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Circular Economy Initiatives at Upstream Surface Facilities

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Abstract

The objective of this paper to showcase the feasibility of a Circular Economy (CE) initiative for upstream surface facilities to recover, reduce, and reuse the wasted energy across different plant equipment, including throttling valves.

Several energy recovery and energy conservation technologies and processes were identified to minimize energy consumption in Tanajib plant. The optimum technology options were selected to minimize the modifications of the existing facilities, while maintaining the flexibility to meet the future production forecast. The study was conducted using the following methodology:

1. Conduct comprehensive energy assessment of all high potential oil, gas, and water streams to recover its wasted energy.
2. Create several process designs/layouts that will incorporate these technologies and enable meeting the required specs at the surface facility.
3. Conduct technical evaluation and lifecycle cost study, to compare different alternatives to meet the objective.

The comprehensive assessment revealed that there are three economically feasible projects out of 10 evaluated business cases to harness wasted energy at Tanajib plants. Hydraulic Power Recovery Turbine (HPRT) technologies were found to be one of the most promising technologies to harness the wasted energy with minimum modifications. HPRT is a Reverse Pump that will harness the wasted pressure drop across the liquid control/throttling valves and convert it into useful power. The 500 MBCD Tanajib plant was used as proof of concept.

Recovering and utilizing the wasted energy will promote circular economy, minimize the imported power from the national grid and minimize CO_2 emissions, while extending the equipment lifetime.

Background

A Hydraulic Power Recovery Turbine (HPRT) can be defined as a machine utilized to recover and restore energy from liquid streams by reducing their pressures. There are several types of HPRT but one common type of HPRT is a reverse-rotating centrifugal pump which is used to recover energy from a high-pressure process liquid by reducing its pressure that will normally be wasted across throttle valves. A centrifugal pump can be utilized as HPRT with introdcung some design changes including vertical or horizontal, overhung or between bearing, single stage or multistage. HPRT can be manufactured with common materials of construction such as carbon steel, stainless steel or chrome.

HPRT design is similar to a pump but it is reversed because of the opposite rotation and the inlet pressure is higher.

The HPRT nozzles are similar to those of a pump but are reversed. This means that the inlet of an HPRT is the discharge of a pump and its outlet is the suction of a pump. The HPRT performance differs from the pump performance. The HPRT should be oprated close to the Best Efficiency Point (BEP) while pumps can be operated ranging from the minimum to the maximum flow design. The HPRT capability to recover energy can deteriorate at some point lower than the BEP and below that it may hinder the system reliability.

The following equation is used to calculate the power recovered by HPRT:

$$HP=\frac{Q \times H \times SG \times E}{3960}$$

where:

HP - energy recovered by turbine, HP

Q - turbine capacity, GPM

H - differential head across turbine, ft

SG - specific gravity of liquid

E – efficiency of turbine, decimal

In GOSPs, there are numerous scenarios where there is a need to reduce pressure of liquid stream(s) from high to low. The conventional method of reducing liquid pressures for process need is by throttling with globe valves or choke valves. This practice is highly prone to wastage of substantial amount of energy. A large amount of energy could be salvage if an alternative system is established to reduce liquid stream pressures and at the same time recover the wasted potential energy of the liquid to useful electrical energy. One proposal for effective energy recovery from high pressure liquid involve installing power recovery turbines in strategic locations to reduce excess pressure of liquid streams to a lower pressure required by a process without jeopardizing operability and functional requirements. HPRT is normally installed in parallel with the existing control valves that traditionally reduce pressure in gas or liquid lines. If flow is too low for efficient generation, or the expansion turbine fails, pressure is reduced in the traditional manner through the control valves.

Process Overview

The Tanajib GOSP processes 600,000 bpd of wet crude oil received via a 36-inch pipeline from Marjan offshore GOSPs. Figure 1 below shows the overview schematic of Tanajib GOSP process. The wet crude flows to the Low-Pressure Production Traps (LPPT). The overhead gas flows to gas compression or HP flare. From the LPPTs the crude product flows to the two atmospheric pressure separators (spheres). More degassing takes place in these spheres. The overhead gas from the spheres flows to atmospheric gas compression or LP flare. The crude oil is pumped from the spheres by the Dehydrator/ Exchanger Feed Pumps, to the Dehydrator Feed Exchangers in the desalting unit. The produced water is pumped to Water Oil Separator Plant (WOSEP) for entrained oil removal.

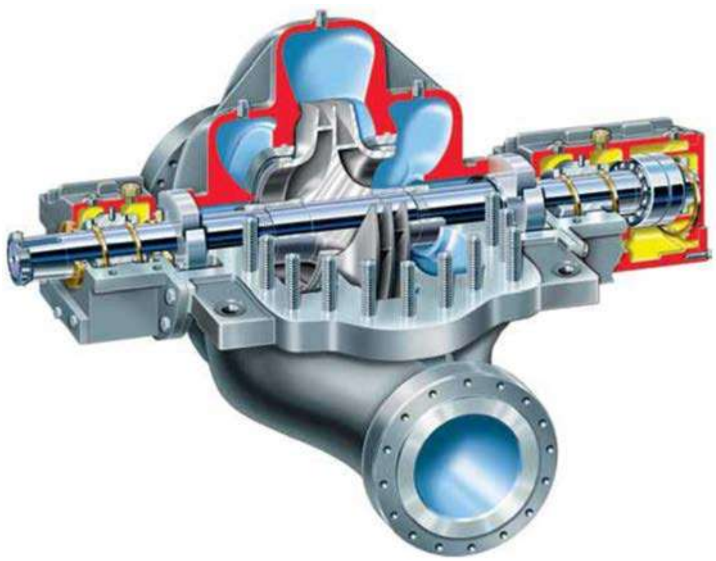

Figure 1—Heavy-Duty, Between Bearings, Axially Split, Single-Stage, Double-Suction Pump (Courtesy of Flowserve)

The crude product is preheated in the dehydrator feed exchangers to enhance oil and gas separation. From the dehydrator feed exchangers, the crude flows through the wet crude trim heaters where further heating takes place. The wet crude oil from the wet crude trim heaters flows to the desalter feed flash drum where more gas oil separation takes place. From the flash drum the wet crude flows to the desalting trains.

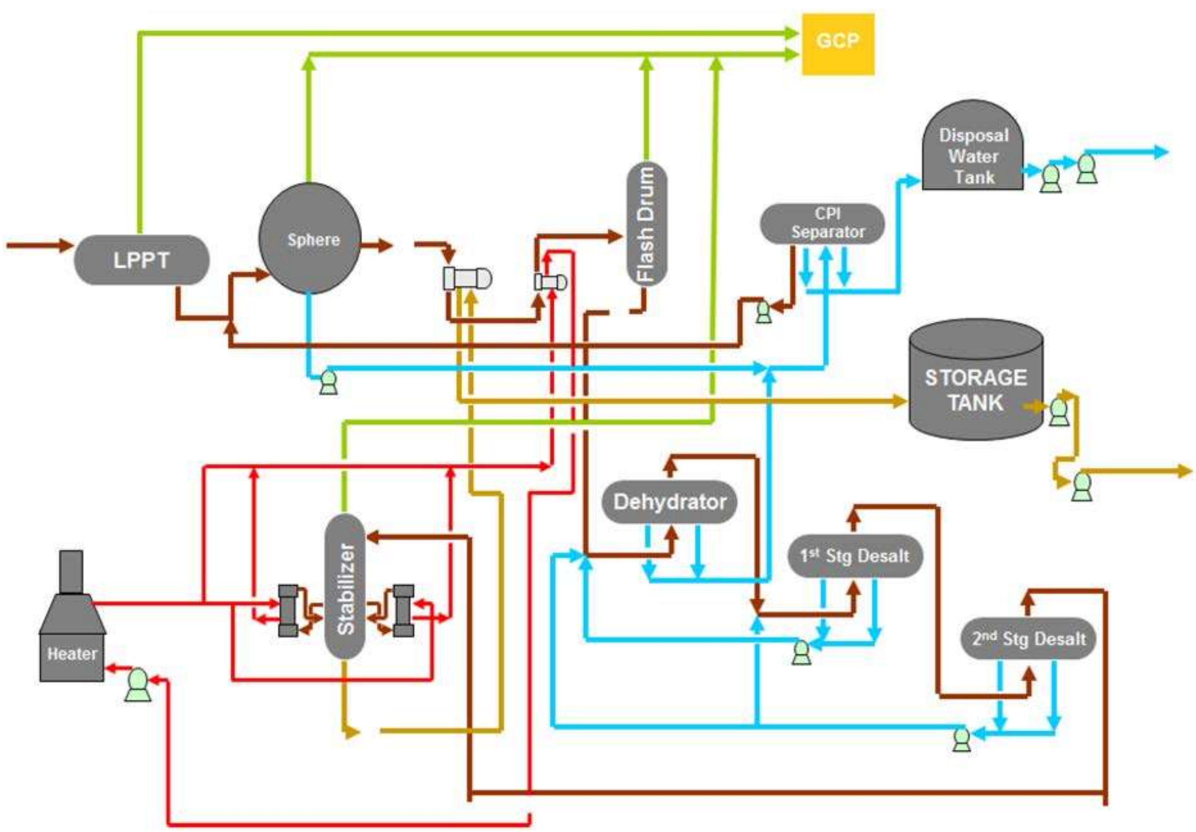

Figure 2—Overview schematic of the Tanajib process

The desalting/dehydration process begins as the crude product from the flash drum flows to the desalting trains, where the amount of salt and water in the crude product is reduced converting it from wet crude to dry crude. Each desalting train consists of three similar vessels: a dehydrator, a first stage and second stage desalter.

The stabilizing process begins as the crude product enters the stabilizers, from the desalting trains. The H_2S and light hydrocarbons are removed as the desalted crude passes over the stabilizing column trays. The gas flows to the gas compression plant. The crude product leaving the stabilizers is no longer sour. The H_2S specification is 10 ppm Weight and the RVP high limit is 10 psia. The key variables that can influence the H_2S and RVP are:

1. Reboiler outlet temperatures
2. Column Pressure

The stabilizer bottoms pumps, transfer the dry stabilized crude back through the dehydrator feed exchangers to the storage tanks providing preheating to the incoming wet crude. The hot oil system heats diesel oil and circulates it as a heating medium to the wet crude trim heaters, re-boilers, and the fuel gas heaters. The hot oil system is a closed loop circulation system. The diesel oil is pumped through the coils of the hot oil furnaces, where it is heated.

Circular Economy:

The circular economy is an important part of today's economy that focuses on sustainability and growth. Before that, we should define the linear economy. The linear economy represents the way that the global economy works where people take resources, materialize and utilize them, and then they dispose them. This creates waste and emissions and it contributes to resources depletion. The linear economy is unsustainable as it leads to diminishing resources and goods. This is a challenge considering that many resources are finite.

Figure 3—A representation of the Linear Economy model

The circular economy can be defined as an industrial system that depends on restoration and regeneration by design, which means that we take resources, or materials, make and consume them, and then we reuse them again or recycle them.

A circular economy model is intended for designing out waste. In fact, a circular economy is based on the idea of eliminating such things as waste.

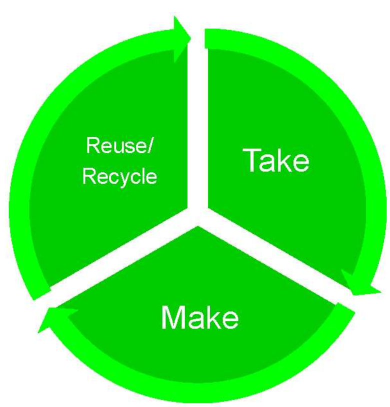

Figure 4—A representation of the Linear Economy model

Circular economy has many benefits including:

- Exploring economic opportunities as we reduce the consumption of resources
- Minimizing waste and environmental impact and emissions
- Conserving natural resources
- Promoting sustainability and growth

This paper will demonstrate how we can promote circular economy in a Gas Oil Separation Plant by eliminating the wasted energy from control valves using Hydraulic Power Recovery Turbine (HPRT) technology.

Study Basis & Assumptions

1. Hysys simulation version-10 was used to come up with physical properties
2. Actual operating pressure drop was taken from the PI and from PFD
3. HPRT efficiency is 80%
4. Operational & Maintenance cost is 3% of the capital cost
5. Economic analysis is based on 20 years project lifecycle
6. Power cost is 0.048 cent/kw-hr.

Results and Discussion

In the following assessment, several cases were analysed to evaluate the feasibility to recover the wasted pressure drop across the control/throttling valve into electric power using proven HPRT technology (Reverse Pump).

Tanajib Plant

In this section, Tanajib Plant streams will be analysed for potential HPRT applications.

Case-1: Wet crude inlet to LPPT.

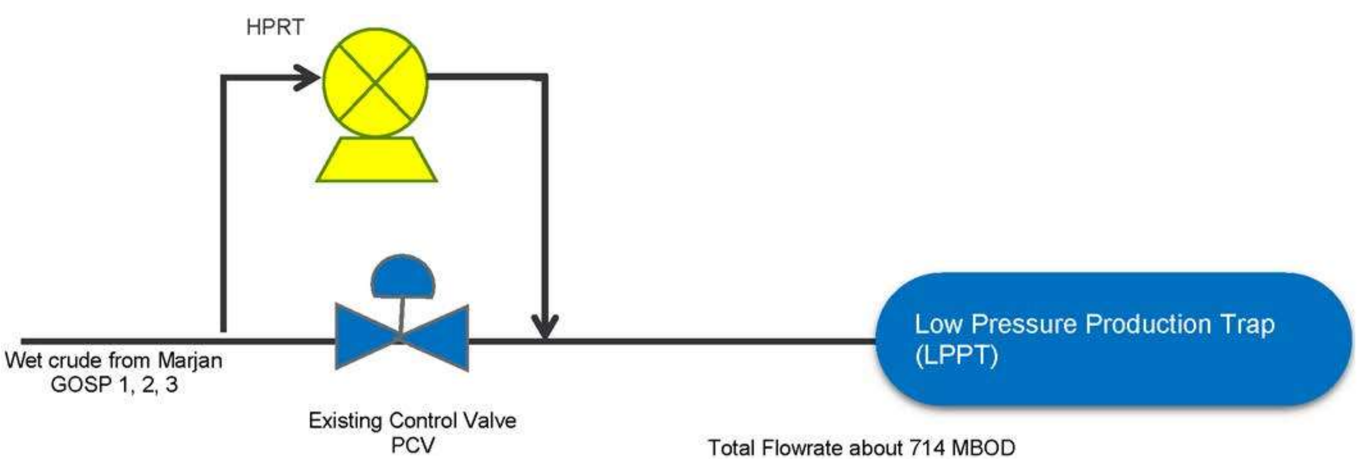

Figure 5—a diagram for wet crude inlet to LPPT

Case description

The wet crude from Marjan GOSP-1, 2 and 3 is received at Tanajib Plant where the pipeline pressure is reduced before introducing the crude to the LPPT from 250 PSIG to 50 PSIG using a PCV. The following table shows the design calculations for HPRT

Table 1—HPRT design calculation for wet crude inlet to LPPT

HPRT Design Calculations		Unit
Flow	357	MBOD
CV Inlet Press	250	psig
CV Outlet Press	50	psig
Head	491	ft
Specific Gravity	0.940	
Efficiency, E	80	%
Potential Power Recovery, hp	725	kW

HPRT was evaluated for Tanajib Plant for wet crude inlet to LPPT. The potential power generation is around 725 kW per train. The net savings generated from this initiative is $817,000/year, which is calculated using the revenue of power generation minus the operational and maintenance cost.

In this initiative, the operating cost is negligible since the HPRT will utilize an existing source, which is the high differential pressure across PCV that is currently wasted.

The table below shows a summary of project economics for two trains, assuming that O&M cost is 3% of the total capital:

Table 2—Economic calculations for wet crude to LPPT case

Project Economics	Value	Unit
Net Savings	817	K$/yr
Number of Trains	2	Train
Total Capital Cost	Significant	K$
Simple Payback Period	10.7	Years
PV (Present Value)	Significant	K$
NPV (Net Present Value)	Significant	K$

This initiative is feasible as it will lead to a significant positive net present value with a payback period of less than 10.7 years. It is recommended to proceed with implementing this initiative.

Case-2: Hot oil from furnace to trim heater

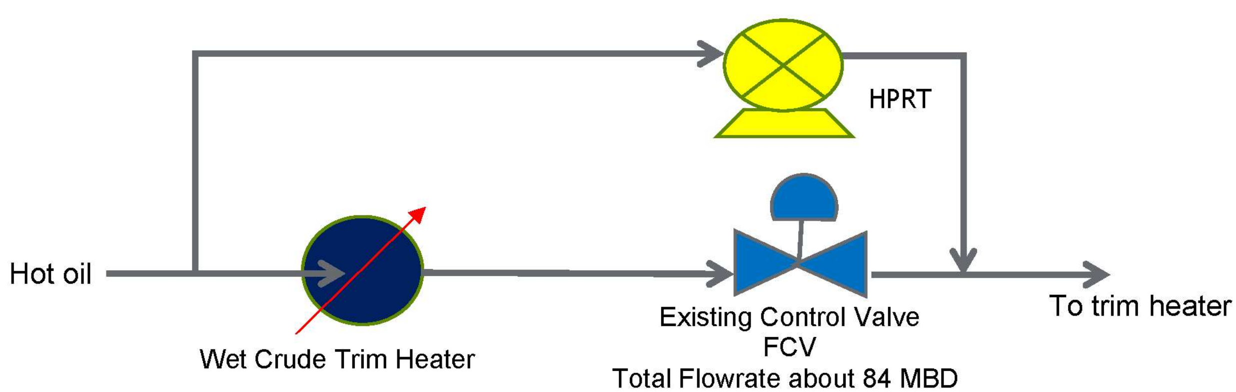

Figure 6—a diagram for hot oil stream from furnace to heater

Case description. The hot oil is used as a heating medium in the wet crude trim heater. The hot oil supply flow at 93 PSIG is controlled by FCVs where its pressure reduces to around 61 PSIG. The table below shows the technical design parameters of this stream.

Table 3—HPRT design calculation for hot oil from furnace to trim heater

HPRT Design Calculations		
Flow	84	MBD
CV Inlet Press	93	psig
CV Outlet Press	61	psig
Head	99	ft
Specific Gravity	0.746	
Efficiency, E	80	%
Potential Power Recovery, hp	27	Kw

The evaluation for Tanajib Plant for hot oil to trim heater shows that the potential power generation is around 27 kW. The potential net saving from this initiative is $85,000/year.

The table below shows a summary of ECI economics and it is shown for three trains assuming that O&M cost is 3% of the total capital:

Table 4—Economic calculations for hot oil from furnace to trim heater

Project Economics	Value	Unit
Project Net Savings	(85)	K$/yr
Number of Trains	3	Train
Total Capital Cost	Significant	K$
simple Payback Period	(153.8)	Years
PV (Present Value)	(877)	K$
NPV (Net Present Value)	Significant	K$

Based on the economic analysis, this case is not feasible since it will have a significant negative NPV since the power generated is low and thus not recommended.

Case-3: Wet crude inlet from LPPT

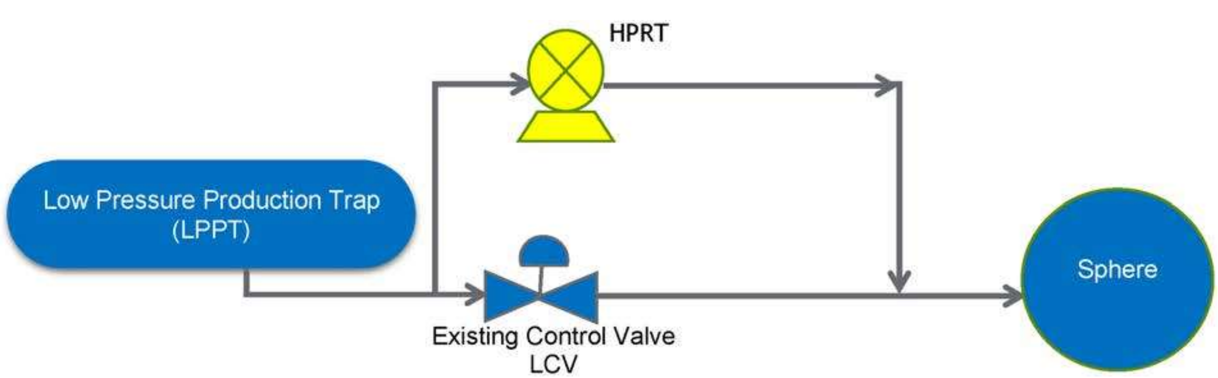

Figure 7—A diagram for wet crude inlet from LPPT case

Case description. The wet crude leaves the LPPT at about 50 psig and pressure is reduced to 3 psig using LCV. The table below shows the design calculations for wet crude from LPPT:

Table 5—HPRT design calculation for wet crude inlet from LPPT

HPRT Design Calculations		Unit
Flow	354.3	MBOD
CV Inlet Press	50	psig
CV Outlet Press	3	psig
Head	116	ft
Specific Gravity	0.940	
Efficiency, E	80	%
Potential Power Recovery, hp	169	kW

HPRT was evaluated for Tanajib Plant for wet crude inlet from LPPT. The potential power generation is around 169 kW. The expected revenue generated from this initiative is $121,000/year. The table below shows a summary of project economics based on two trains assuming that O&M cost is 3% of the total capital:

Table 6—Economic calculations for HPRT for wet crude inlet from LPPT

Project Economics	Value	Unit
Project Net Savings	121	K$/yr
Number of Trains	2	Train
Total Capital Cost	Significant	K$
simple Payback Period	72.1	Years
PV (Present Value)	Significant	K$
NPV (Net Present Value)	Significant	K$

The economic analysis of this initiative shows that the Net Present Value (NPV) is negative because of high capital cost compared to revenues. Therefore, implementing this initiative is not feasible because the NPV is negative

Case-4: Produced Water from Dehydrator

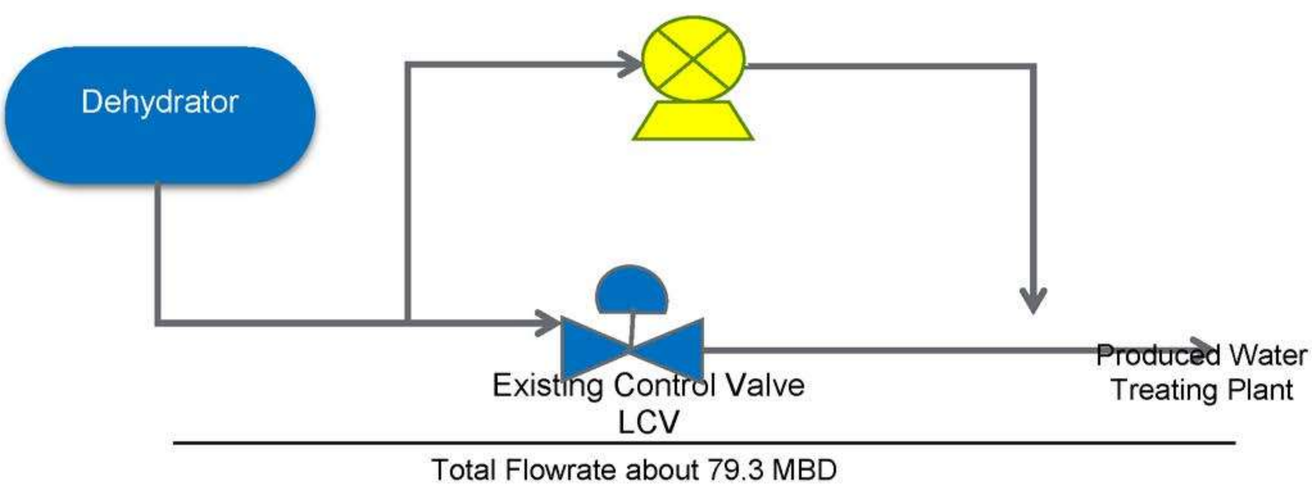

Figure 9—a diagram for produced water from dehydrator

Case description. The produced water from Dehydrator is sent to the water treating plant where its pressure is reduced from 145 PSIG to 16 PSIG using LCV. The table below shows the design calculations for this case.

Table 7—HPRT design calculations for produced water from dehydrator case

HPRT Design Calculations		
Flow	79.3	MBD
CV Inlet Press	145	psig
CV Outlet Press	16	psig
Head	307	ft
Specific Gravity	0.970	
Efficiency, E	80	%
Potential Power Recovery, hp	104	kW

The evaluation for Tanajib Plant for produced water from dehydrator reveals that the potential power generation is only around 104 kW. The expected revenue generated from this initiative $59,000/year.

The table below shows a summary of project for three trains.

Table 8—Economic calculations for HPRT for produced water from the dehydrator

Project Economics	Value	Unit
Project Net Savings	59	K$/yr
Number of Trains	3	Train
Total Capital Cost	Significant	K$
simple Payback Period	221.5	Years
PV (Present Value)	Significant	K$
NPV (Net Present Value)	Significant	K$

As shown in the table above, this case is not feasible since it will generate a negative NPV and the amount of power generated is low.

Case-5: Dry crude from 2nd Stage Desalters to Stabilizer

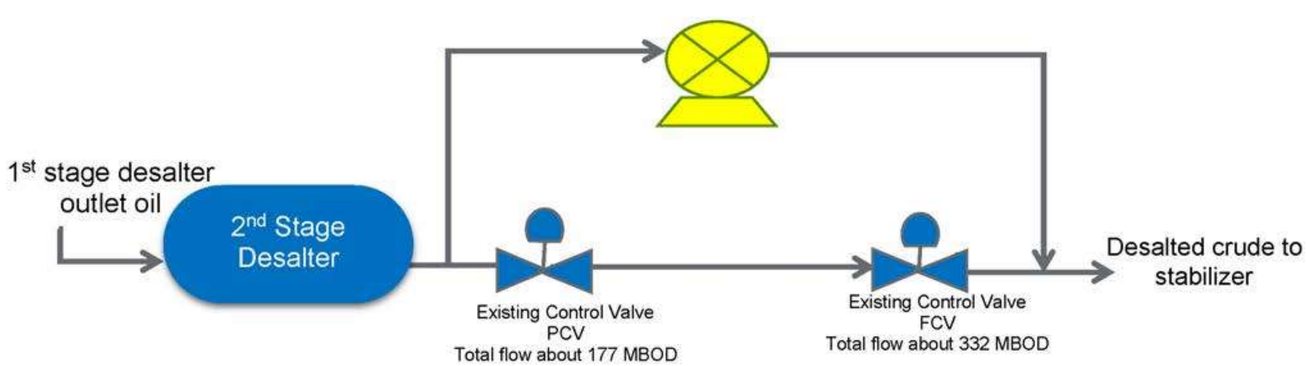

Figure 10—A diagram for dry crude from 2nd stage desalter to stabilizer case

Case description. The dry crude from the 2nd stage desalter is routed to the stabilizer and the pressure of crude is reduced through two control valves from 92 PSIG to 10 PSIG. The table below shows the design parameters for HPRT.

Table 9—HPRT design calculation for dry crude from 2nd stage desalter to stabilizer

HPRT Design Calculations		
Flow	177	MBOD
CV Inlet Press	92	psig
CV Outlet Press	10	psig
Head	232	ft
Specific Gravity	0.816	
Efficiency, E	80	%
Potential Power Recovery, hp	147	Kw

The evaluation for Tanajib Plant for dry crude from desalter reveals that the potential power generation is only around 147 kW. The expected revenue generated from this initiative is $48,000/year. The table below shows a summary of project economics for two trains.

Table 10—Economic calculations for HPRT for dry crude from 2nd stage desalter to stabilizer

Project Economics	Value	Unit
Project Net Savings	48	K$/yr
Number of Trains	3	Train
Total Capital Cost	Significant	K$
Simple Payback Period	273	Years
PV (Present Value)	Significant	K$
NPV (Net Present Value)	Significant	K$

The economic analysis shows that the case's NPV is negative and as a result it is not recommended to implement it.

Tanajib Plant Case Summary

For Tanajib Plant, the team evaluated streams having high differential pressure across the control valves and came up with the following list in Table 11.

Table 11—Summary for HPRT feasibility evaluation for Tanajib Plant.

Stream	Control Valve	Differential Pressure, psi	Flow rate, MBD	Power Generation, kW	Saving ,$/yr	NPV (K$)	Recommendation for implementation
Wet crude inlet to LPPT	PCV	200	714	1449	817,000	Significant	Yes
Hot oil from furnace to trim heater	FCV	32	84	27	(85,000)	Significant	No
Wet crude inlet from LPPT	LCV	47	708	169	121,000	Significant	No
Produced water from Dehydrator	LCV	129	79.3	104	59,000	Significant	No
Dry Crude from Desalters to Stabilizer	FCV	82	531	147	48,000	Significant	No

Tanajib New Plant

Tanajib's new plant will be constructed as part of the Marjan Increment Program to receive partially degassed crude from Marjan GOSP-4. This section evaluates the potential HPRT opportunities at the new plant.

Case-1: Wet crude inlet to LPPT

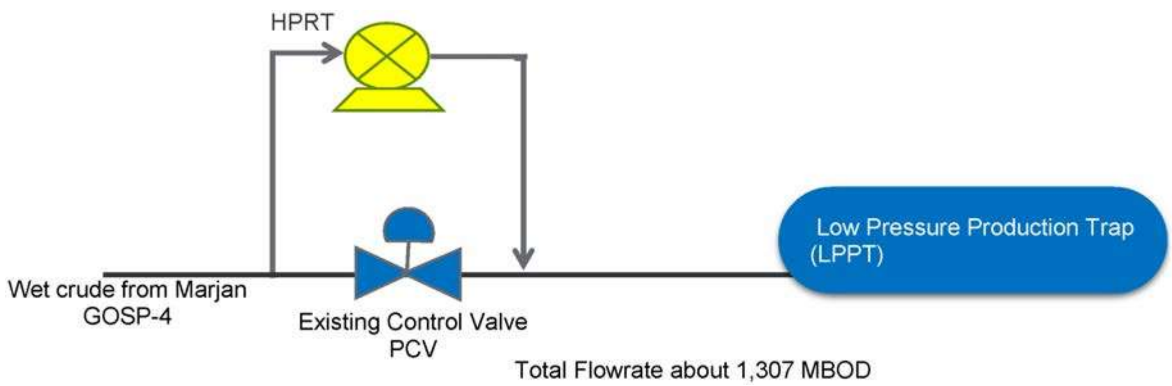

Figure 11—a diagram for wet crude inlet LPPT

Case description. The wet crude from Marjan GOSP-4 is received at Tanajib Plant where the pipeline pressure is reduced before introducing the crude to the LPPT from 250 PSIG to 50 PSIG using a PCV. The table below shows the technical parameters for this stream.

Table 12—HPRT design calculations for wet crude inlet to LPPT

HPRT Design Calculations		
Flow	1,307	MBOD
CV Inlet Pressure	250	psig
CV Outlet Pressure	50	psig
Head	564	ft
Specific Gravity	0.820	
Efficiency, E	80	%
Potential Power Recovery, hp	2653	kW

The evaluation for Tanajib Plant for wet crude to LPPT reveals that the potential power generation is around 2,653 kW. The expected annual revenue generated from this initiative is significant. The following table shows the economic calculations for this case for one train.

Table 13—Economic calculations for HPRT for wet crude inlet to LPPT

Project Economics	Value	Unit
Project Net Savings	Significant	K$/yr
Number of Trains	1	Train
Total Project Capital Cost	Significant	K$
Simple Payback Period	4.4	Years
PV (Present Value)	Significant	K$
NPV (Net Present Value)	Significant	K$

The economic analysis shows that this case is profitable and feasible since it will generate $MM 37.5 of NPV. The high flow rate of wet crude to the control valve is significantly contributing to highly positive NPV

Case-2: Dry crude from 2nd Stage Desalters to Stabilizer

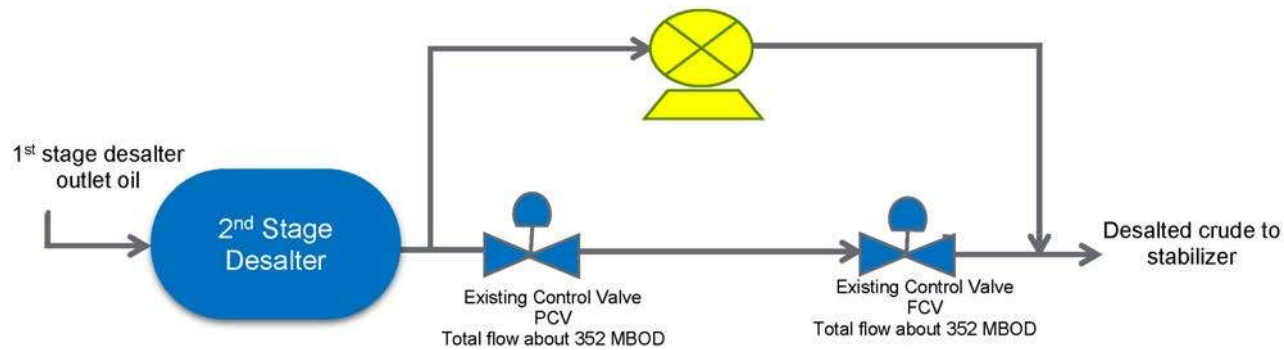

Figure 12—a diagram for the dry crude from 2nd stage desalter to stabilizer case

Case description. The dry crude from the 2nd stage desalter is routed to the stabilizer and the pressure of crude is reduced through 2 control valves from 108 PSIG to 0.8 PSIG. The table below shows the design parameters for this stream.

Table 14—HPRT design calculations for dry crude from 2nd stage desalter to stabilizer

HPRT Design Calculations		
Flow	351.7	MBOD
CV Inlet Press	108	psig
CV Outlet Press	0.8	psig
Head	303	ft
Specific Gravity	0.817	
Efficiency, E	80	%
Potential Power Recovery, hp	383	kW

The evaluation for Tanajib Plant for dry crude from 2nd stage desalter to stabilizer shows that the potential power generation is around 383 kW. The expected revenue generated from this initiative is $302,000/year. The economic analysis is shown in the table below for one train:

Table 15—Economic calculations for HPRT for dry crude from 2nd stage desalter to stabilizer

Project Economics	Value	Unit
Project Net Savings	302	K$/yr
Number of Trains	1	Train
Total Capital Cost	Significant	K$
Simple Payback Period	16.8	Years
PV (Present Value)	Significant	K$
NPV (Net Present Value)	Significant	K$

The economic analysis of this case reveals that the NPV is positive and as a result, this project is feasible and recommended for implementation.

Case-3: Hot oil return from trim heater

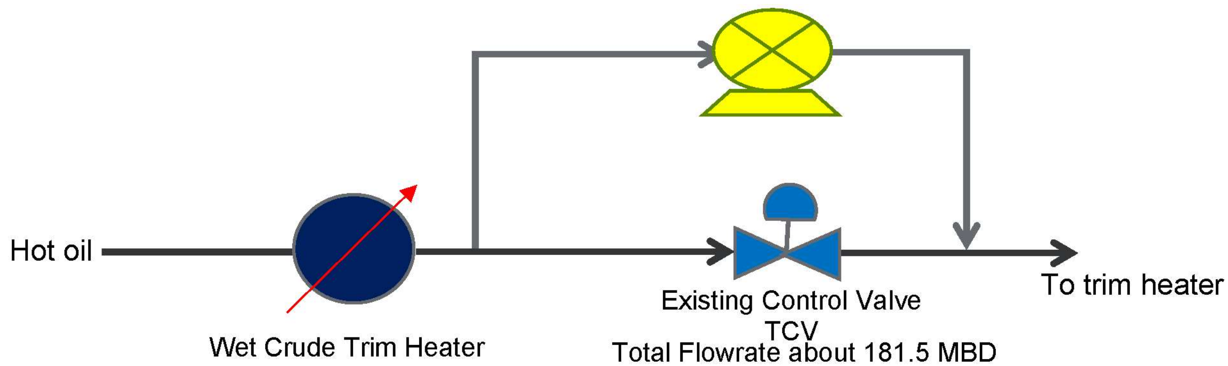

Figure 13—A diagram for hot oil stream from furnace to trim heater case

Case description. The wet crude trim heater uses hot oil as a heating medium to heat wet crude. The hot oil outlet temperature to the trim heater is controlled by TCV where its pressure is reduced from 260 PSIG to 204 PSIG (assuming that the pressure drop across the trim heater is 15 PSIG). The case is to recover the pressure drop across the valve into electric power through Hydraulic Power Recovery Turbine (HPRT). The table below shows the design parameters for this stream.

Table 16—HPRT design calculations for hot oil return from trim heater

HPRT Design Calculations		
Flow	181.5	MBD
CV Inlet Press	260	psig
CV Outlet Press	204	psig
Head	140	ft
Specific Gravity	0.927	
Efficiency, E	80	%
Potential Power Recovery, hp	103	kW

The table above for hot oil return from trim heater shows that the potential power generation is around 103 kW. The expected revenue generated from this initiative is $269,000/year.

Table 17—Economic calculations for HPRT for hot oil return from trim heater

Project Economics	Value	Unit
Project Net Savings	269	K$/yr
Number of Trains	2	Train
Total Capital Cost	Significant	K$
Simple Payback Period	37.8	Years
PV (Present Value)	Significant	K$
NPV (Net Present Value)	Significant	K$

The case's economics is detailed in the table below.

As shown in the project economics, this project will generate a negetative NPV. Therefore, we do not recommend implementing this case.

Case-4: Wet crude inlet from LPPT

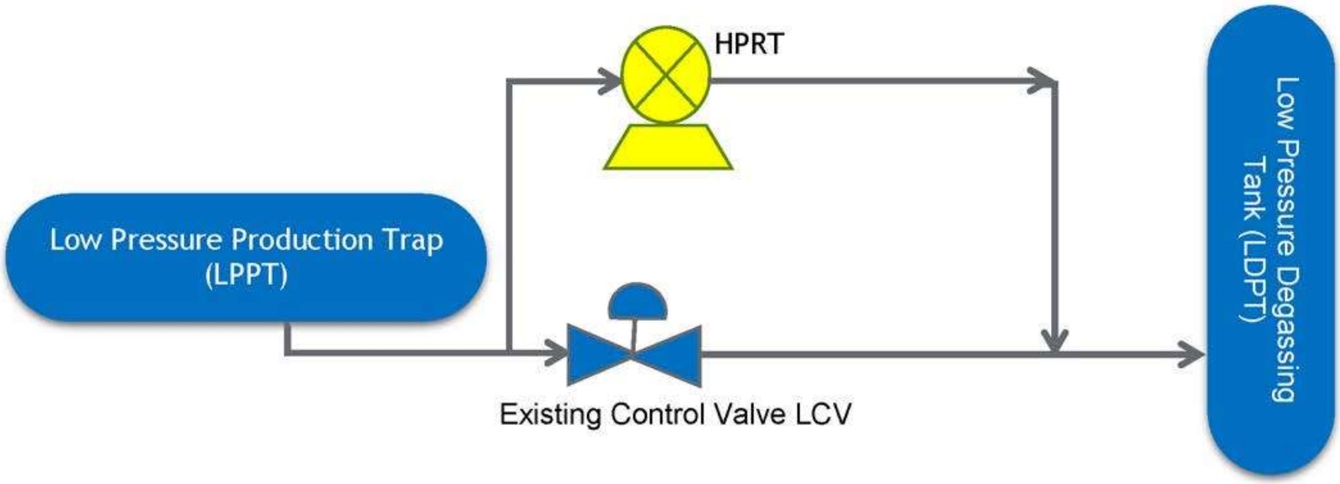

Figure 14—A diagram for wet crude inlet from LPPT

Case description. The wet crude leaves the LPPT at about 50 psig and pressure is reduced to 3 psig using LCV. The case is to recover the pressure drop across the valve into electric power through Hydraulic Power Recovery Turbine (HPRT). The table below shows the design calculations for wet crude from LPPT.

Table 18—HPRT design calculations for wet crude inlet from LPPT

HPRT Design Calculations		
Flow	432.5	MBOD
CV Inlet Press	50	psig
CV Outlet Press	3	psig
Head	132	ft
Specific Gravity	0.820	
Efficiency, E	80	%
Potential Power Recovery, hp	206	kW

The design calculations for wet crude inlet from LPPT show that the potential power generation is around 206 kW. The expected revenue generated from this initiative is $589,000/year.

The following table lays out the case's economics for three trains:

Table 19—Economic calculations for HPRT for wet crude inlet from LPPT

Project Economics	Value	Unit
Project Net Savings	589	K$/yr
Number of Trains	3	Train
Total Capital Cost	Significant	K$
Simple Payback Period	25.8	Years
PV (Present Value)	Significant	K$
NPV (Net Present Value)	Significant	K$

Thus, is is not recommended to go with this case as it has a negative NPV.

Case-5: Produced water from Dehydrator

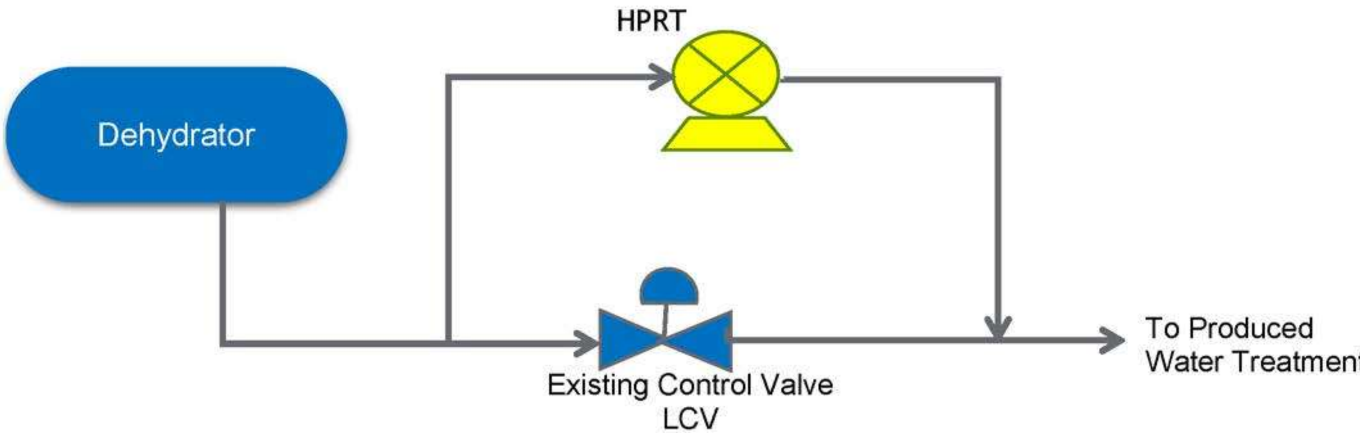

Figure 15—A diagram for wet crude inlet from LPPT

Case description. The produced water from Dehydrator is sent to the water treating plant where its pressure is reduced from 107 PSIG to 50 PSIG using LCV. The case is to recover the pressure drop across the valve into electric power through Hydraulic Power Recovery Turbine (HPRT). The table below shows the technical details of this case.

Table 20—Economic calculations for HPRT for produced water from Dehydrator

HPRT Design Calculations		
Flow	149	MBD
CV Inlet Press	107	psig
CV Outlet Press	50	psig
Head	136	ft
Specific Gravity	0.970	
Efficiency, E	80	%
Power, HP	86	kW

The design calculations for produced water from dehydrator shows that the potential power generation is around 86 kW. The expected revenue generated from this initiative is $124,000/year.

The economic analysis is shown in the following table:

Table 21—Economic calculations for HPRT for produced water from Dehydrator

Project Economics	Value	Unit
Project Net Savings	124	K$/yr
Number of Trains	1	Train
Total Capital Cost	Significant	K$
Simple Payback Period	40.8	Years
PV (Present Value)	Significant	K$
NPV (Net Present Value)	Significant	K$

As shown in the table, the case is going to generate a negative NPV value and low power generation and thus it is not feasible to implement it.

In addition, there were other evaluated cases at Tanajib's new plant, but they were not found feasible because the power generated was insignificant. For example, the hot oil from the stabilizer reboiler, would generate only 26 kW

Tanajib New Plant Case Summary

For the new plant in Tanajib, the team evaluated streams having high differential pressure across the control valves. There are two feasible cases out of five in the new plant. The following table summarizes the technical data of the five cases.

Table 22—Summary for HPRT feasibility evaluation for Tanajib New Plant

Stream	Control Valve	Differential Pressure, psi	Flow rate, MBD	Power generation, kW	Saving in K$/yr	NPV (K$)	Recommendation for implementation
Wet crude inlet to LPPT	PCV	200	1,307	2,653	Significant	Significant	Yes
Dry Crude from Desalters to Stabilizer	FCV	107.2	351.7	383	302	Significant	Yes
Hot oil reutrn from trim heater	TCV	56	181.5	103	269	Significant	No
Wet crude inlet from LPPT	LCV	47	432.5	206	589	Significant	No
Produced water from Dehydrator	LCV	57	149	86	124	Significant	No

Conclusion

In conclusion, the Hydraulic Power Recovery Turbine (HPRT) evaluation was completed for Tanajib Plants. The evaluation revealed that there are three economically feasible cases with positive net present value to install HPRT at Tanajib Plants to recover wasted energy across the throttling valves. HPRT will harness the wasted energy and convert it into useful power distributed in the plants. Consequently, the deploying of the HPRT technology will minimize the imported power from SEC, minimize CO_2 emissions and strengthen Safaniya Onshore Producing Department's involvement in the circular economy.

Acknowledgements

The authors would like to thank Northern Area Technical Support Department management and Saudi Aramco for the permission to publish this paper.

Nomenclature

GOSP Gas Oil Separation Plant
Dehydrator & Desalter Electrostatic Coalescers for removal of majority of water and salt from crude oil
MBCD Thousand Barrels per Calendar Day
MBOD Thousand Barrels per Operating Day
Water cut (Percent) Produced water rate*100/(Crude rate+ Produced water Rate)
HHP Hydraulic Horse Power
BHP Brake Horse Power
LPDT Low Pressure Degassing Tank

HPPT High Pressure Production Trap
LPPT Low Pressure Production Trap

References

1. Improve Energy Efficiency Using Hydraulic Power Recovery Turbines, Sebastiano Giardinella, Katherine Chung and Martín Ávila Ecotek, David López, https://www.chemengonline.com/improve-energy-efficiency-using-hydraulic-power-recovery-turbines/?pagenum=2
2. Circular Economy Introdcution, Ellen Macarthur Foundation, https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview