

PU2 - CD4 SCW HEX Reliability Improvement

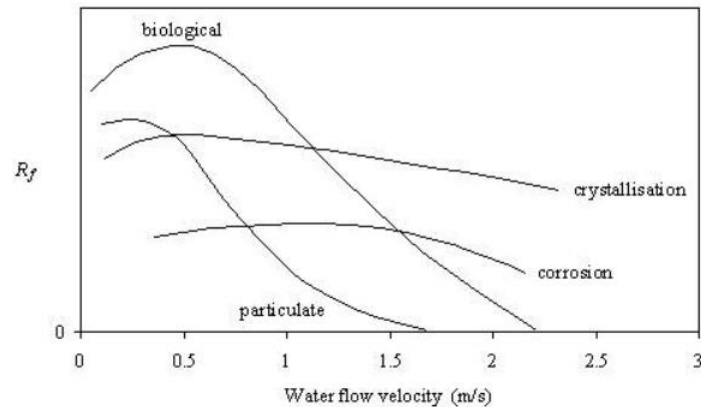


Hydraulic Threats Assessment to SCW Coolers

Tiger Team with PU2 Ops & Tech

Background

1. SCW network in Bukom is ~50 year old & over a period of time it is expected that this network would accumulate marine debris and foulants.
2. In 2015-2018 Hypo dosing was stopped, leading to accelerated marine growth. Re-starting hypo dosing in 2018, can cause marine species to die and get released into the network on a random basis.
 - Above causes further of debris in the system, leading to network high network pressure loss.
 - Low velocities in HEX's tubes causing debris accumulation in the tubes (refer below chart), leading to under deposit corrosion
 - Released debris also get stuck in the tubes causing localized erosion corrosion.
3. High process temp. leading to high MMT on the SCW side causing salting & localized hydrolysis corrosion (Salting). This is accelerated due to low flows.
4. High elevation HEX's operating in vacuum with outlet open vents, leading to ingress of air into the HEX's causing cavitation and subsequent tube damages.
5. Changes to process flow rates/ temperatures from 2019 onwards for E7526, E7535, E7536.

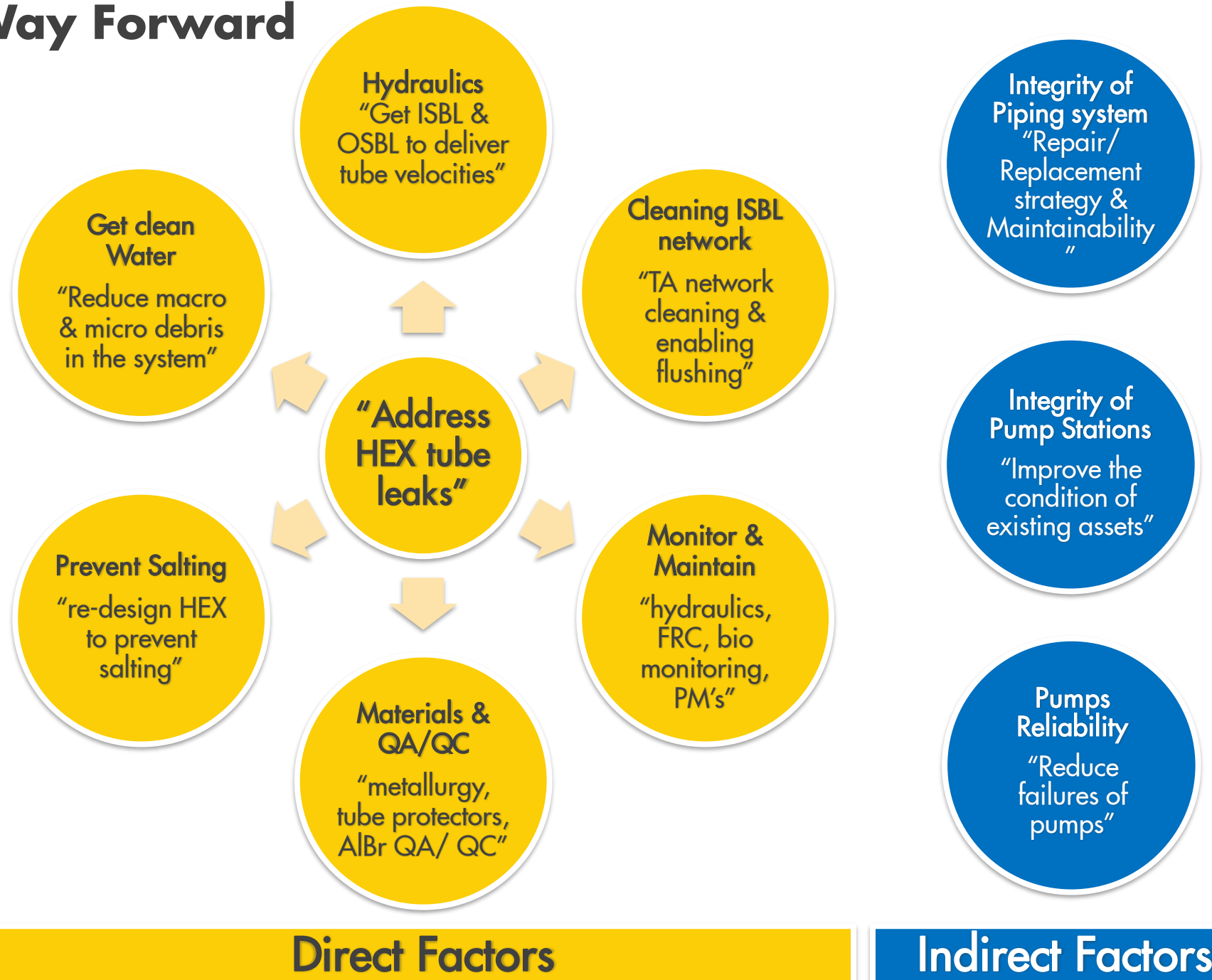


Name	EDRS Flow rate (m3/h)	Existing Vol. Flow (m3/hr) based on UFM measurement	Post project estimated flow rates (m3/hr)	Future case - if network pressure drop increase by 10-15% Reduction in Vol. Flow (m3/hr) in case this project is NOT done.
E-7405	161	58	100	49
E-7408	11	15.8	25	14
E-7407A	60	78	78	72
E-7525	29	70	70	63
E-7522	160	160	260	143
E-7535	198	110	201	107
E-7536	198	170	211	155
E-7406	66	42	44	38

Figure 4. Effect of water velocity on various fouling mechanisms at constant temperature

- Even though tubes are now converted to titanium, that helps with only erosion corrosion phenomenon.
- Do nothing as an option will reduce flow rates even further. Refer above estimated flow reduction based on 10-15% increase in network fouling. Currently we have 0.5 bar additional network fouling in front of E7536 (based on pressure measurements comparison with hydraulics model).

Background: SCW Way Forward



Problem Statements

Project Scope	Hear Exchanger	Previous Failure/ Retubing history	2019 RCA Report and 2018 SCW HEX failure investigation report Primary failure mode	Proposed Project Scope & it's Intent	Operational availability Impact	Availability loss % per year per RAM model	Margin loss per year
Booster Pump modification (pump head increase)	E7522 (Ti tubes)	Retubing 1971/1991*/2008/2016/ 2017 Leaked 2016/17 Mechanism – under deposit corrosion, salting, marine debris	Erosion corrosion, Partial blocking of tubes	Increased SCW flow of 300 m3/h is required as per HTRI calc however practically on site with the pump modification flow of ~ 220 – 230m3/h can be achieved without hitting process side alarm of 45 deg C	100% Overhead impact 40% Crude impact	0.17	Scenario: CD4 slowdown for 14 days, once in 22 years. 2.45mln\$ potential margin loss once in 22 years For 20 years 2.2 mln\$ loss
	E7535 (Ti tubes)	Retubing 1980/1991*/2008/ 2017 No leaking Mechanism - Tube blockage	No Investigation	Existing increased SCW flow from 2019 onwards, with pump modification flow of ~201 m3/h can be achieved	100% CD4 S/D	0.12	Scenario: CD4 shutdown for 14 days, once in 32 years 8.4 mil\$ potential margin loss once in 32 years For 20 years 5.2 mln\$ loss
	E7536 (Ti tubes)	Retubing 1991/ 1999 /2012	No Investigation	Existing increased SCW flow from 2019 onwards, with pump modification flow of ~220 m3/h can be achieved	100% CD4 S/D	0.12	Scenario: CD4 shutdown for 14 days, once in 32 years 8.4 mil\$ potential margin loss once in 32 years For 20 years 5.2 mln\$ loss
	E7511A (Ti tubes)	Retubing1971/2002*/2012/2017 Leaked 1979/2018 Mechanism – Erosion-corrosion	Erosion corrosion	This HEX on non boosted header, once 3 of other HEX shifted from non boosted to boosted, E7511AB will get increased flow ~180m3/h	100% Overhead impact 40% Crude impact	0.05	Scenario: CD4 shutdown for 14 days, once in 76 years 2.45mil\$ potential loss once in 76 years For 20 years 2.2 mln\$ loss
	E7511B (Ti tubes)	Retubing1987/ 1994/ 2002/ 2012 No leaking	'B' HEX is salting out, due to series process & bypass HEX	This HEX on non boosted header, once 3 of other HEX shifted from non boosted to boosted, E7511AB will get increased flow ~180m3/h	100% Overhead impact 40% Crude impact	0.07	Scenario: CD4 shutdown for 14 days, once in 54 years 2.45mil\$ potential loss once in 54 years For 20 years 2.2 mln\$ loss
	E7526 (Ti tubes)	Mechanism – Erosion-corrosion, under deposit corrosion Tube leak in 2010	No Investigation	Existing increased SCW flow from 2019 onwards	100% CD4 S/D	0.2	Scenario: CD4 shutdown for 14 days, once in 19 years 12mln\$ potential margin loss once in 19 years For 20 years 12 mln\$ loss

Problem Statements

Project Scope	Hear Exchanger	Previous Failure/ Retubing history	2019 RCA Report and 2018 SCW HEX failure investigation report Primary failure mode	Proposed Project Scope & it's Intent	Operational availability Impact	Availability loss % per year per RAM model	Margin loss per year
RO+ manual valve Dead end flushing of SCW header (only for E7540AB,E7539AB , E7541AB)	E7540AB (Ti tubes) E7439AB, E7541AB (Ti tubes) E7524ABCD E7405,E7406, E7407, E7408	E7540AB – retubing 1994, tubes upgraded to Ti, E7540A retubing in 2017, CD4 s/d due to E7540A leaking in 2019,	This HEX has been prone to debris clogging due to its location at end of SCW header per 2019 inspection pictures Mechanism: under deposit corrosion, erosion corrosion	Back pressuring set up of RO + valve will minimise vacuum in SCW outlet lines, high vacuum of -1.1 to be minimised to -0.1 barg, although it is not possible to have complete positive pressure in SCW return lines, aim is to minimise it as low as possible to avoid erosion, corrosion, cavitation issues Proposed SCW dead end header flushing arrangement will serve to remove debris accumulated	100% CD4 S/D if E7540AB, E7539AB, E7541AB fail	0.06 – E7540AB 0.05 – E7539AB 0.09 – E7541AB	Scenario: CD4 shutdown for 14 days, once in 42 years (E7539AB) 6.5mln\$ potential margin loss once in 42 years For 20 years 3 mln\$ loss
Additional instrumentation for SCW network monitoring	FT on start of boosted and non boosted header	-	-	Although there is no direct failure due to lack of FT / PT/ TT in the SCW network, it will boost network monitoring greatly	-	-	-

Cost of Do-Nothing Option

- Practically the entire network cannot be cleaned to the level of what it was 50 years back and hence there will be structural increase in pressure loss causing reduction in SCW flows to HEX's.
- Overall combined there is a potential impact of **0.93** % MDT impact based on RAM model.
- Above MDT impact is equivalent to **32** mln% margin impact in the coming 20 years.
- Missed Opportunity to improve monitoring of SCW network that may lead to further optimization benefits.
- Upsizing of the booster pumps will enable sustainable operation of HDS3 in HP mode. Currently both pumps running with significant back pressure on the left had side of the curve.

Background – Earlier CAC Problem Statement (CD4/ HDS3)

- Process changes for HEX E7522, E7511A/B
- Existing increased SCW flow rate from 2019 onwards to E7526, E7535, E7536
- Existing SCW network issues

- HEX Failure- CD4100% Crude Impact CD4 Shutdown
- HEX Failure- 40% Crude Impact (CD4 Slowdown)
- HEX Failure- 20% Crude Impact (CD4 Slowdown)
- HEX Failure- 10-15% Crude Impact (CD4 Slowdown)
- (S) – Salting Probability HEX

CD4 HEX SCW flow measurement is completed in 2 rounds and hydraulic model further validated based on site conditions and scope changes have been developed for the reason stated in next slides.

**2 x 100%
SCW Booster Pumps**

- 1) Insufficient monitoring of SCW header for pressure and flowrate
- 2) Lack of valves at critical locations on SCW network for tuning purpose

E7540AB-22m
E7539 - 22m
E7541A-21m
E7541BC-21m

- 1) High Vacuum at the HEX Outlet
- 2) Dead End at the HEX Inlet

E7519ABCD - 15m

E7515 - 15m

E7525 -3m

E7512ABC -16m
E7513 -16m

E7405 (S)-17m
E7407ABC -18m
E7408 -18m
E7406-15m

E7536-1m
E7535 (S)-1m

Lack of SCW flow E7522
Redesign
as stacked exchangers
(2 shells)

E7524AB -14m
E7524CD -14m

E7522 (S)-3m

E7508ABCD (S)-
2m

E7516ABCDEF-15m

E7511AB (S)-2m

E7526 (S)-2m

Revised Scope – WHY?

Based on flow measurement at site, there is significant increased pressure drop in the network, Only piping modification to increase the SCW flow rate is not sufficient, post validation of hydraulic model and its assessment, BOOSTER pump modification is proved to be essential to overcome the high resistance in network

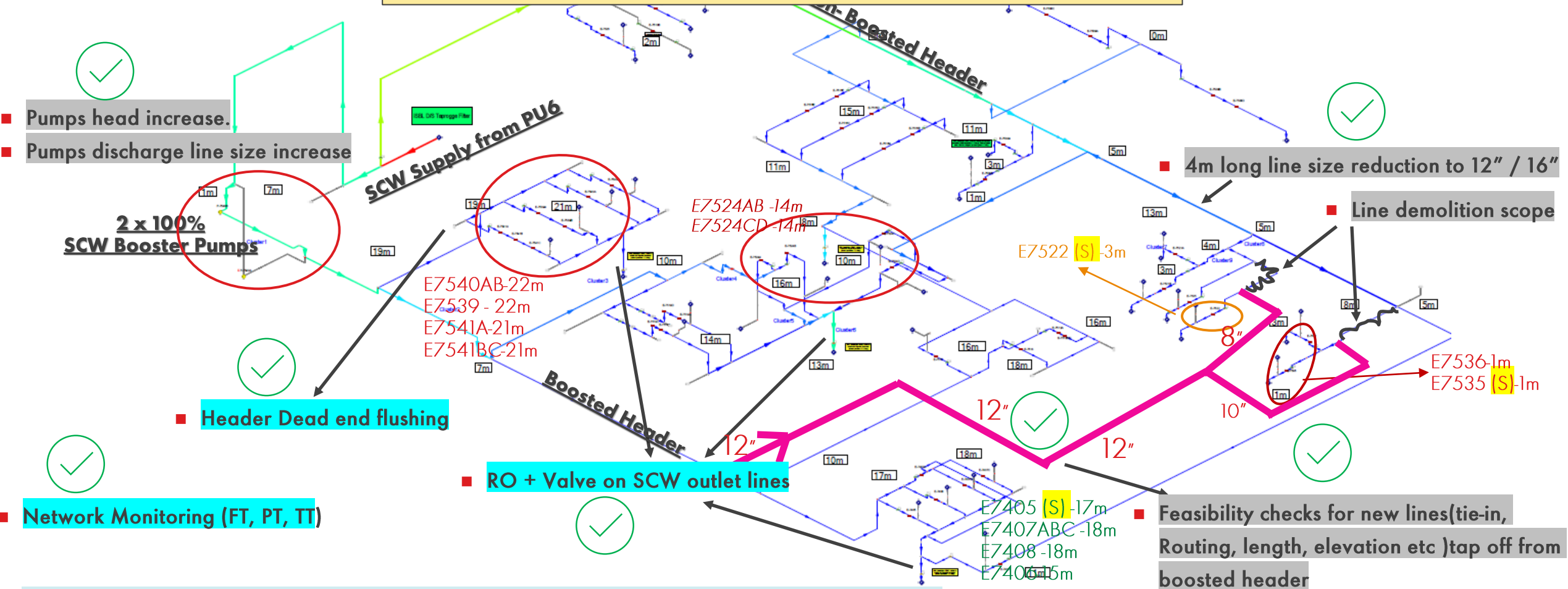
Therefore only piping modification for E7536, E7536, E7524ABCD will not serve purpose. Also we have optimized the scope for HEX's modifications.

Validation of model:

- 1) SCW flow rate measured as on site were added in model, in total ~70% of flow is measured
- 2) It has been observed that actual valve opening % on site Vs valve opening % in model is **different**.
- 3) Model was indicating **less opening** % of valves required as compared to site valve opening % to match the measured flow rates (So model was giving more flexibility to open valves further to get more flows, however actual was different)
- 4) Therefore to match the site valve opening %, additional pressure drop across heat exchangers were added in model. This suggests that either site SCW network or the HEX are fouled.
- 5) After the above is done, the model is able to exactly match the measured flow rates and site valve opening %, thereby validating the model to match the site condition with fouling.
- 6) It was suggested to carry out pressure measurement at critical locations. This is to further validate the model and also to identify the locations of fouling in the network. If HEX inlet pressures are high, it suggests HEX is fouled. If HEX inlet pressures are low, it suggests SCW Network is fouled.



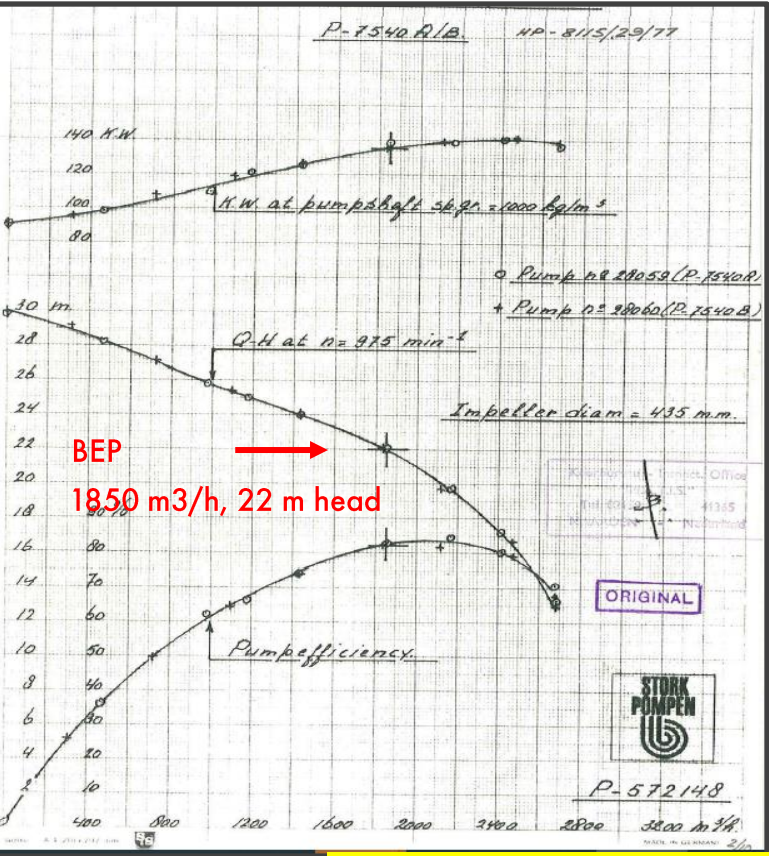
There is a significant reduction in the TA scope earlier foreseen. Piping modification for E7535, E7536, E7524ABCD, E7511AB removed.
E7522 HEX's modification scope removed.
Refer to next slides.



Hydraulic model assessment and Revised scope is based on removal of existing RO at supply of E7519 AB and CD
Also as confirmed with Ops there is no RO on SCW supply for E7524AB on boosted network

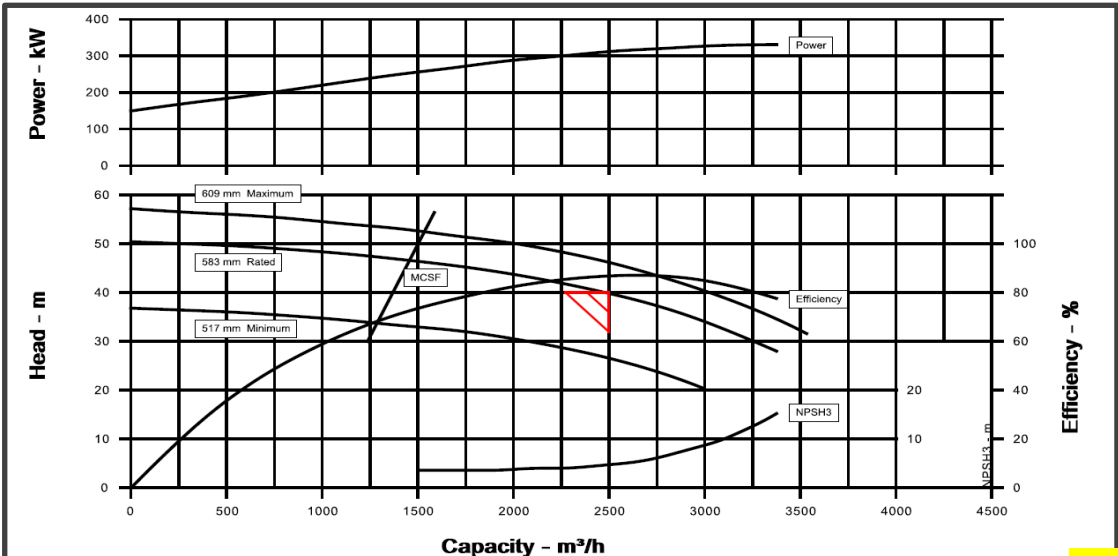
P7540A/B modification scope

- 1) Modified pump capacity of 2500m3/h at ~ 40m head (which is around 35% shift in pump curve) is required. Pump vendor confirmation and all related process checks are ongoing, **pump modification in Non TA scope**
- 2) P7540A,B discharge lines (approximately 12m each) to be upsized to 24", **TA scope**,
Necessary Process checks are going to confirm no issues with running current pump with increased line size and future Big pump.



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Existing Booster Pumps



Hydraulic power	: 272 kW
Pump speed	: 985 rpm
Pump overall efficiency (CE=1.00)	: 87.3 %
NPSH required (NPSH3)	: 4.8 m
Rated brake power	: 311 kW
Maximum brake power	: 332 kW
Driver power rating	: 355 kW / 476 hp
Casing working pressure	: 5.0 barg
(based on shut off @ cut dia/rated SG)	
Maximum allowable	: 10.0 barg
Hydrostatic test pressure	: 15.0 barg
Estimated rated seal chamber pressure	: -

Impeller diameter	
Rated	: 583 mm
Maximum	: 609 mm
Minimum	: 517 mm
Ns / Nss (per eye)	: 51 / 153 (SI)
Minimum continuous flow	: 1,460.1 m³/h
Maximum head at rated diameter	: 50.56 m
Flow at BEP	: 2,649.3 m³/h
Flow as % of BEP	: 94.4 %
Efficiency at normal flow	: -
Impeller diameter ratio (rated/max)	: 95.7 %
Head rise to shut off	: 26.4 %
Total head ratio (rated / max) / (max / rated)	: 86.5 % / 115.5 %

New Booster Pumps



Electrical and Civil scope in pump modification-

Revised Electrical Scope required for upsized pumps :

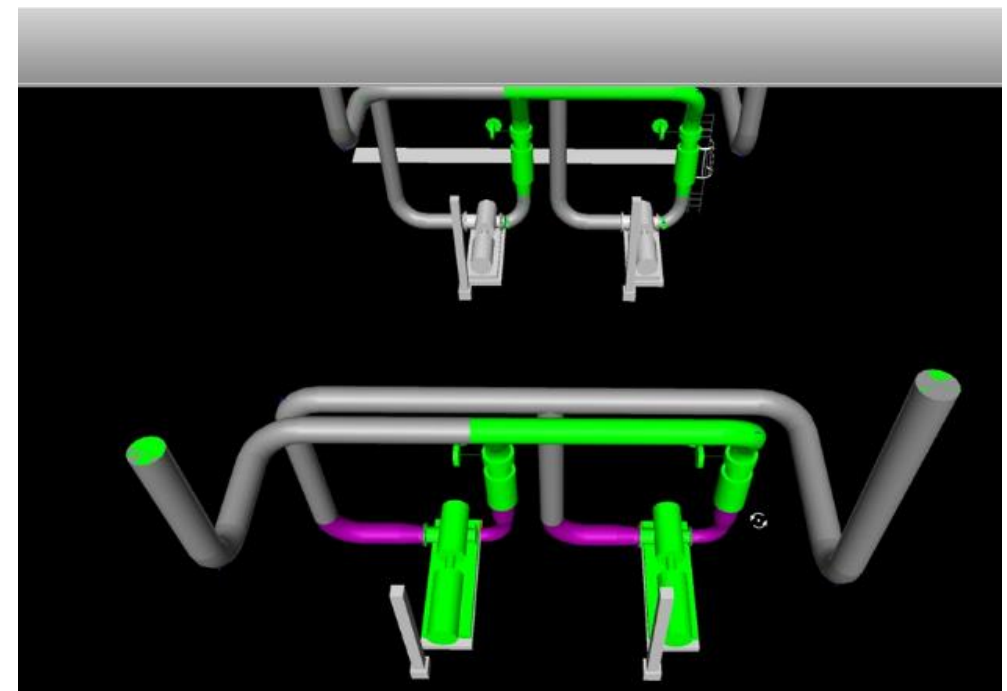
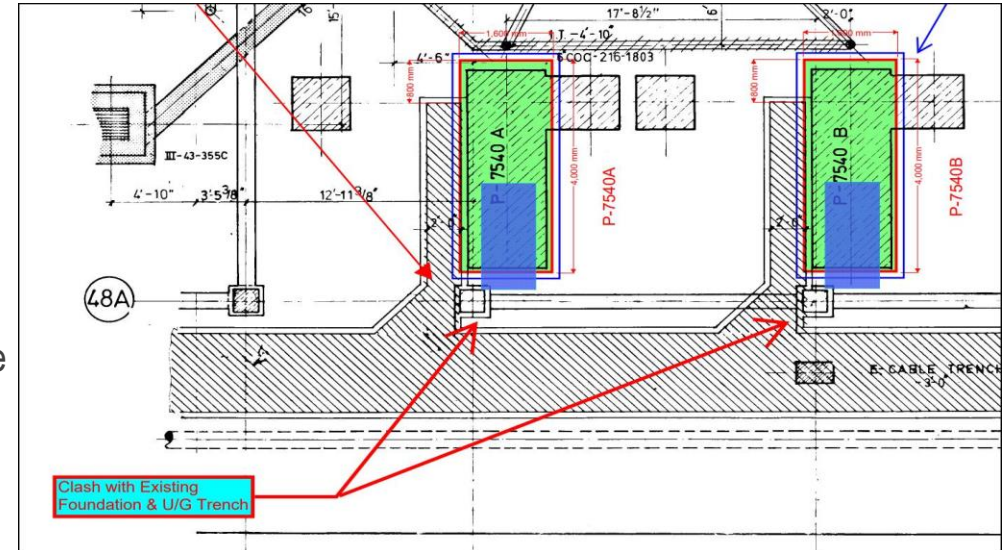
1. New motor cables – Excavation and cable laying can be done anytime.
2. Switchboard modification – Motor need to shutdown
3. Cable termination - Motor need to shutdown

For item 2 and 3, since there are A and B motor, it doesn't need to be done during TA, if one motor can be shutdown during operation.

Revised Civil Scope required for upsized pumps:

1. Depending on the pump nozzle locations and size of the new pump, foundation level needs to be trimmed/ raised and size needs to be extended.
2. With current info micro piling is not envisaged, as pump kw rating is estimated to be below 375kw not requiring dynamics.
3. Plan to modify piping system (in TA) in such a way that new pump nozzle center line can be moved 200mm inside to clear the clash

All the above can be done out of the TA window, if one motor can be shutdown during operation.



Strategy to replace pump post TA

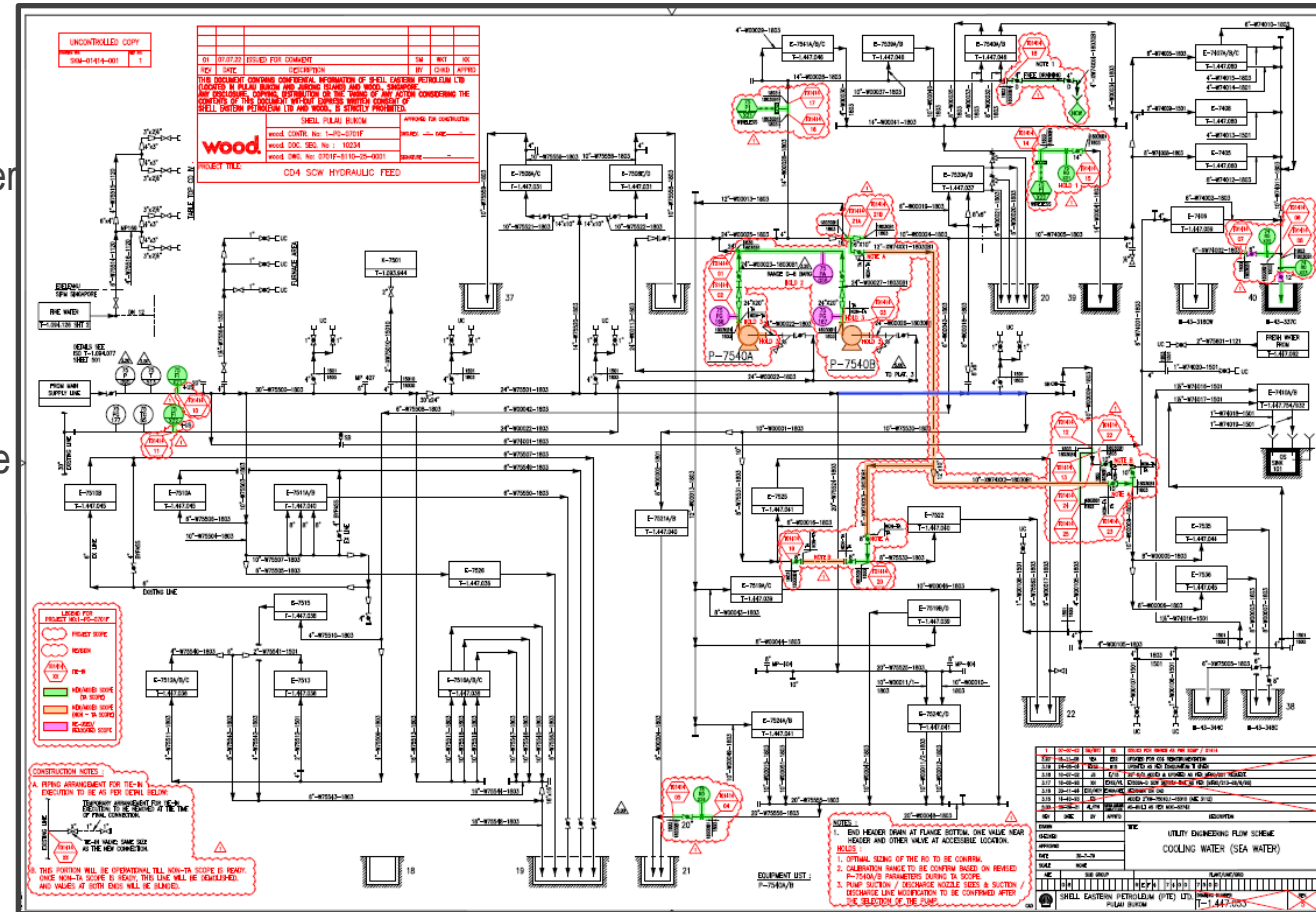
- To reduce the workload during TA, both booster pumps A & B are proposed to be replaced post CD4 TA, one by one.
- As per the records, P7540B is recently overhauled in Jul 2021, therefore it is proposed to continue to use P7540B post TA, whilst P7540A being replaced with new - **Alignment completed with Rotating/ Ops/ Tech.**
- Preliminary 1.5-month outage of each pump is envisaged due to replacement - **Alignment with TAC team is ongoing.**
- Once new pump installation is complete, it will be commissioned and tested for stable operation.
- Once it is assured that new pump is running well, P7540B will be taken out for replacement.
- Note that, HDS3 will run in LP mode when unit is running with one CW pump – **Alignment completed with Ops/ Tech.**

Risk Assessment for running on one CD4 CW pump:

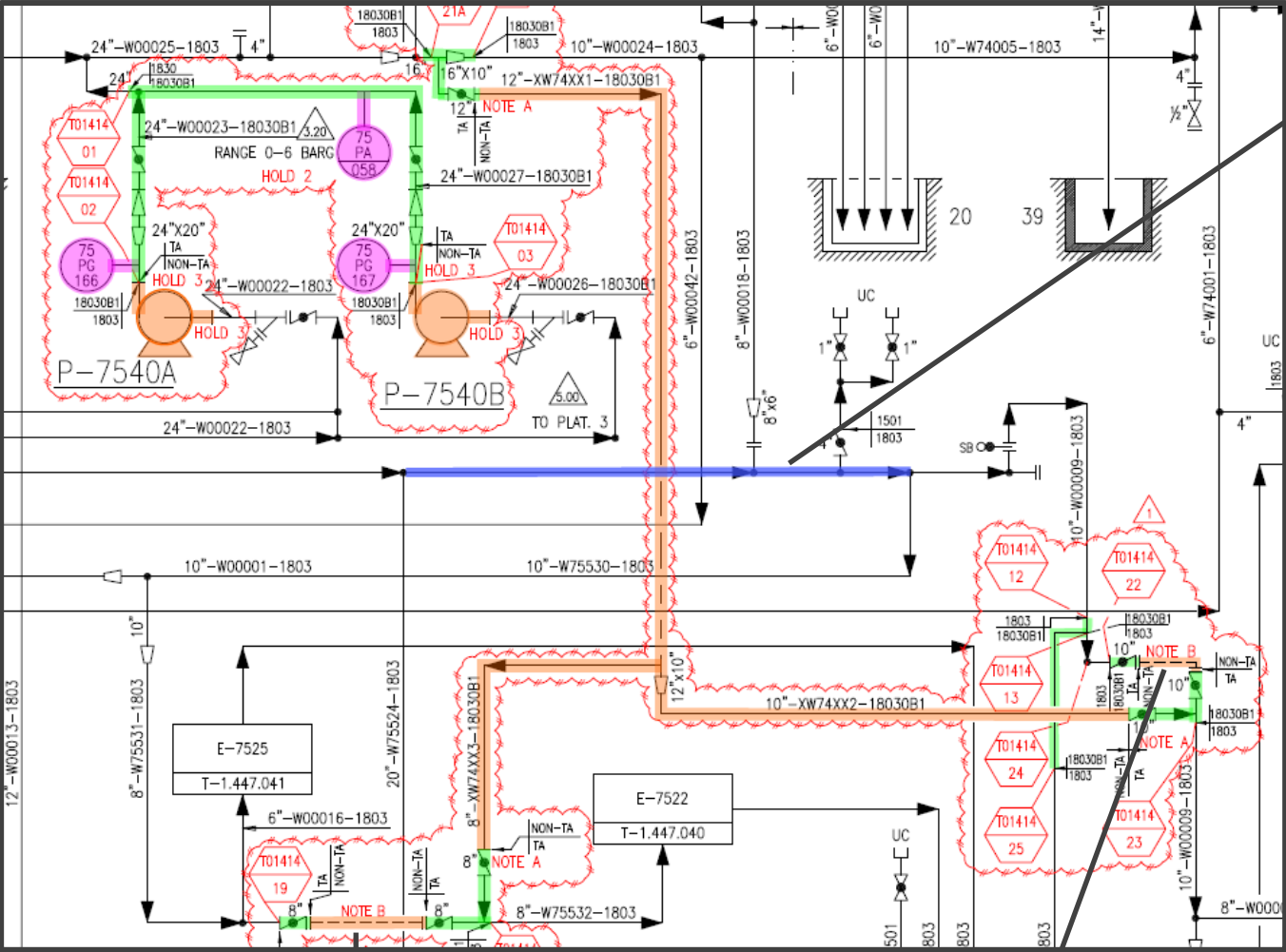
- Risk exposure period would be ~10 days. After taking out A pump, if the B pump gets damaged; then we can replace the B pump with A pump that we took out. Approx. 10 days for this replacement.
- Based on E&S numbers, 27.4 mln\$ per month loss on CD4 shutdown, proportionate \$ number impact 9.1mln\$ for 10 days. Based on 4 years pump MTBM with overhaul in 2021, likelihood of failure before end of 2025 is less. Based on proactive MTO risk scoring approach, likelihood is C (0.25) failure between 3 to 10 years. Hence, risk would be **3C (yellow)** & MTO score would be **125,000**.
- To mitigate the above risk, propose to carry out general inspection of existing P7540A/B before CD4 S/D, like vibration assessment, oil sample analysis/ replacement, et al to proactively identify any problems for mitigation.

New tap off from Boosted header to supply SCW to E7522, E7535, E7536

- 1) Currently E7522, E7535, E7536 are getting SCW from non-boosted header however with past salting history and associated issues, all these 3 exchangers need increased SCW supply
 - 2) It will be achieved by connecting these 3 exchangers to boosted header by new 12" line, taking tap off from boosted header, Tentative TP's are indicated, however further detail checks for TP and alignment with operations to be done as Project scope. Refer screenshot aside.
 - 3) Feasibility checks for New lines - TP, routing, elevation, length etc to be done further as project scope
 - 4) **New lines are Non TA scope however all TP's (with valves and flanges, spool) are in TA scope**
 - 5) Current SCW supply lines to these 3 exchangers will be provided with isolation valves, flanges and spool during TA
- Once new lines are operational, spool piece to be demolished



Demolition scope-



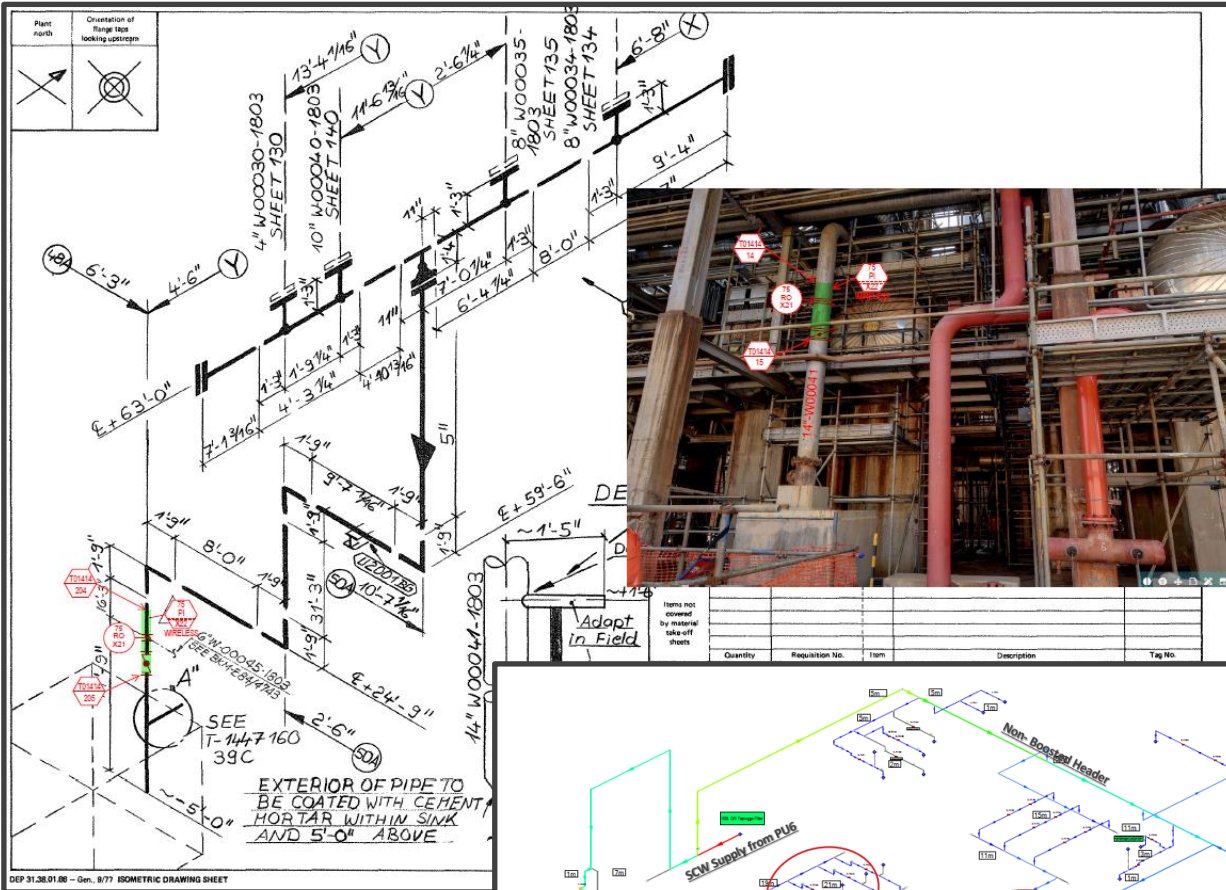
Small portion of (approximately 4m) of non boosted header (as indicated BLUE) will observe low velocity of @ 0.4 m/s once E7522, E7535 and E7536 are shifted from non boosted to boosted header. This header need size reduction from 24" to 16". This scope will be executed in 2028 TA as line can not be released during 2024 TA or Post TA.

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Demolition scope – Non TA scope

Date Month 2016

**E7405, E7406, E7407, E7408 – RO + Throttling valve on SCW outlet lines
- TA Scope**



E7540AB, E7539, E7541ABC
E7524 A/B/C/D
E7405, E7406, E7407, E7408

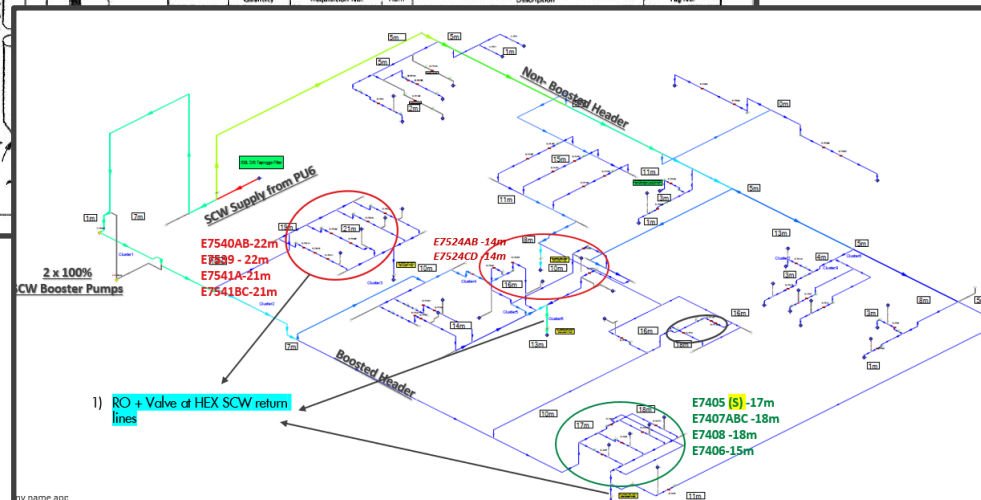
High Vacuum at the HEX Outlet for the entire cluster.
Negative pressure upto -0.9 to -1.3 barg

Back pressuring setup by installing throttling valve and RO, with a Wireless Pressure Indicator (PI) at the SCW outlet (similar to HVU5). Based on 2018 survey most of the HEX were seen throttled at inlet

TOTAL 3 LOCATIONS for RO + Valve to minimise
NEGATIVE pre

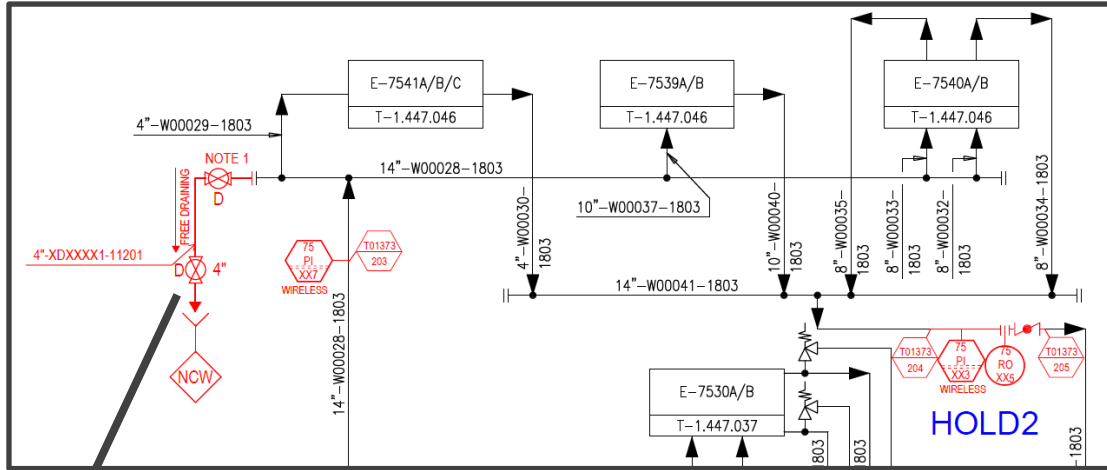
All 3 locations on boosted network where pump pressure is increased

Vibrations of the lines to be checked in throttled conditions due to 2 phase flow



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Scope of E7540A/B, E7539A/B, E7541A/B - SCW Supply Header Dead End flushing arrangement - TA Scope

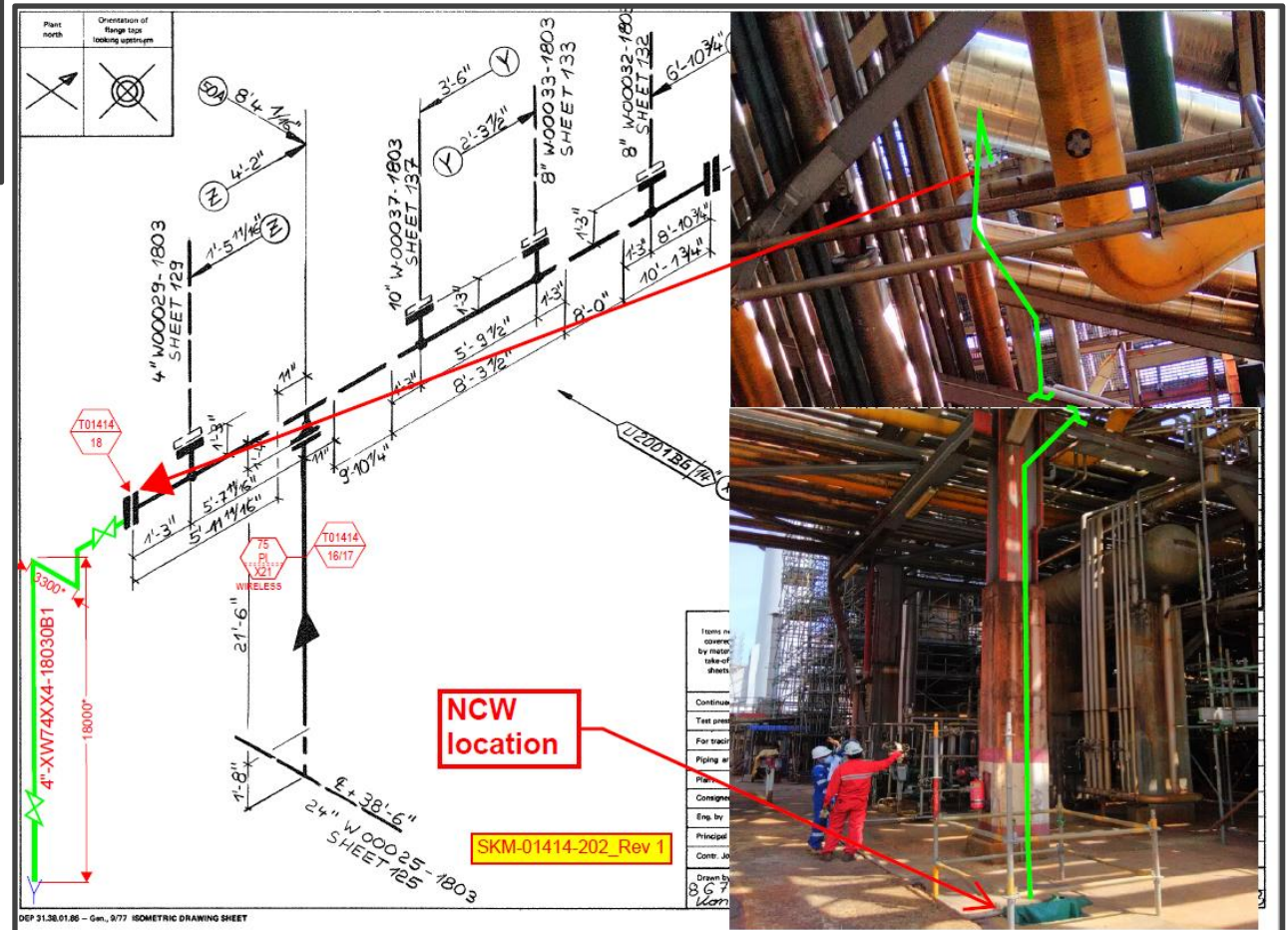


DEAD END FLUSHING ARRANGEMENT - TA scope

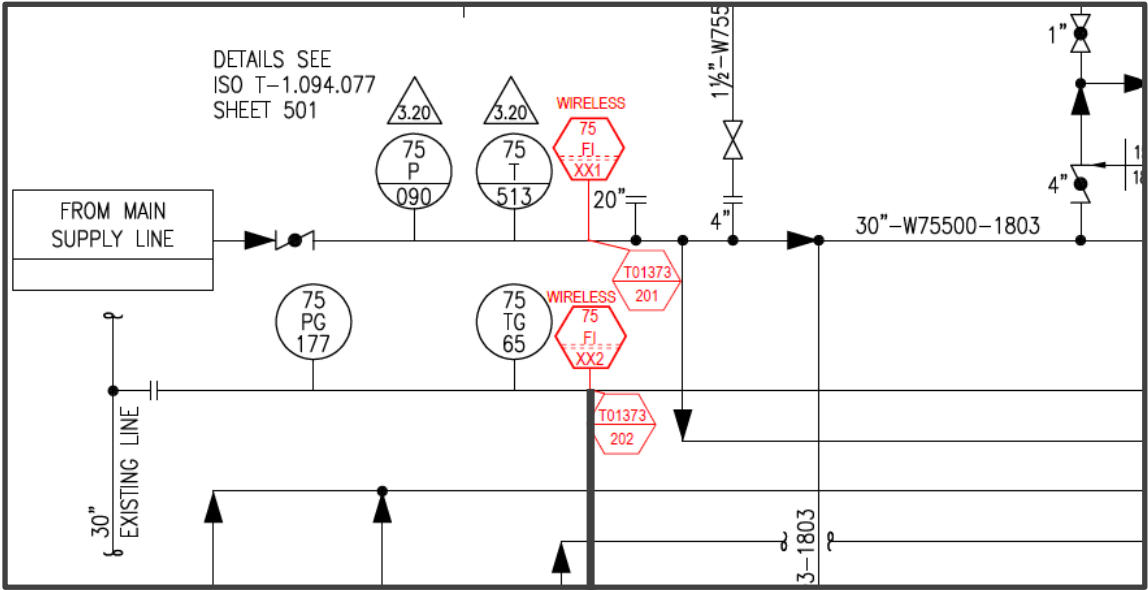
Marine Debris usually collect at the end of header and can plug heat exchanger if agitated.

Header Dead End flushing setup. Similar has been done for ECC CW system.

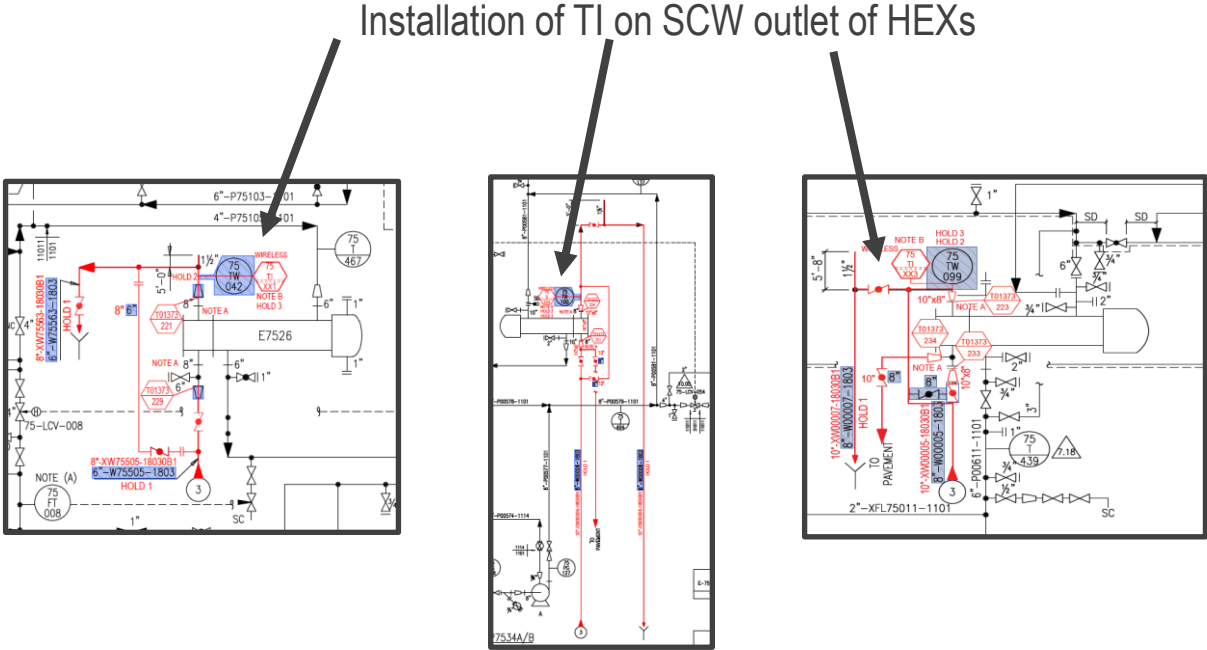
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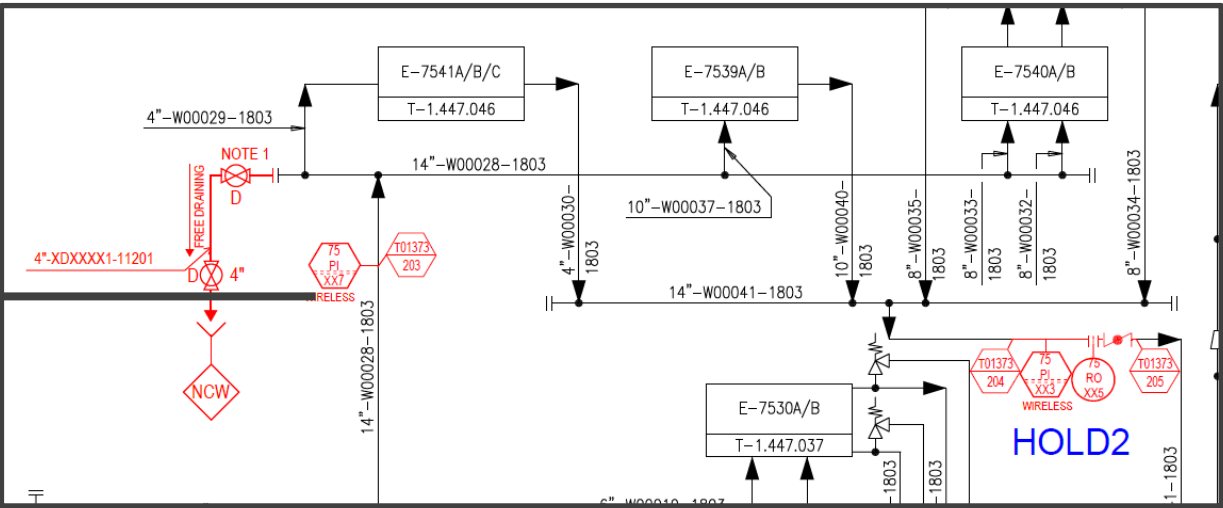
Improved Monitoring of SCW headers- TA Scope



Installation of FT on SCW main headers



Installation of PT on SCW headers



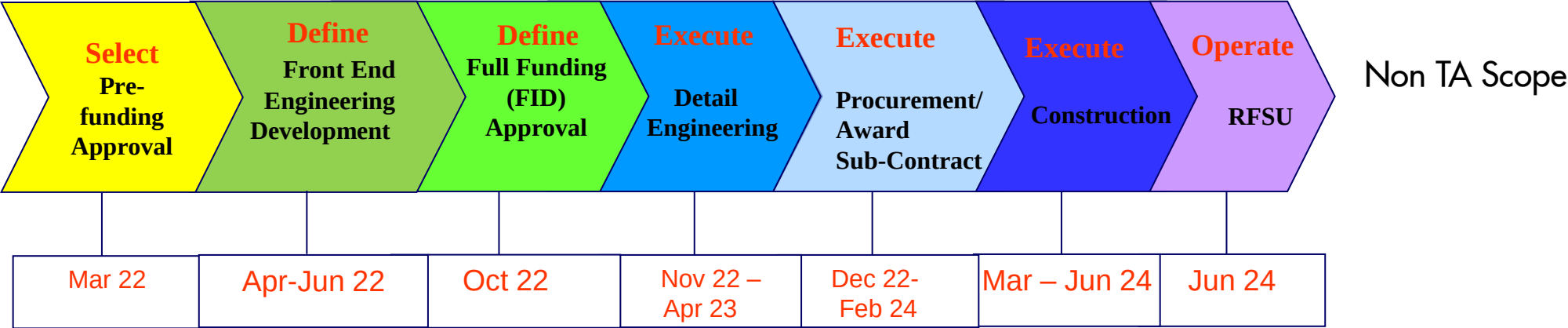
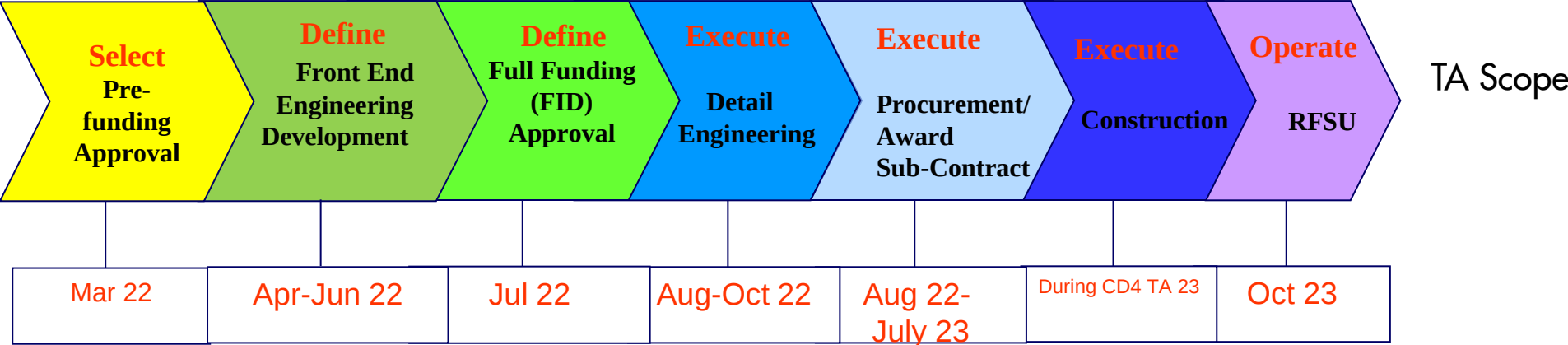
Other benefits from revised scope

- HP mode of operation is required for HDS3 due to Bukom RSZ, however E7405 & E7508 in HDS3 are unable to provide enough cooling duty to enable this HP mode operation
- Currently both of these exchangers are getting far less SCW than required
- With the modification to P7540AB, higher SCW flow to E7405 (@100 m³/h, ~80% more flow) and E7408 (25m³/h, ~125% more flow) can be enabled as compared to current flow (55 m³/h and 8 m³/h respectively)
- PU2 Tech is working on long term solution for HP mode operation of HDS3 by utilizing HDS2 tail gas compressor for HDS3, however this concept is not mature enough at this stage for details on engineering, execution and cost
- If this option materialize, HP mode of may become only short-term operating mode hence benefit of increase in SCW also short term
- Contrary if the option delayed for any reason, upsizing of the booster pumps will enable sustainable operation of HDS3 in HP mode incurring significant benefits
- Currently both the pumps are running to enable HP mode which is not sustainable as the pumps are running on the left-hand side of the curve with significant discharge side pressure drop (2oo2 pump operation)
- VIR credit is not taken for the option of upsizing of the pumps due to unclarity of other option

Way Forward-

- Seek support from BLT on the change in scope from CAC.
- Seek support to carry out post-TA pump replacement scopes on the run.
- Contractor has been informed of the change in scope and they have started working on the same (pre-FEED + FEED combined).
- In about a month's time, further engineering details and cost will be available from contractor and we will share the same with Steering team for PAC approval (29th July target).
- For the TA tie-ins scope, we foresee being able to meet the July 2022 FID timelines, due to limited TA scopes.
- Non TA scope FID is estimated to be at Oct 2022 FID.

Project Schedule



CAC Cost Estimate : USD \$ 1,980k (+/- 30%)

Team is working on the cost estimate. Likely to be a similar number due to decrease in HEX's and piping scopes.

➤ EPCM	\$173,601	8%
➤ Procurement	\$473,205	25%
➤ Construction	\$907,814	46%
➤ Overhead	\$187,648	9%
➤ Contingency	\$238,691	12%
➤ Total Cost	USD \$1,980,960	100%

- ❖ **Notes:**
1. Bulk of the material cost is on the account of the equipment / new HEX(~220 k USD)
 2. Bulk of the construction cost is on the account of the piping works (~700K USD) (~6100 dia inch)

Justification –

Category		
AI	C (Compliance)	
	HSE	
	R (Reputation)	
	CS (Internal Standards)	

MM	REL (Reliability)	X
	IR (Infrastructure Renewal)	
	MR (Margin Recovery)	
GR	G (Growth)	

Mark with X where applicable

Key in the following score for VIR / MTA / RAM
AIMM – MTA Scoring
AIMM – RAM Rating
GR & MM – VIR

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Justification		
RAM		Rating
	R+5Y	
	Red	Asset (D4)
	Blue	
VIR		8.85 Early stage 3.96 Middle stage 1.76 Late stage

	BP premise intake	Reduced Intake-1	Reduced Intake-2	Min intake	Shutdown	Comments
CD4	14.0 ktpd	12.0 ktpd		10.0 ktpd	0 ktpd	
Impact M/mth		1.6		4.9	27.4	CD4 s/d = LOC s/d, not able to run LOC w/o CD4 beyond ~10-14 days

VIR is calculated based on estimated 2 weeks shutdown of CD4 due to unavailability of any of these HEXs.
However ENS impact predicting higher loss of 27.4 mil /month.
This incident is estimated to happen once in 10 years on conservative basis.

Date Month 2016

Refer email to CH



SCW System : HEX Failure Modes

1. Most of the failure cases are related to **localized erosion corrosion** (due to debris stuck in tubes and tube protectors design).
2. There are cases of **under-deposit corrosion**.
3. **SCW water quality** (organic and non-organic debris) is a big cause for the above failure modes.

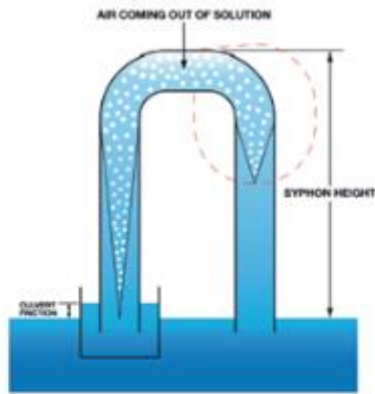
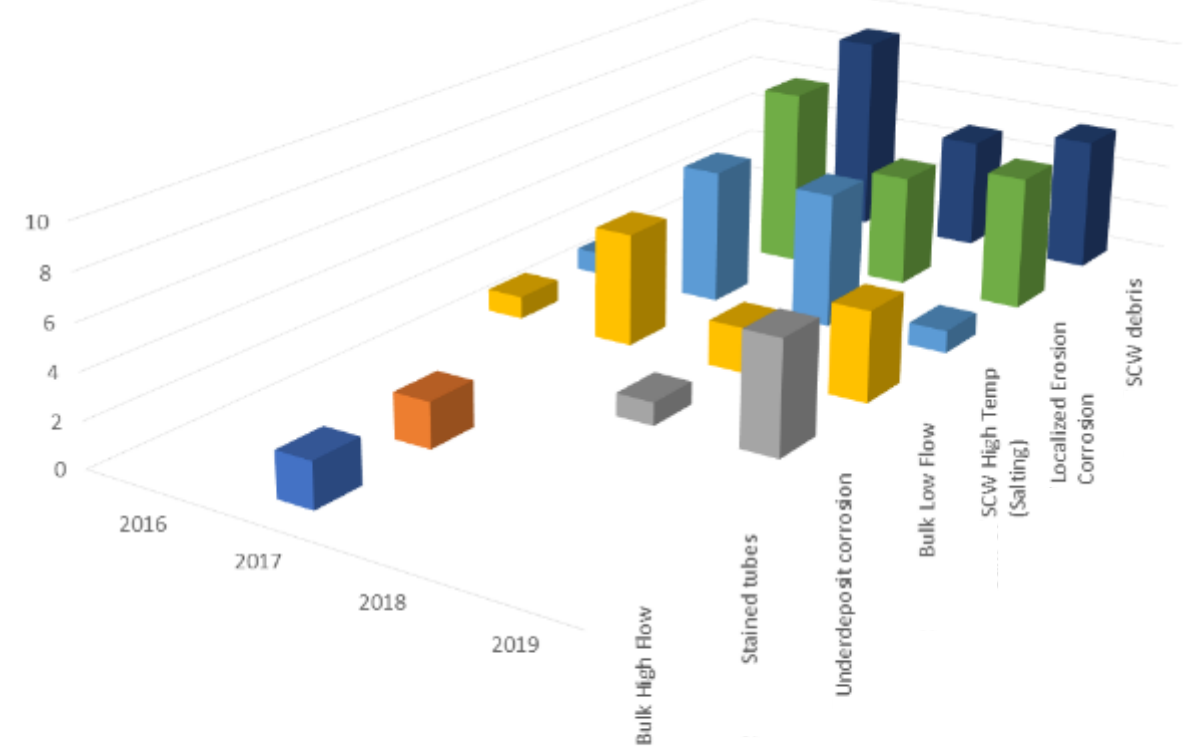


Figure 4 - Diagram showing syphonic air release



Figure 5 - Severe erosion corrosion of 25.4 mm OD 6620/22 Cu-Ni-Pb-Mn in a dump condenser due to syphonic air release

Split of Failure modes and findings from previous two Investigations



4. **Hydraulics** (low flow) accelerates debris deposition in the system.
5. **Hydraulics** (operating HEX in vacuum on SCW side and with open vent, without using syphonic recovery) causes cavitation in the tubes.
6. High temp. **Salting** failure mode is also prominent.
7. **Bulk high velocity** and **Material related issues** are very limited and hence can be regarded non-structural one off cases, with specific actions being taken.

CD4 Heat Exchangers Threats:

Threat Title	MTO Score
I-0206523 (E7536) E7536 High risk of salting on SCW side based on SCW & process side flow/temp	2,625,000
I-0206465 (E7540A/B,E7539A/B) High vacuum at SCW outlet for E7540AB,E7539,E7541ABC leading erosion in tubes	125,000
I-0206478 (E7540A/B,E7539A/B) Risk of debris accumulation in the dead end header	250,000
I-0206476 Lack of SCW flows in E7524 series HEX's leading to debris accumulation	2,625,000
I-0206473 Lack of flow instrumentation available to monitor the SCW network in CD4	125,000
I-0206472 Lack of temperature instrumentation available to monitor the SCW network in CD4	125,000
I-0206466 (E7511A/B) High risk of salting on SCW side based on SCW & process side flow/temp condition	250,000

Validation of Hydraulic Model -

HEAT EXCHANGE	AFT Supply valve open %	On site Supply valve OPEN	UFM Flow (m3	EDRS flow (m3	AFT flow as per project scope (without piping modification)	Header
E7536	52.80	50.00	170	198	211	Non boosted
E7535	30.60	30.00	110	198	201	Non boosted
E7522	57.00	70.00	160	159	260	Non boosted
E7525	46.00	50	70	29		Non boosted
E7511A	48.00	50	185	260		Non boosted
E7511B	46.00	50	185	260		Non boosted
E7510A	49.00	50	-	110		Non boosted
E7510B	48.00	50	160	110		Non boosted
E7516A/B	80.00	100.00	361	360		Non boosted
E7516C/D	66.00	100.00	273	360		Non boosted
E7526	60.50	50.00	185	98	185	non Boosted
E7524C	25.50	20.00	145	469		
E7524D	48.20	50.00	182	469		
E7508A/C	57.00	100.00	325	344		
E7521A	45.00	50.00	90	257.9		
E7521B	47.00	50.00	160	257.9		
E7530B	54.00	100.00	43.5	78.5		

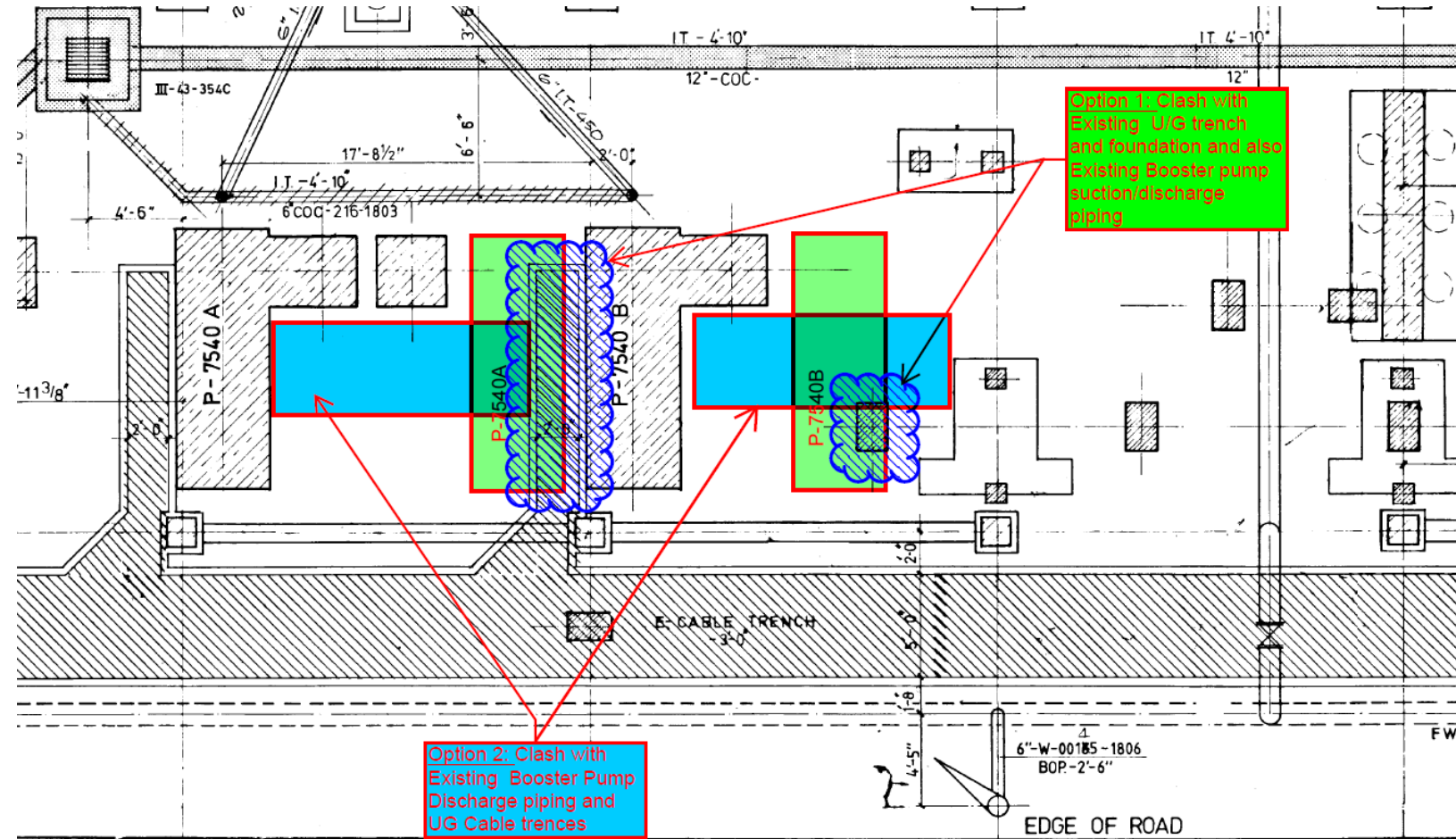
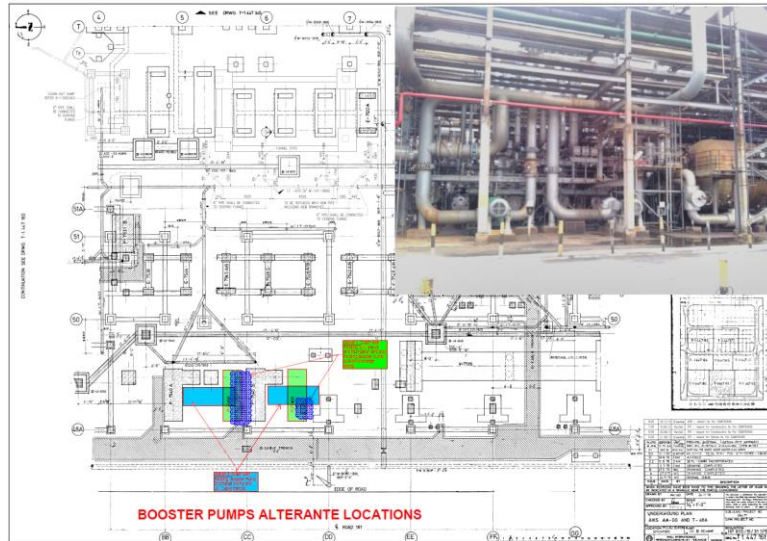
Valve opening % (Actual Vs model)

Company name appears here



Alternate option studied:

- Feasibility of installing new pumps along with running existing pumps in same plot is studied and it is found to be not feasible for various reasons such as piping clash etc.



BOOSTER PUMPS ALTERANTE LOCATIONS

P7540A,B modification scope-

- 1) Modified pump capacity of 2500m³/h at approximately 40m head (which is around 35% shift in pump curve) is required. Refer below screenshot for modified pump curve and new operating point, Pump vendor confirmation and all related process checks to be done, **pump modification in Non TA scope**
- 2) P7540A,B discharge lines (approximately 12m each) to be upsized to 24", **TA scope**,
Necessary Process checks to be done to confirm no issues with running current pump with increased line size and future Big pump.

Only TA scope of the 12 m +12 m 24" discharge line located nearby plant road (non congested area).

Add piping GA SNAPSHOT FOR PUMP non TA and TA SCOPE,

INFO on new pump and existing pump

Elctrical scope change for pump, what change in switch house TA , any work in TA for cable

To develop philosophy of non TA scope – run 1 pump during execution of non ta scope of pump, timeline of running 1 pump either 1 or 2 months, rina will tell, foundation change in pump. Test run, risk to PU, HIGH Level chekc for use of any other new plot but not possible

Idea from rina – both pumps to be inspected in TA for any potential issue and sort of correction to be done in TA,

Schedule a meeting with RE SHELL AND WOOD ON 5HT OR 6TH , DISCUSS MITIGATION, AGREE PHILOSOPHY AND AGREE OVERHAUL,

TAKE INFO FROM wood FOR LAYOUT AND PUMP curve, add plot plan of pump

Friday meeting with WOOD list down all points

