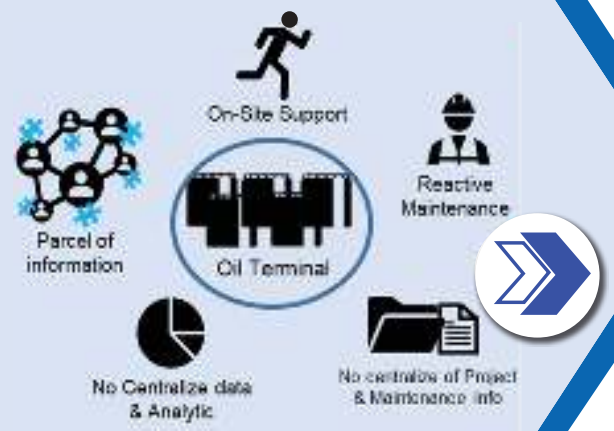
The Smart Terminal is a 'blueprint' for the future terminal expansion. The Conceptual Design optimizes manpower requirements while increasing terminal efficiency with a combination of changes to work methods and state of the art digital technology. The Operation, Safety & Maintenance Philosophies for the Smart Terminal were developed to solve the existing 'pain points' from both a system/procedure point of view and a hardware/software perspective.

These philosophies are supported by the implementation of intelligent data management systems, data analytics, productivity/collaboration tools and mobility applications.

PTTES worked in partnership with the client to develop the Smart Terminal Conceptual. The project was completed in two stages;

Typical Existing Terminal



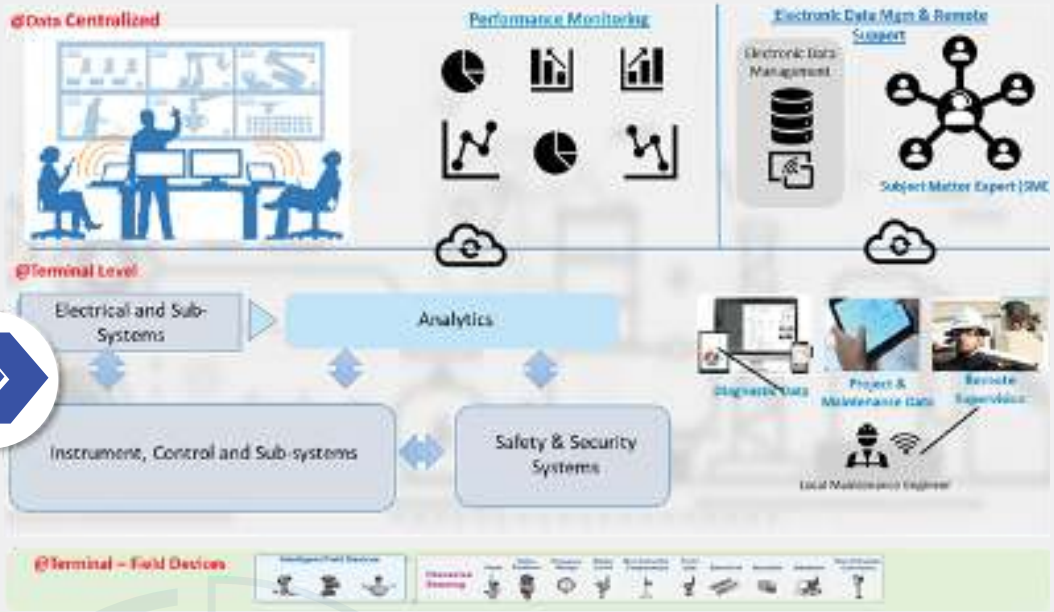
01 **'Preliminary Assessment'** consolidating the present situation involving;

- Scouting survey of the existing conditions, practices and key operation activities
- Data gathering and evaluation
- Workshop to understand the "As is" pain points and opportunities for improvement
- Consolidation of data and requirements to define the preliminary conceptual design

02 **The 'Conceptual Design'** building on the 'Preliminary Assessment' in greater detail.

- Design the elements required to achieve an integrated solution.
- Workshop to develop the "To be" smart terminal requirements.
- Investigate available technologies, prioritize and supply budget estimates.
- Develop the conceptual design package of the Smart Terminal.

Smart Terminal



Greenfield & Brownfield Solutions

The 'blueprint' was designed for new terminals where the maximum benefits can be achieved.

Smart Terminal Benefits

- Increase staff Efficiency
- Optimize Truck Turnaround Time
- Centralize information systems such as Order to Cash, Terminal Operation, Safety & Security and Maintenance
- Increase equipment reliability
- Reduce maintenance cost
- Remote support and diagnostic ability
- Mobility solutions for operation & maintenance tasks
- Increase compliance with systems and procedures
- Reduce safety risks

However, the Smart Terminal principles and potential solutions are also applicable for upgrade and refurbishment of existing terminals.

SEA WATER
DESALINATION PROCESS

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Fresh Water Generation on an Island

Desalination is the removal process of dissolved salt from sea water to produce fresh water for human consumption, industrial usage and to produce demineralized water for use in steam generators. Desalination process has two main categories, thermal processes and membrane processes. Theses well-known desalination technologies are indicated as follows.

KM Corner

Thermal

- Multistate Flash (MSF)
- Multiple Effect Distillation (MED)

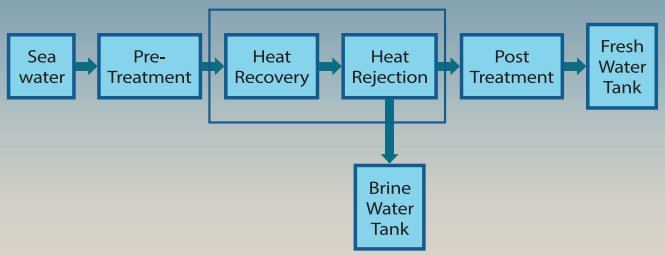

Fig 1: Multistate Flash or Multiple Effect Distillation - Typical Flow Diagram

Membrane

- Reverse Osmosis (SWRO)

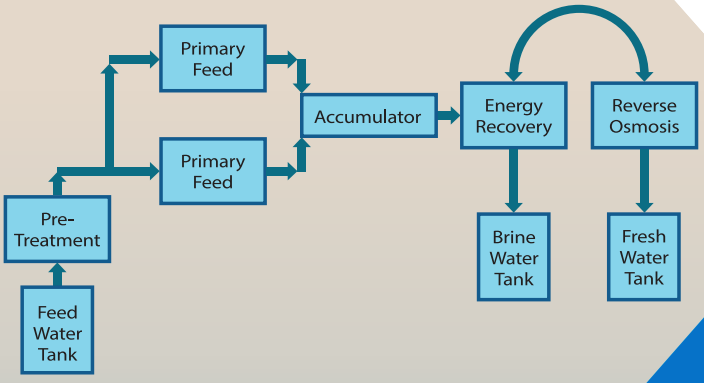

Fig 2: Sea Water Reverse Osmosis - Typical Flow Diagram

The brine discharge generated from each desalination process shall be sent back to the sea after treatment according to regulations.

Zero Liquid Discharge (ZLD)

for salt product and chlor-alkali

- Evaporator and Crystallizer

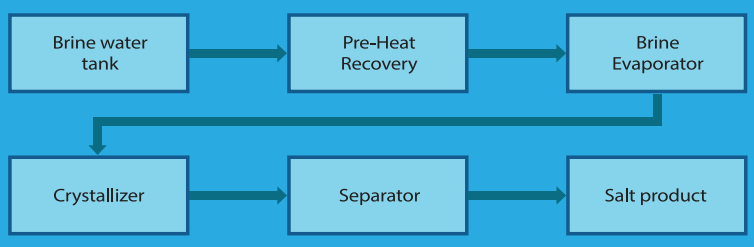

Fig 3: Zero Liquid Discharge – Typical Flow Diagram

	Multistate Flash (MSF)	Multiple Effect Distillation (MED)	Reverse Osmosis (RO)
Capacity	Suitable for large capacity	Suitable for large capacity	Relatively lower investment cost
Investment cost	High capacity cost	High capacity cost	Higher cost chemical and membrane (5-7 years) replacement, higher auxiliary power requirement
Technology	Proven and reliable technology with long operating life	Proven and reliable	Proven and reliable, also continue developing membrane and modular design
Require thermal consumption	High	Moderate	None
Heat Energy	Can be sourced by combining with power generator	Can be sourced by combining with power generator	None
% Fresh water recovery	25-50%	35%	30-60%
Feed water Quality	No impact	No impact	High impact
Fresh water Quality	<50 mg/L TDS	<10 mg/L TDS	<500 mg/L TDS
Complexity of plant operation and maintenance	Slow start up rates, maintenance requires entire plant shutdown, requires minimal pre-treatment of feed water, high technical knowlegde requires	Product water requires cooling and blending prior to being used for potable water needs, requires minimal pre-treatment of feed water	Membrane susceptible to fouling, no cooling for water product, simple operate and fast start up, not mechanical failure due to high pressure
Fresh water Quality	Larger footprint require (land and material)	Larger footprint require (land and material)	Small footprint require (not included pre and post treatment)

Table 1: Desalination Process Technology Comparison

PTTES performs the Project development study,
PTTES evaluate and propose the most suitable investment option to our clients, *Research Tech. Market Availability, Technical Evaluation and to develop conceptual study* to help a client investigate how they can study desalinate sea water project as make-up raw water in their site.

EXTENDING the life of cyclic duty equipment

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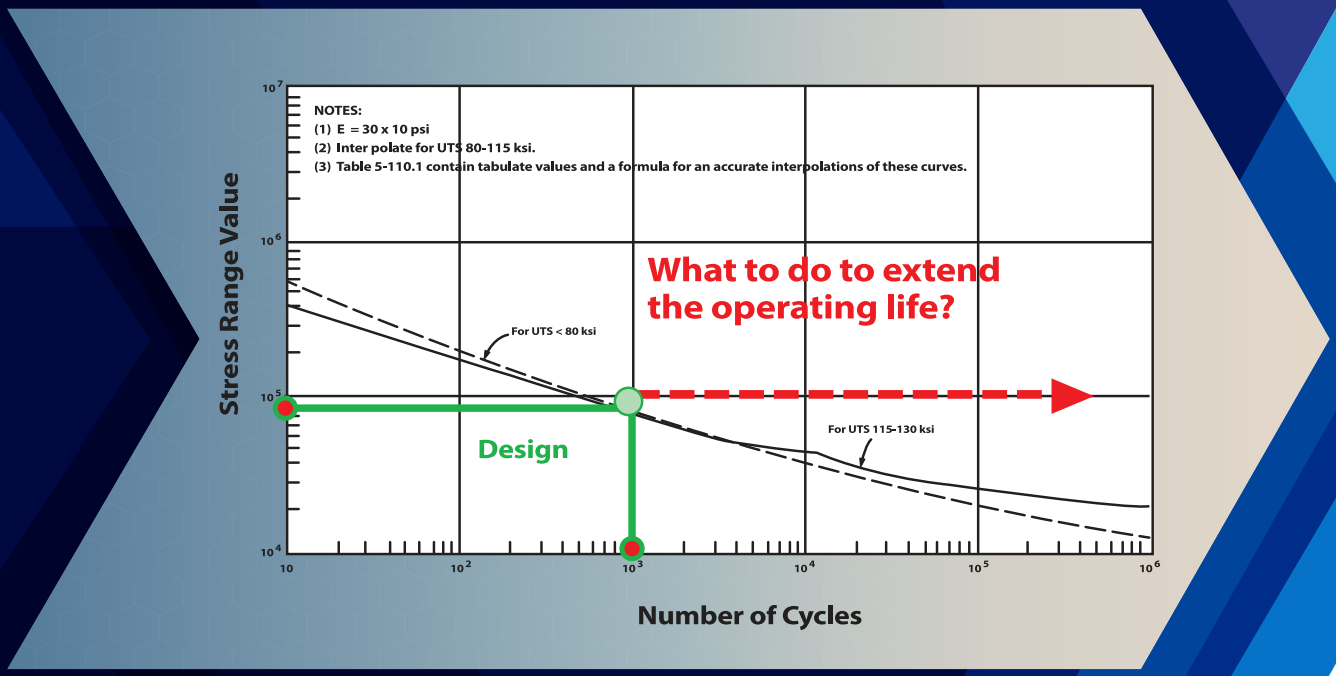
Cyclic Duty Equipment is given a finite life based on a specific number of loading cycles. How do we justify continued operation beyond the design life? What is the ongoing inspection strategy?

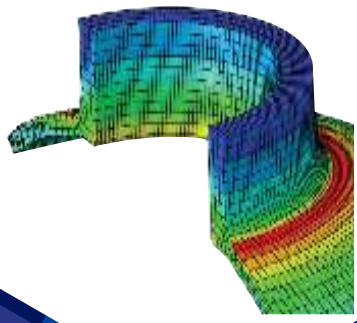
KM Corner

Fatigue Design by Rule

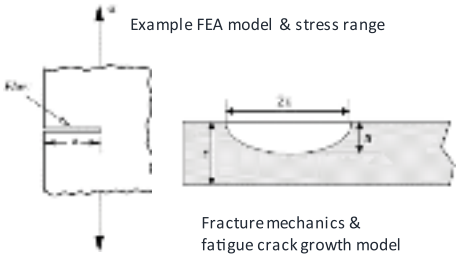
- Design codes use Stress-Cycle (S-N) Curves
- Stress levels are limited by design to achieve the required life
- The life is defined in a number of cycles of stress or load.
- The stress to cycle relationship is not linear it is logarithmic – a small reduction in stress leads to a much longer life.

Pressure Swing Adsorbers, Gas Driers, Coke Drums and Auxiliary Boilers are examples of cyclic duty equipment.





Example FEA model & stress range



Fracture mechanics &
fatigue crack growth model

STEP 1:
Identify Equipment Stress Range

Finite Element Analysis (FEA) is used to determine the stress range in locations such as nozzles, manways, dished ends, skirt connections etc.

KM Corner

STEP 2:
Fitness for Service Assessment

API579 Level 3 Fracture Mechanics calculations to arrive at a critical defect size beyond which the equipment will be at risk of failure. Determination of the cycles for a detectable defect to grow to the critical size

STEP 3:
Specify future inspection tasks and frequency

Specify inspecton tasks and frequency to locate potential defects in the equipment. Use advanced NDT to allow in-service inspection externally. Move to a Non-intrusive inspections scheme - no confined space entry. Frequency of inspection increased by 2x

Project Benefits

- ✓ No need for replacement equipment
- ✓ Continued safe & reliable operation
- ✓ Reduced costs & efficient use of inspection resources
- ✓ Risks of confined space vessel entry removed
- ✓ Local knowledge transfer to the client

Update inspection tasks and extend frequency using a Focused Scheme Of Examination (FSOE)

AI BASED PRODUCT QUALITY PREDICTION MODEL

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KM Corner

Data science is widely applied in various business areas where insight is crucial. The following procedure is conducted to evaluate the most effective results for the application of data science.

For refineries and petrochemical industries, data science has served various applications, including product quality estimation, equipment failure probability detection, stock database deduplication, product blending prediction, etc. For example, the result of applying the data science work process to real industrial application is illustrated in the following.

1	**Business Understanding**	Understand the business problem and receive relevant information. The objectives must be clearly defined to select the appropriate algorithm to solve the problem.
2	**Data Mining**	Gather and extract essential data via various methods e.g. data association, data classification, and data clustering.
3	**Data Cleaning**	Eliminate outlier data and fix any inconsistencies. Missing values should be handled in order to aid in hypotheses justification.
4	**Data Exploration**	Formulate hypotheses and draw out inferences by applying statistical methods, and then illustrate the results via visualizing.
5	**Feature Engineering**	Select important features which represent the strongest relation between input and output. This step is one of the most crucial to bring out optimal model performance.
6	**Predictive Modeling**	Select an appropriate machine learning model, training algorithm, and evaluation method.
7	**Data Visualization**	The developed model is then used to predict information and illustrate via interactive visualizations for ease of communication and making effective decisions.

Fig. 1 Data Science Work Process

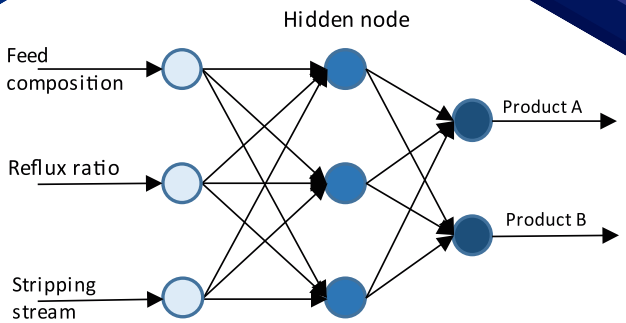

Fig. 2 Deep-learning model structure

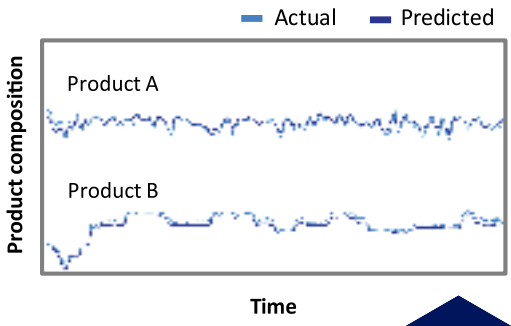

Fig. 3 Model performance

The objective is to develop a data driven based predictive model for distillate product quality estimation. In this case, data exploring is conducted which included several parameters of the distillation unit. Correlation study and feature ranking is applied to evaluate inferences of the correlation between each operating parameter and the process output (product composition).

The parameters with highest impact, namely feed composition, reflux ratio, stripping steam rate are included in the modeling. According to numerous data sets and non-linear process behavior, a highly flexible configuration method called deep-learning is applied to develop a model for product composition prediction.

As a result, the developed model is validated with an unseen actual data set, showing the average percent error between 1 – 3 %. However, the work process (e.g. re-data featuring, and model retraining) can be repeated to improve the accuracy which increases benefits such as product loss prevention.

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