REFINING OF SLOP OIL

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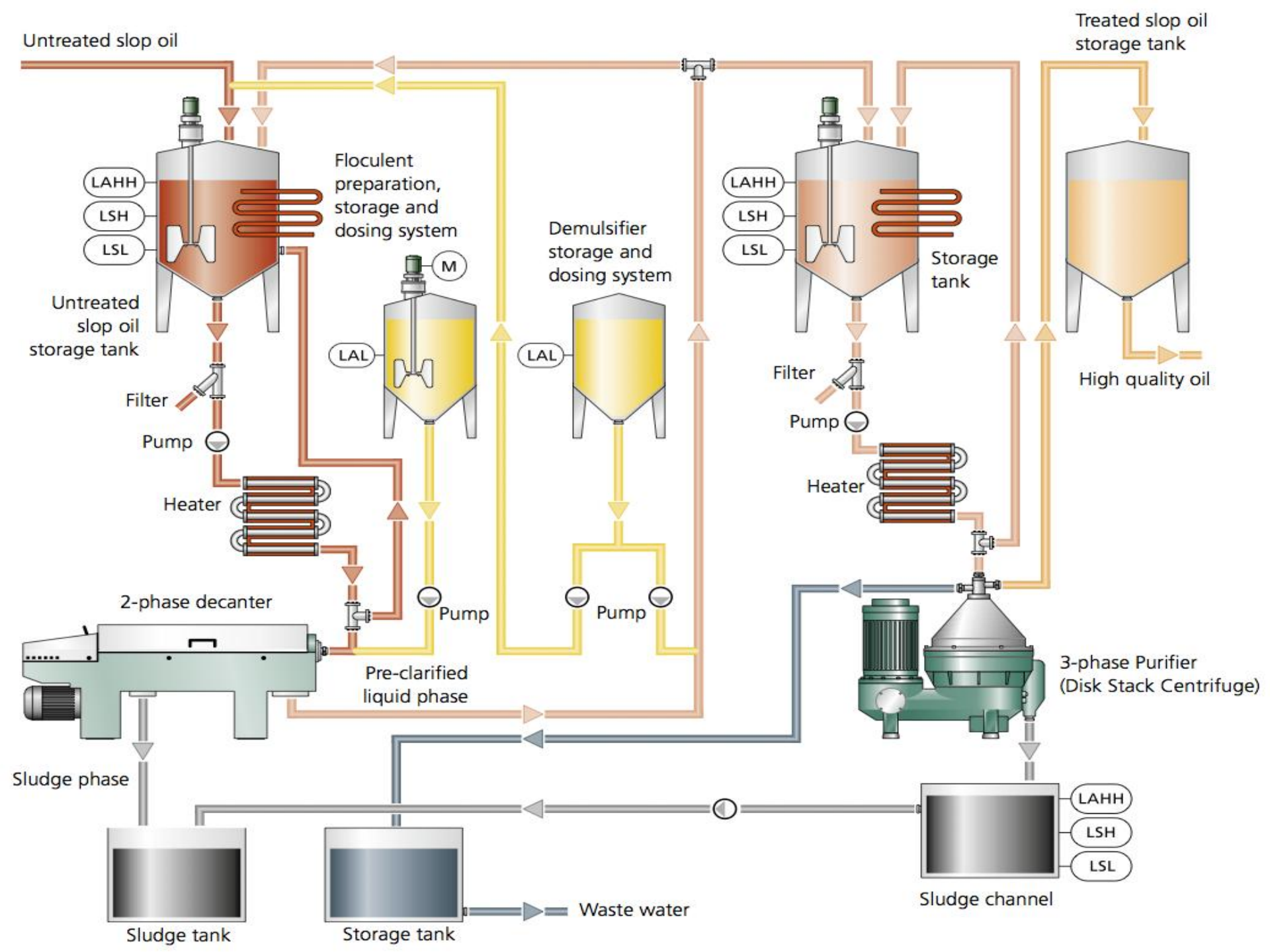
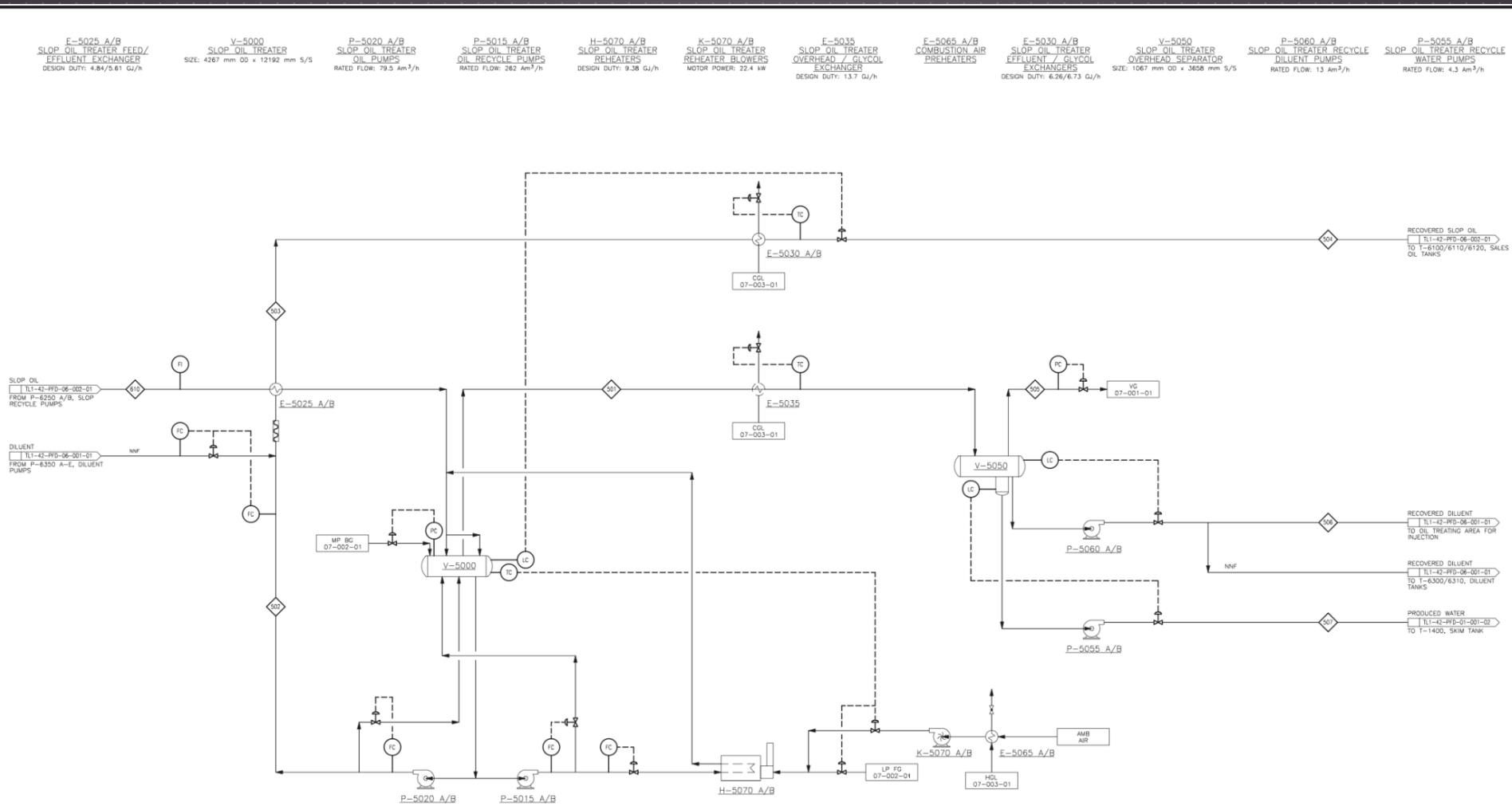
PROCESS OVERVIEW

- Purpose of the Process and Product
  - Recover clean oil and water from slop oil
  - Separation via decantation and centrifugal technology
- Alternatives
  - slop oil was incinerated and the solid waste disposed into waste pits
  - contaminates local groundwater that leads to health problems
  - Very expensive, especially with government fines
- Process Capacity and Economics

	Inlet(slop oil)	Recovered Slop oil	Output Water	Recovered Diluents
Mass flow rate(t/d)	44	33.8	4.6	5.5


Untreated slop oil
Treated slop oil storage tank
LAHH
LSH
LSL
Floculent preparation, storage and dosing system
M
Demulsifier storage and dosing system
LAHH
LSH
LSL
Storage tank
Untreated slop oil storage tank
LAL
LAL
Filter
Pump
Heater
Filter
Pump
Heater
High quality oil
2-phase decanter
Pump
Pump
Pre-clarified liquid phase
3-phase Purifier (Disk Stack Centrifuge)
Sludge phase
LAHH
LSH
LSL
Sludge channel
Sludge tank
Storage tank
Waste water

PIPING AND INSTRUMENTATION DRAWING



NOTES:
1. ALL EQUIPMENT SHOWN IS PHASE A, EXCEPT WHERE NOTED.
2. ALL TAG NUMBERS TO BE PREFIXED BY "TL1-".

Source: Cenovus, Tri Ocean Engineering.

cenovus ENERGY Cenovus TL ULC Telephone Lake Project	Process Flow Diagram Slop Oil Treating System Phases A and B	DATE: December 2011 PROJECT: CE0339901 ANALYST: KW QA/QC: KW EH EH	FigATT07-22 Oil Treat 11-12-13 PROJECTION/DATUM: UTM Zone 12 NAD83 PROVIDED BY: Cenovus FINAL MAPPING BY: AMEC	Figure ATT7-22

OPERABILITY

- Reliability
  - Redundancy

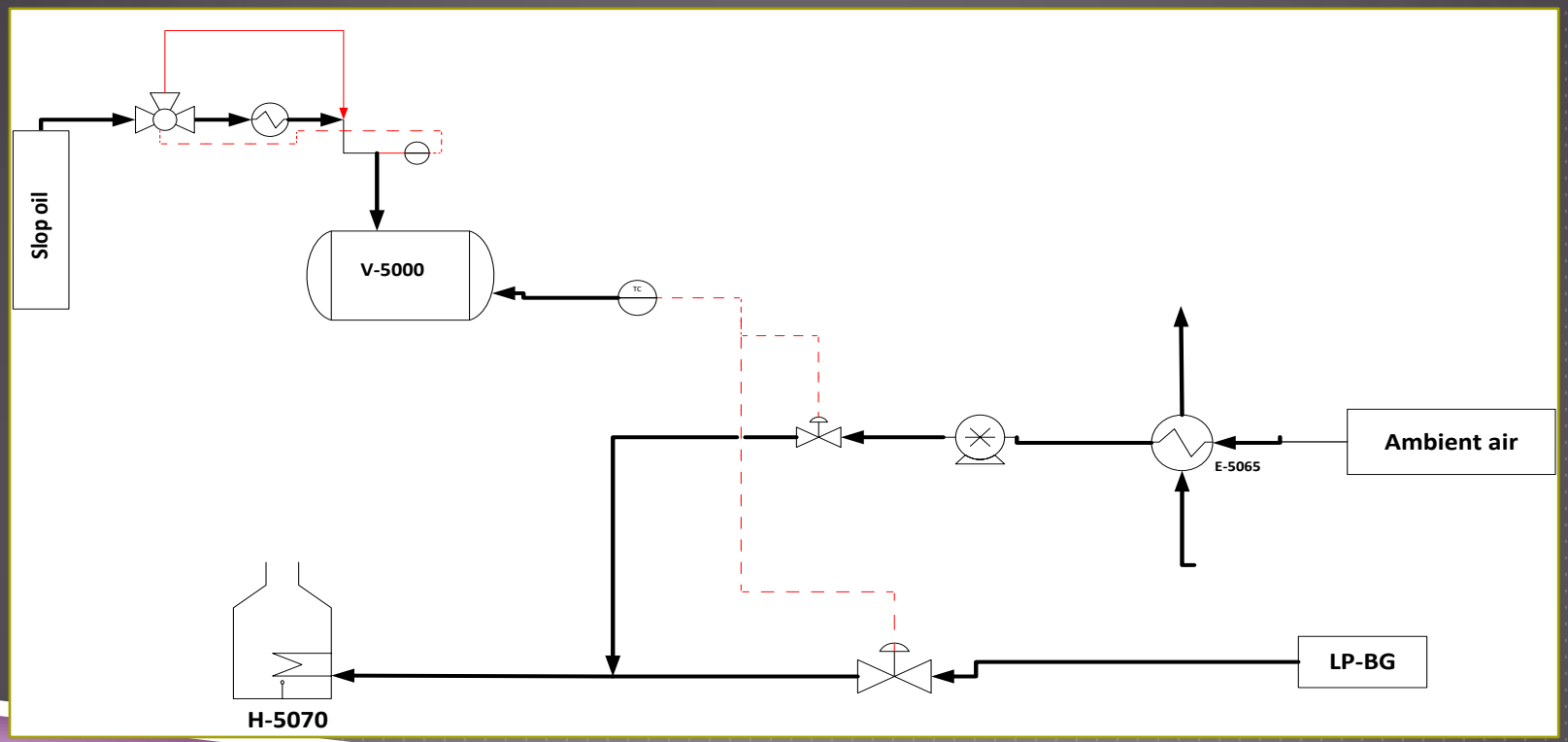
Equipment	Failure Rate (failures/year)	Single Unit Reliability (years)	MTTF (years)	Parallel Reliability (years)
Vessel	0.0063	0.9937	158.61	/
Heat Exchanger	0.0143	0.9857	69.69	0.999
Pumps	0.0277	0.9726	36.09	0.999
Control Valves	0.0231	0.9771	43.19	0.999

  - Preventative Maintenance

Period	Preventative Maintenance Method
Daily	- Check low-level cut-offs for vessels
Weekly	- Start-up standby heat exchangers and pumps - Shut down operational heat exchangers and pumps
Monthly	- Check calibration of all controllers
Semi-Annually	- Regular equipment check - Safety check
Bi-Annually	- Recertify safety valves

OPERABILITY - CONTINUED

- Flexibility



OPERABILITY - CONTINUED

- Transition
  - Start up Procedure
    - Ensure all equipments are set at desired values (pumps, valves, sensors)
    - Purge all lines
    - Preheat overhead separators to attain desired temperature set points
    - Monitor start-up conditions of all variables and follow operational procedures
  - Turnaround Procedure
    - Shut off inlet supply into the system
    - Monitor controllers in the vessels (level, temperature, pressure)
    - Reduce heat supply, shut off one of the recycle pumps as described in operational procedure
    - Purge all lines, ensure all valves are closed, and pumps are shut off.
    - Place lock-out tags on all equipments and vessels in confined space entry requirements in accordance with site safety and regulations.

SAFETY ISSUES

- Six Levels of Safety
  - BPCS – Control Valve with Oxygen Composition Sensor for Flow of Ambient Air
  - Alarms – High Level Alarm on Slop Oil Treater V-5000
  - SIS – Pump P-5020 Immediately Shut Down when Malfunctioning
  - Safety Relief Device – Pressure Relief Valve on Slop Oil Treater V-5000
  - Containment – Construction of Sumps around Slop Oil Storage Tanks
  - Emergency Response – In the Event of Fuel Gas Build-up in Furnace H-5070
- HAZOP Description
  - Example of a Standard HAZOP Analysis Conducted

HAZOP ANALYSIS - EXAMPLE

Node: Exit pipe from HX E-5030 to Sales Oil Tank T-6100, T-6110, T-6120, Line 504
Parameter: Flow

GW	Deviation	Cause	Consequence	Layers of Protection	Actions
More	More Flow	- Control Valve fails open or sensor fails - Pump is set to a higher flow than nominal	- Inadequate heating leading to hot material flowing to tanks causing damage - Pump will empty V-5000 leading to cavitation of pump, eventual failure and release of slope oil	- Control Valve after E-5030 - No other protection exists	- Install a high flow alarm - Install SIS to stop Pump P-5020 or reduce Slop Oil Flow out of Slop Oil Treater V-5000 - Pressure relief valve to redirect the extra flow back to V-5000

CLASS ACTIVITY

A Different Method of Root Cause Analysis