Report

Thickener Area Mini-HAZOP Report

H354600-3310-142-066-0001

					PP	
2021-06-29	A1	Approved for Use	J. Yesberg	B. Stewart	P. Pouliot	S. Somasundaram
DATE	REV.	STATUS	PREPARED BY	CHECKED BY	APPROVED BY	APPROVED BY
				Discipline Lead	Functional Manager	Project Manager

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1. Executive Summary

A Mini Hazard and Operability Study (HAZOP) Study was conducted for the thickener area for Project Lucy 2.0 Phase 1 on 10 September 2020. The HAZOP record is provided in Appendix C.

2. HAZOP Scope & Methodology

2.1 HAZOP Scope

The Mini HAZOP was to address design changes related to the two thickeners relocated from the DWP2 area for the first phase of Lucy 2.0. Table 2-1 shows the nodes that were to be considered. During the workshop, it was decided that there was insufficient clarity around the fire water requirement, and therefore Node 9 was not analysed.

Table 2-1: Nodes for HAZOP Study

Node	Description	P&ID
1	Thickener overflow to screen spray wash.	H354600-3300-270-276-0001 H354600-3300-270-276-0017 H354600-3300-270-276-0041
2	Screen bypass to thickener feed boxes	H354600-3300-270-276-0001 H354600-3300-270-276-0002
3	Thickener underflow to southern slurry pipeline tie-in	H354600-3300-270-276-0001 H354600-3300-270-276-0002
4	Removal of runoff water line to thickener overflow tanks	H354600-3300-270-276-0017
5	Thickener overflow diversion to KO2	H354600-3300-270-276-0017
6	Flocculant make-up water source	H354600-3300-270-276-0020
7	Thickener process water tank	H354600-3300-270-276-0040
8	Thickener air compressor	H354600-3300-270-276-0033
9	Fire Water *(analysis not conducted)*	H354600-3300-270-276-0029
10	Overall system. (Overview guidewords apply)	All above

2.2 HAZOP Objective

The objective of this study was to perform a hazard and operability (HAZOP) study. The principal objectives were to:

- Systematically examine the proposed systems and equipment in order to identify the potential hazards to people, plant assets, operations and the environment.
- Assess the hazards and the proposed methods of control and decide on appropriate actions which will enable the risks to be reduced or eliminated.

- Assess the design and operations controls and their effects on the potential hazards.
- Document the proposed actions and assign people to be responsible for completing each action and dates for completion
- Get engagement and alignment from the stakeholders around the key hazards and recommended controls.

2.3 HAZOP Methodology

A HAZOP is a detailed systematic examination of a process and/or design. It aims to identify and assess the potential hazards and operational problems and the proposed methods of their control. It is undertaken by a group comprised of the design, operations and maintenance personnel who are familiar with the process. Where hazards or potential operational problems are identified, appropriate changes to the design or procedures are recommended.

The HAZOP procedure is facilitated by a comprehensive checklist of guidewords, which prompt the team to think of potential problems. Three types of guidewords were used in this study:

- Fluid systems guidewords; which are appropriate for examination of logical operational units at the detail level. It was determined during the study that the following guidewords were not required in this workshop:
  - Agitation, Rotation, Speed
  - Volume Mass
  - Tension, Current, Frequency Power
- Non-fluid systems guidewords; which are appropriate for examination of physical processing equipment such as conveyors and stockpile machines. It was agreed that there were no cases where these words were to be applied in this study.
- Overview guidewords; used in reviewing the system holistically, including the interface with the environment.

A list of the HAZOP guidewords used in this study is given in Table 2-2.

Table 2-2: HAZOP Guidewords

Fluid System	Non Fluid Guidewords	Overview
High Flow – High Level	Position	Toxicity
Low Flow - Low Level	Movement	Physical Damage
Reverse Flow	Load	Fire/Explosion
High Pressure	Energy	Environment impact
Low Pressure	Timing	Materials of construction

Fluid System	Non Fluid Guidewords	Overview
High Temperature	Contamination	Access
Low Temperature	Size	Utilities and services
Process Control	Process Control	Start up / Shut down
Contamination	Maintenance	Safety Equipment
Electrical Safety		Natural Hazards
Maintenance		Inspection & Testing
Agitation, Rotation, Speed		Procedures Development & Documentation
Volume, Mass		Quality Control
Tension, Current, Frequency, Power		

The HAZOP is carried out by a team including the design, operations and maintenance people who are familiar with the plant and relevant Vendors and management. The technique assumes that errors in the design arise because of the complexity. To cope with this HAZOP uses a systematic examination to identify where deviations from the design intent can occur.

HAZOP meetings are chaired by a facilitator who has an adequate knowledge of the system being assessed, and also has good experience in the HAZOP technique. The role of the facilitator is to facilitate and coordinate the compilation of issues based on available information and the perceptions of the workshop team. The level of detail and time involved in the study precludes the facilitator from validating the identified issues, or determining whether they had been underrated, overlooked or misinterpreted. The facilitator recorded the outcomes of the discussions in an electronic worksheet using PHA Pro software. These records were displayed on the screen to ensure they communicated the consensus outcomes.

It was initially planned to assign risk levels for risks before and after the application of recommended controls. The risk matrix proposed for this was from PRNC HAZOP Record PR-E-235E_HazOp_Rev8. However, it was felt that the rating of the risks could be left for another occasion, if it is required at all.

3. HAZOP Participants

Personnel from PRNC and Hatch attended the HAZOP. The participants are shown in Table 3-1.

Table 3-1: HAZOP Participants

Name	Responsibility	Company
Jeremy Szopa	Project Manager	PRNC
Phillipe Prevot	Project Director	PRNC
Mauricio Orsolani	Supervisor Operation DWP1	PRNC
Lionel Aune	Maintenance Planner	PRNC
Thomas Lundqvist	Construction Supervisor	PRNC
Andre Rosa		PRNC
Claire Vaguener	Geotechnical Engineer	PRNC
Werner Gerritsen	Engineering Manager	Hatch
Pascal Pouliot	Area Manager	Hatch
Ian Weatherhead	Design Coordinator	Hatch
Brett Stewart	Mechanical Lead	Hatch
Nicholas Henderson	Structural Lead	Hatch
Cledson Sabino	Electrical and Control Lead	Hatch
David Martin	Civil	Hatch
Flore Blanchet	Process Lead	Hatch
Duncan Faulkner	Process	Hatch
Winnie Chan	Tailings	Hatch
Alan Cooper	Project Controls	Hatch
Bruno Dallacqua	Electrical Designer	Hatch
Glenn Howarth	Piping Designer	Hatch
Sylvain Bourque	Project Advisor	Hatch
John Yesberg	Facilitator	Hatch

4. Recommendations

In the table of recommendations, the Causes column is a reference to the node, deviation (guideword), and cause, as listed in Appendix B. For example, cause 2.11.1 refers to Node 2, Deviation 11, Cause 1.

Recommendation	Causes	Action By
1. Ensure appropriate pump control in place.	Causes: 1.1.1	Flore
2. Calculate condition-based maintenance for sprinklers. Baseline pressure/flow characteristics during commissioning and look for anomalies during operation.	Causes: 1.2.1	Flore
3. Check whether screen overflow will be directed to bund or bin.	Causes: 1.2.1	Brett
4. Consider whether limit switches are required on manual valves to interlock pump start.	Causes: 1.2.1	Brett
5. Confirm pump stops on insufficient flow after 30 seconds.	Causes: 1.2.1	Mateus
6. Need to ensure consistent overall approach to control of dilution (internal and external)	Causes: 1.8.1	Brett
7. Review possibility of blockage of this node (and also existing KO2 line) and flush methods.	Causes: 2.11.1	Brett
8. Standard operating procedure should avoid closing the valve when line is full of slurry - should clean/flush first.	Causes: 2.11.1	PRNC
9. Review dead legs as part of design review, and consider flushing capability for gate valves.	Causes: 2.11.1	Parking Lot
10. Show vacuum breakers on P&ID	Causes: 3.1.1	Brett
11. Confirm thickener underflow pumps can handle this level of solids.	Causes: 3.2.3	Brett
12. Verify that KO2 barge pump can provide sufficient flow for flushing.	Causes: 3.2.2	Brett
13. Review of next P&ID version to identify flushing configurations	Causes: 3.2.2	Brett
14. Confirm that control strategy is adequate to cope with capacity. Will require changes to existing assets.	Causes: 5.1.1	Brett
15. Identify strategy for dealing with excess water in KO2 area.	Causes: 5.1.2	Brett
16. Confirm that pipeline can handle sufficient pressure and pumping arrangement. Consider removing vent. May require pressure measurement (Antenna Pass modifications).	Causes: 5.1.3	Brett
17. Ensure temperature transmitters are shown at pump discharges and thickener overflow and barge discharge as required.	Causes: 5.6.1	Mateus
18. Ensure that automatic valves are used to select destination. (Currently in markups)	Causes: 5.6.1	Mateus

Recommendation	Causes	Action By
19. Ensure functional description integrates existing and new systems well (noting separate DCS, the two DCS systems do not communicate). 285 will need to control the water that goes to 285. 285 will need information about what is coming from DWP2 - not necessarily with a DCS interface.	Causes: 5.8.1	Mateus, Flore
20. Ensure pump 36/37 start is interlocked to control valve.	Causes: 7.1.2	Mateus
21. Add flow switch on common discharge to protect pump.	Causes: 7.2.1	Mateus
22. Add spool for basket strainer at suction of pumps 012, 013.	Causes: 7.9.1	Brett
23. Verify P&ID updated correctly.	Causes: 8.2.2	Brett
24. Check valve to be removed upstream of accumulator	Causes: 8.4.1	Brett
25. Ensure we purchase a oil/water separator for the condensate system (already specified.)	Causes: 8.9.1	Brett
26. Once equipment has been purchased, ensure that condensate from dryer and accumulator are routed to compressor.	Causes: 8.9.1	Brett
27. Clarify with vendor(s) whether bypass is available.	Causes: 8.11.2	Brett
28. Incorporate point for external compressed air source	Causes: 8.11.3	Brett
29. Verify that external source pressure is not too high, else include pressure control valve.	Causes: 8.11.3	Brett
30. Confirm pressure requirement for instrument and service air	Causes: 8.11.3	PRNC
31. Ensure that fire detection is in place	Causes: 10.3.1	Brett
32. Confirm P&ID revision shows that valves going to thickener will fail closed on loss of power, and valves to KO2 will fail open.	Causes: 10.7.1	Mateus
33. Assess the possibility of water hammer as valves operate on electrical failure.	Causes: 10.7.1	Brett
34. Confirm that valves fail correctly, and that suitable services (e.g. accumulator) are included.	Causes: 10.7.1	Brett
35. Consider supplying emergency power to thickener area air compressor.	Causes: 10.8.1	Cledson
36. Ensure that thickener underflow pump has emergency power.	Causes: 10.8.1	Cledson
37. Revisit load shedding plan - this area may no longer be a priority for power. To be determined.	Causes: 10.9.1	PRNC

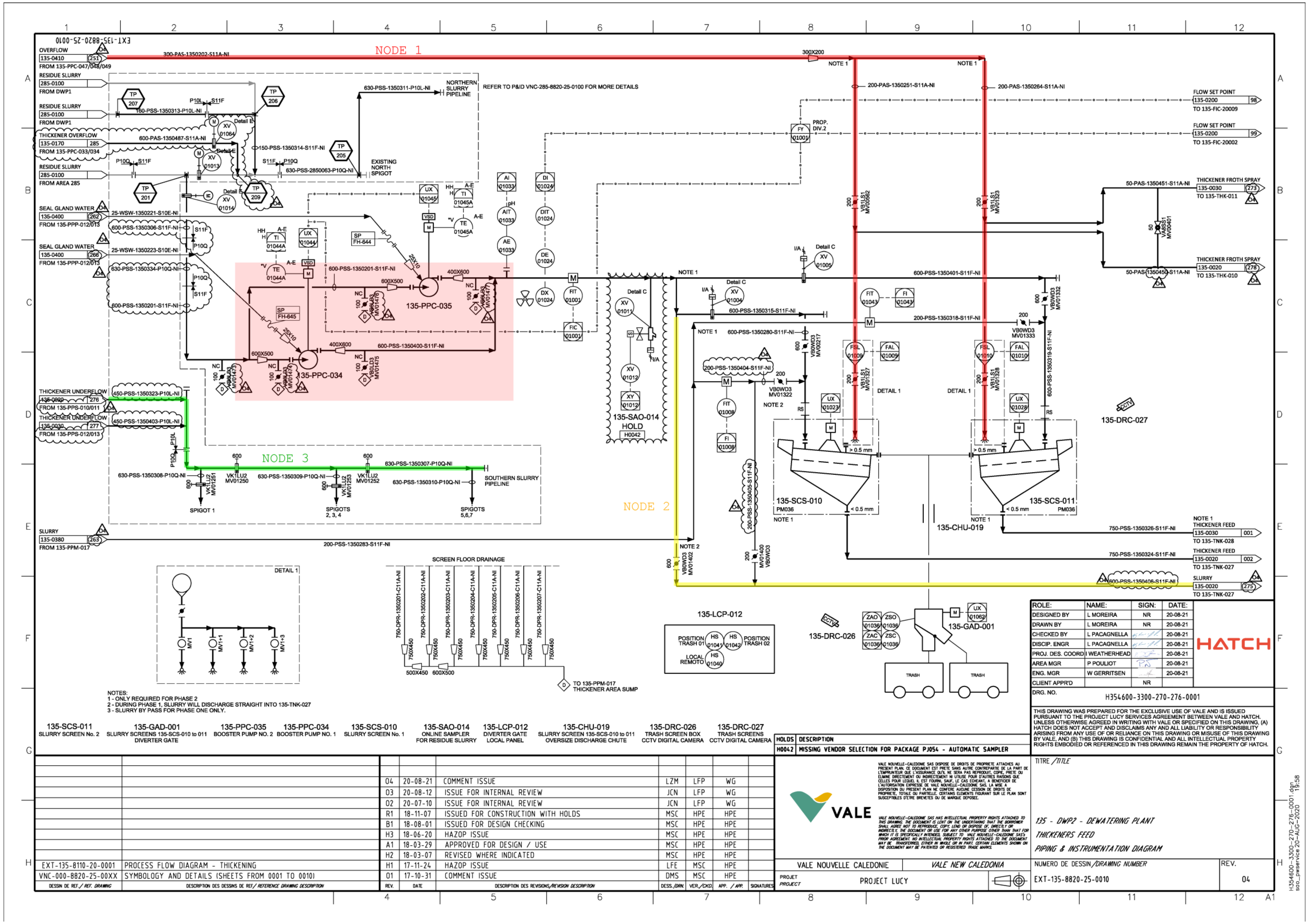
5. References

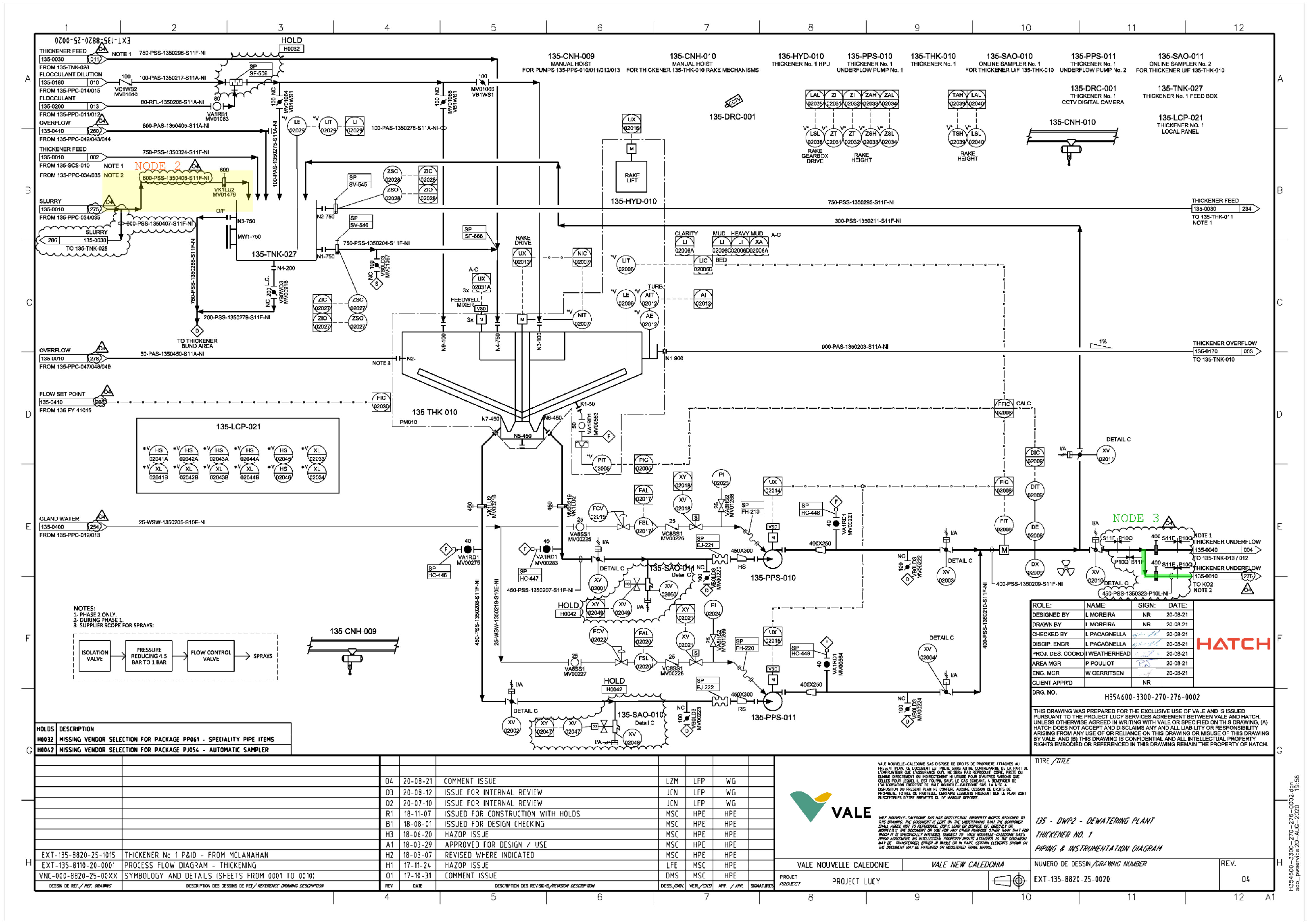
The following drawings were used for the HAZOP.

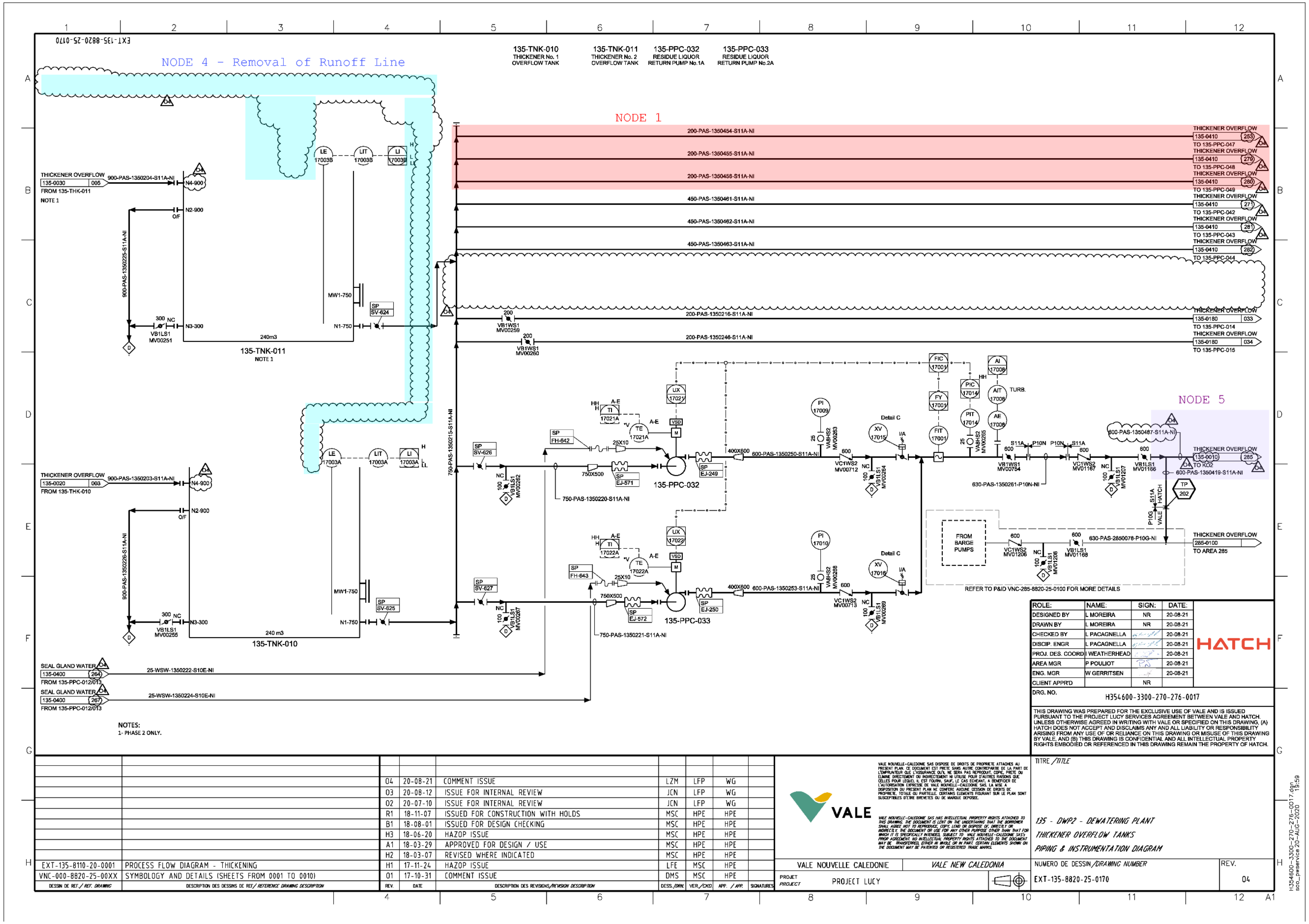
Title	Drawing Number	Hatch Drawing Number	Rev	Date
Thickening PFD	EXT-135-8110-20-0001	H354600-0000-210-282-0001	A5	2020-08-14
Thickeners Feed P&ID	EXT-135-8820-25-0010	H354600-3300-270-276-0001	04	2020-08-21
Thickener No. 1 P&ID	EXT-135-8820-25-0020	H354600-3300-270-276-0002	04	2020-08-21
Thickener No. 2 P&ID	EXT-135-8820-25-0030	H354600-3300-270-276-0003	04	2020-08-21
Thickener Overflow Tanks P&ID	EXT-135-8820-25-0170	H354600-3300-270-276-0017	04	2020-08-21
Thickener Overflow Tanks P&ID	EXT-135-8820-25-0170	H354600-3300-270-276-0017	R1	2018-11-07
Flocculant Plant and Distribution P&ID	EXT-135-8820-25-0200	H354600-3300-270-276-0020	04	2020-08-21
Fire Water Ring Main	EXT-135-8820-25-0290	H354600-3300-270-276-0029	04	2020-08-21
Squeezing Air / Service Compressors P&ID	EXT-135-8820-25-0330	H354600-3300-270-276-0033	04	2020-08-21
Thickener Process Water Tank P&ID	EXT-135-8820-25-0400	H354600-3300-270-276-0040	03	2020-08-21
Screen Spray Water Pumps and Overflow Dilution Pumps P&ID	EXT-135-8820-25-0410	H354600-3300-270-276-0041	03	2020-08-21

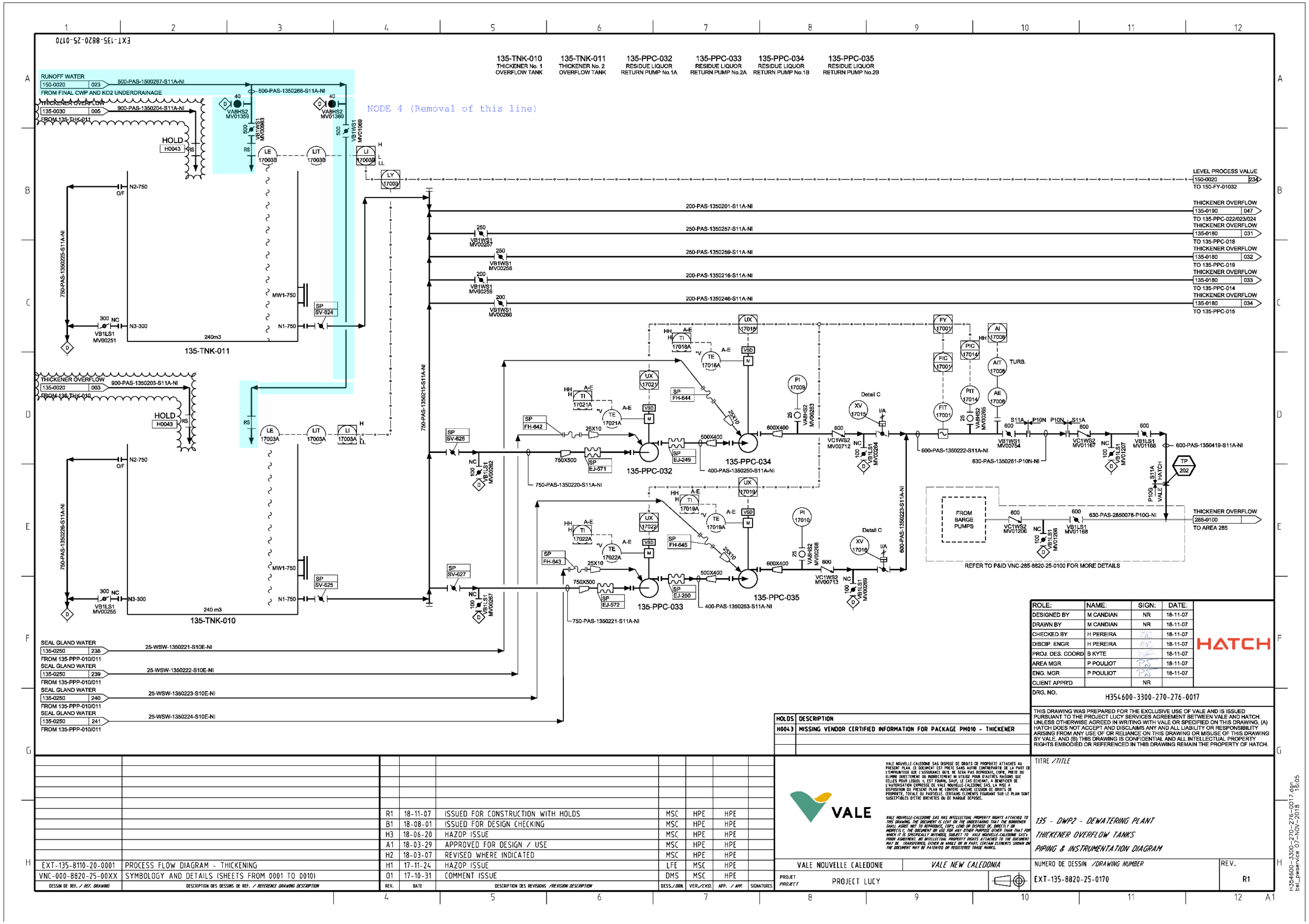
Appendix A

Marked up Nodes (P&ID)


NODE 1
NODE 2
NODE 3
135-PPC-035
135-PPC-034
135-SAO-014
HOLD
135-SCS-010
135-SCS-011
135-CHU-019
135-DRC-027
135-DRC-026
135-LCP-012
135-GAD-001
SCREEN FLOOR DRAINAGE
DETAIL 1
NOTES:
1 - ONLY REQUIRED FOR PHASE 2
2 - DURING PHASE 1, SLURRY WILL DISCHARGE STRAIGHT INTO 135-TNK-027
3 - SLURRY BY PASS FOR PHASE ONE ONLY.
135-SCS-011 SLURRY SCREEN No. 2
135-GAD-001 SLURRY SCREENS 135-SCS-010 to 011 DIVERTER GATE
135-PPC-035 BOOSTER PUMP NO. 2
135-PPC-034 BOOSTER PUMP NO. 1
135-SCS-010 SLURRY SCREEN No. 1
135-SAO-014 ONLINE SAMPLER FOR RESIDUE SLURRY
135-LCP-012 DIVERTER GATE LOCAL PANEL
135-CHU-019 SLURRY SCREEN 135-SCS-010 to 011 OVERSIZE DISCHARGE CHUTE
135-DRC-026 TRASH SCREEN BOX CCTV DIGITAL CAMERA
135-DRC-027 TRASH SCREENS CCTV DIGITAL CAMERA
H0042 MISSING VENDOR SELECTION FOR PACKAGE PJ054 - AUTOMATIC SAMPLER
04 20-08-21 COMMENT ISSUE
03 20-08-12 ISSUE FOR INTERNAL REVIEW
02 20-07-10 ISSUE FOR INTERNAL REVIEW
R1 18-11-07 ISSUED FOR CONSTRUCTION WITH HOLDS
B1 18-08-01 ISSUED FOR DESIGN CHECKING
H3 18-06-20 HAZOP ISSUE
A1 18-03-29 APPROVED FOR DESIGN / USE
H2 18-03-07 REVISED WHERE INDICATED
H1 17-11-24 HAZOP ISSUE
01 17-10-31 COMMENT ISSUE
EXT-135-8110-20-0001 PROCESS FLOW DIAGRAM - THICKENING
VNC-000-8820-25-00XX SYMBOLOGY AND DETAILS (SHEETS FROM 0001 TO 0010)
VALE
VALE NOUVELLE CALEDONIE
VALE NEW CALEDONIA
PROJECT LUCY
HATCH
DRG. NO. H354600-3300-270-276-0001
135 - DWP2 - DEWATERING PLANT
THICKENERS FEED
PIPING & INSTRUMENTATION DIAGRAM
EXT-135-8820-25-0010
REV. 04


NODE 2
NODE 3
135-CNH-009 MANUAL HOIST FOR PUMPS 135-PPS-010/011/012/013
135-CNH-010 MANUAL HOIST FOR THICKENER 135-THK-010 RAKE MECHANISMS
135-HYD-010 THICKENER No. 1 HPU
135-PPS-010 THICKENER No. 1 UNDERFLOW PUMP No. 1
135-THK-010 THICKENER No. 1
135-SAO-010 ONLINE SAMPLER No. 1 FOR THICKENER U/F 135-THK-010
135-PPS-011 THICKENER No. 1 UNDERFLOW PUMP No. 2
135-SAO-011 ONLINE SAMPLER No. 2 FOR THICKENER U/F 135-THK-010
135-DRC-001 THICKENER No. 1 CCTV DIGITAL CAMERA
135-TNK-027 THICKENER No. 1 FEED BOX
135-LCP-021 THICKENER NO. 1 LOCAL PANEL
135-TNK-027
135-THK-010
135-LCP-021
135-CNH-009
135-PPS-010
135-PPS-011
135-SAO-010
NOTES:
1- PHASE 2 ONLY.
2- DURING PHASE 1.
3- SUPPLIER SCOPE FOR SPRAYS:
ISOLATION VALVE
PRESSURE REDUCING 4.5 BAR TO 1 BAR
FLOW CONTROL VALVE
SPRAYS
HOLDS DESCRIPTION
H0032 MISSING VENDOR SELECTION FOR PACKAGE PP061 - SPECIALITY PIPE ITEMS
H0042 MISSING VENDOR SELECTION FOR PACKAGE PJ054 - AUTOMATIC SAMPLER
04 20-08-21 COMMENT ISSUE
03 20-08-12 ISSUE FOR INTERNAL REVIEW
02 20-07-10 ISSUE FOR INTERNAL REVIEW
R1 18-11-07 ISSUED FOR CONSTRUCTION WITH HOLDS
B1 18-08-01 ISSUED FOR DESIGN CHECKING
H3 18-06-20 HAZOP ISSUE
A1 18-03-29 APPROVED FOR DESIGN / USE
H2 18-03-07 REVISED WHERE INDICATED
H1 17-11-24 HAZOP ISSUE
01 17-10-31 COMMENT ISSUE
EXT-135-8820-25-1015 THICKENER No 1 P&ID - FROM MCLANAHAN
EXT-135-8110-20-0001 PROCESS FLOW DIAGRAM - THICKENING
VNC-000-8820-25-00XX SYMBOLOGY AND DETAILS (SHEETS FROM 0001 TO 0010)
VALE
VALE NOUVELLE CALEDONIE
VALE NEW CALEDONIA
PROJECT LUCY
135 - DWP2 - DEWATERING PLANT
THICKENER NO. 1
PIPING & INSTRUMENTATION DIAGRAM
EXT-135-8820-25-0020
REV. 04
DRG. NO. H354600-3300-270-276-0002
HATCH


NODE 4 - Removal of Runoff Line
NODE 1
NODE 5
135-TNK-010
THICKENER No. 1 OVERFLOW TANK
135-TNK-011
THICKENER No. 2 OVERFLOW TANK
135-PPC-032
RESIDUE LIQUOR RETURN PUMP No.1A
135-PPC-033
RESIDUE LIQUOR RETURN PUMP No.2A
NOTES:
1- PHASE 2 ONLY.
H354600-3300-270-276-0017
VALE
VALE NOUVELLE CALEDONIE
VALE NEW CALEDONIA
PROJECT LUCY
135 - DWP2 - DEWATERING PLANT
THICKENER OVERFLOW TANKS
PIPING & INSTRUMENTATION DIAGRAM
EXT-135-8820-25-0170
04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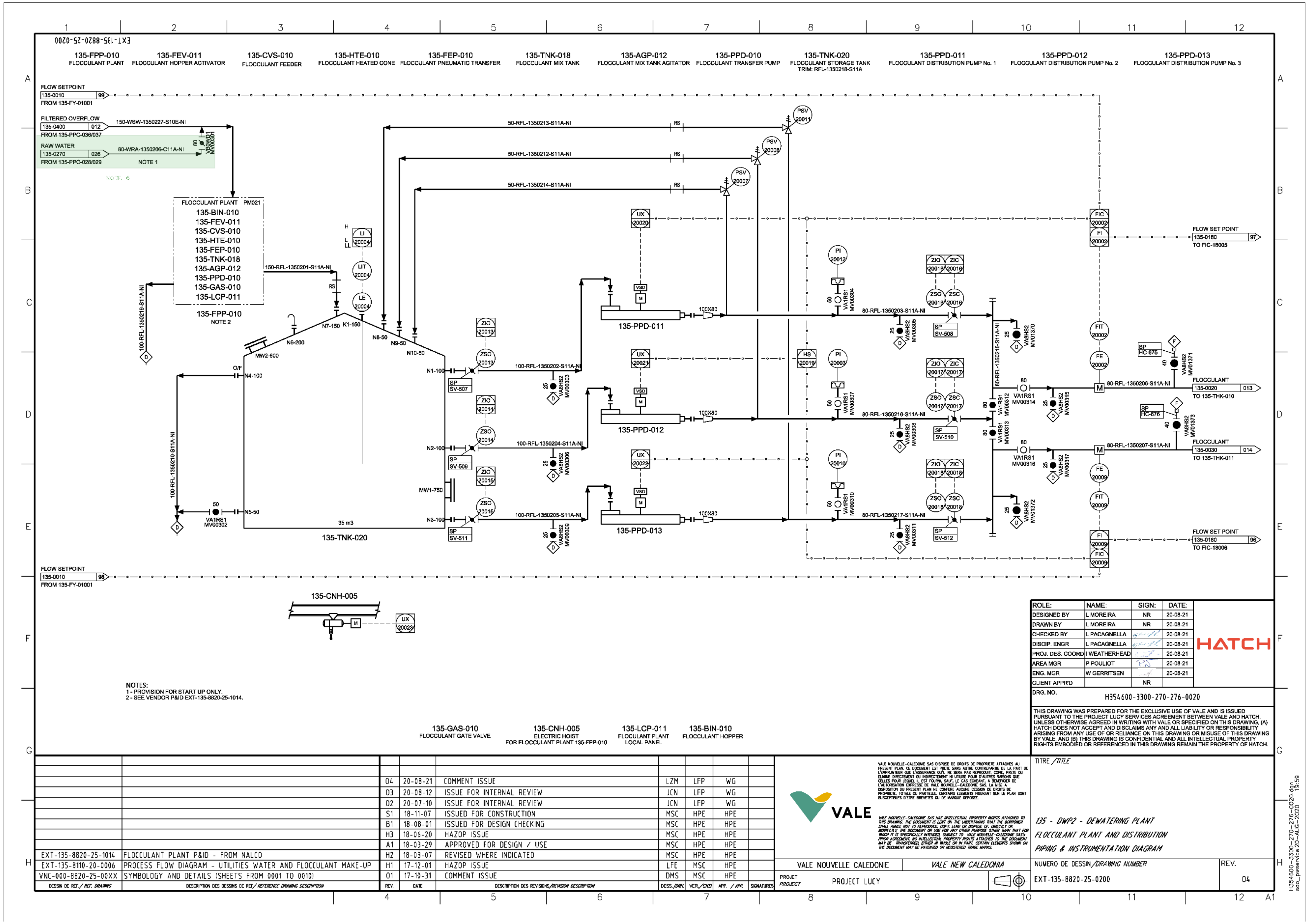
135-TNK-010
THICKENER No. 1 OVERFLOW TANK
135-TNK-011
THICKENER No. 2 OVERFLOW TANK
135-PPC-032
RESIDUE LIQUOR RETURN PUMP No.1A
135-PPC-033
RESIDUE LIQUOR RETURN PUMP No.2A
135-PPC-034
RESIDUE LIQUOR RETURN PUMP No.1B
135-PPC-035
RESIDUE LIQUOR RETURN PUMP No.2B
NODE 4 (Removal of this line)
RUNOFF WATER
FROM FINAL CWP AND KO2 UNDERDRAINAGE
THICKENER OVERFLOW
FROM 135-THK-011
FROM 135-THK-010
HOLD
H0043
LEVEL PROCESS VALUE
TO 150-FY-01032
TO 135-PPC-022/023/024
TO 135-PPC-018
TO 135-PPC-019
TO 135-PPC-014
TO 135-PPC-015
FROM BARGE PUMPS
REFER TO P&ID VNC-285-8820-25-0100 FOR MORE DETAILS
TO AREA 285
SEAL GLAND WATER
FROM 135-PPP-010/011
HOLDS
DESCRIPTION
H0043
MISSING VENDOR CERTIFIED INFORMATION FOR PACKAGE PM010 - THICKENER
HATCH
VALE
VALE NOUVELLE CALEDONIE
VALE NEW CALEDONIA
PROJECT LUCY
135 - DWP2 - DEWATERING PLANT
THICKENER OVERFLOW TANKS
PIPING & INSTRUMENTATION DIAGRAM
H354600-3300-270-276-0017
R1 18-11-07 ISSUED FOR CONSTRUCTION WITH HOLDS
B1 18-08-01 ISSUED FOR DESIGN CHECKING
H3 18-06-20 HAZOP ISSUE
A1 18-03-29 APPROVED FOR DESIGN / USE
H2 18-03-07 REVISED WHERE INDICATED
H1 17-11-24 HAZOP ISSUE
01 17-10-31 COMMENT ISSUE
EXT-135-8110-20-0001 PROCESS FLOW DIAGRAM - THICKENING
VNC-000-8820-25-00XX SYMBOLOGY AND DETAILS (SHEETS FROM 0001 TO 0010)


135-FPP-010 FLOCCULANT PLANT
135-FEV-011 FLOCCULANT HOPPER ACTIVATOR
135-CVS-010 FLOCCULANT FEEDER
135-HTE-010 FLOCCULANT HEATED CONE
135-FEP-010 FLOCCULANT PNEUMATIC TRANSFER
135-TNK-018 FLOCCULANT MIX TANK
135-AGP-012 FLOCCULANT MIX TANK AGITATOR
135-PPD-010 FLOCCULANT TRANSFER PUMP
135-TNK-020 FLOCCULANT STORAGE TANK
135-PPD-011 FLOCCULANT DISTRIBUTION PUMP No. 1
135-PPD-012 FLOCCULANT DISTRIBUTION PUMP No. 2
135-PPD-013 FLOCCULANT DISTRIBUTION PUMP No. 3
FLOW SETPOINT
FROM 135-FY-01001
FILTERED OVERFLOW
FROM 135-PPC-036/037
RAW WATER
FROM 135-PPC-028/029
NOTE 1
FLOCCULANT PLANT PM021
135-TNK-020
135-PPD-011
135-PPD-012
135-PPD-013
FLOCCULANT
TO 135-THK-010
TO 135-THK-011
TO FIC-18005
TO FIC-18006
135-CNH-005
NOTES:
1 - PROVISION FOR START UP ONLY.
2 - SEE VENDOR P&ID EXT-135-8820-25-1014.
135-GAS-010 FLOCCULANT GATE VALVE
135-CNH-005 ELECTRIC HOIST FOR FLOCCULANT PLANT 135-FPP-010
135-LCP-011 FLOCCULANT PLANT LOCAL PANEL
135-BIN-010 FLOCCULANT HOPPER
ROLE: | NAME: | SIGN: | DATE:
DESIGNED BY | L MOREIRA | NR | 20-08-21
DRAWN BY | L MOREIRA | NR | 20-08-21
CHECKED BY | L PACAGNELLA | | 20-08-21
DISCIP. ENGR | L PACAGNELLA | | 20-08-21
PROJ. DES. COORD | I WEATHERHEAD | | 20-08-21
AREA MGR | P POULIOT | | 20-08-21
ENG. MGR | W GERRITSEN | | 20-08-21
CLIENT APPR'D | | NR |
DRG. NO. H354600-3300-270-276-0020
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03 | 20-08-12 | ISSUE FOR INTERNAL REVIEW | JCN | LFP | WG
02 | 20-07-10 | ISSUE FOR INTERNAL REVIEW | JCN | LFP | WG
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B1 | 18-08-01 | ISSUED FOR DESIGN CHECKING | MSC | HPE | HPE
H3 | 18-06-20 | HAZOP ISSUE | MSC | HPE | HPE
A1 | 18-03-29 | APPROVED FOR DESIGN / USE | MSC | HPE | HPE
EXT-135-8820-25-1014 | FLOCCULANT PLANT P&ID - FROM NALCO | H2 | 18-03-07 | REVISED WHERE INDICATED | MSC | HPE | HPE
EXT-135-8110-20-0006 | PROCESS FLOW DIAGRAM - UTILITIES WATER AND FLOCCULANT MAKE-UP | H1 | 17-12-01 | HAZOP ISSUE | LFE | MSC | HPE
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VALE NOUVELLE CALEDONIE | VALE NEW CALEDONIA
PROJET PROJECT | PROJECT LUCY
TITRE /TITLE
135 - DWP2 - DEWATERING PLANT
FLOCCULANT PLANT AND DISTRIBUTION
PIPING & INSTRUMENTATION DIAGRAM
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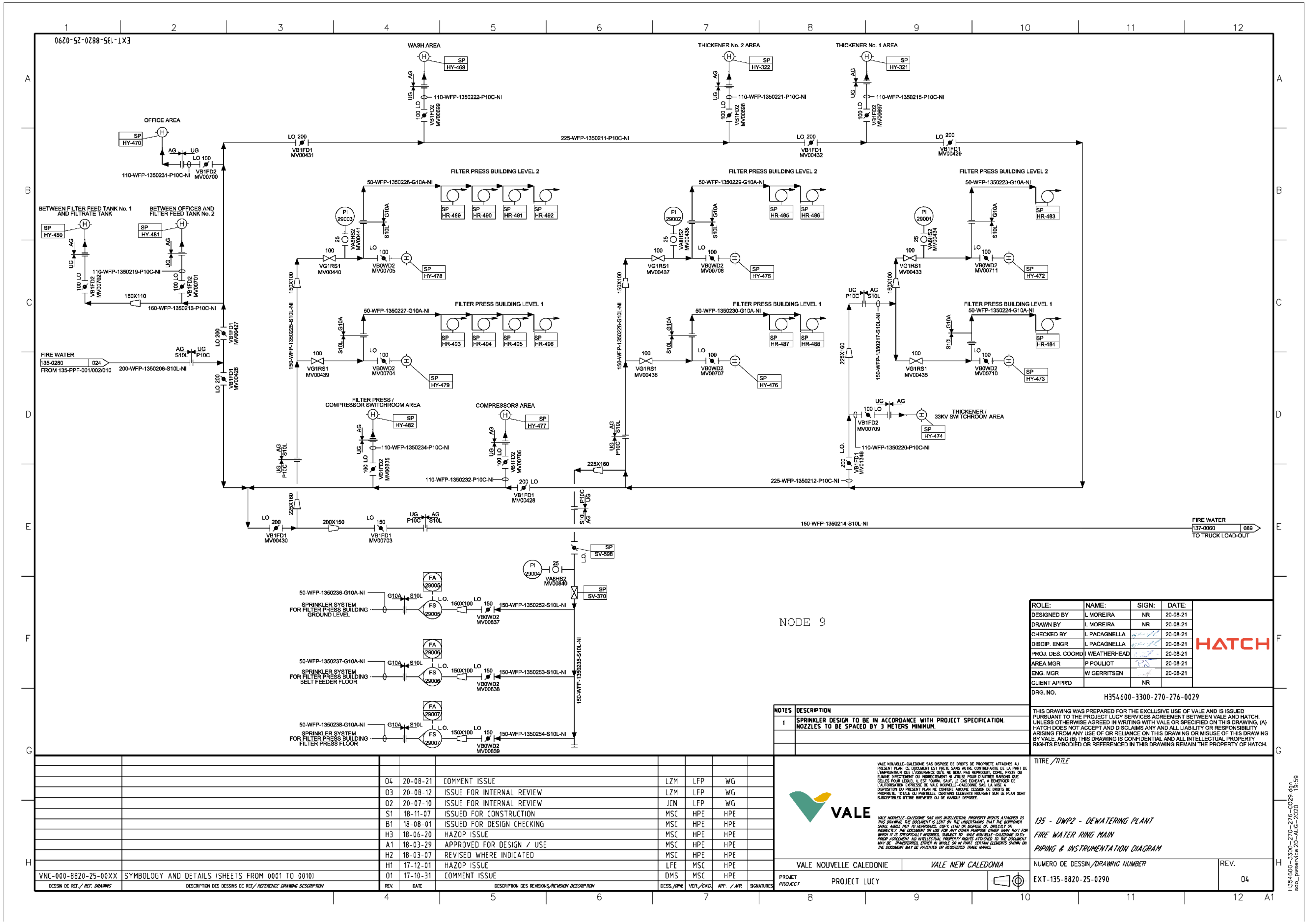
EXT-135-8820-25-0290
WASH AREA
THICKENER No. 2 AREA
THICKENER No. 1 AREA
OFFICE AREA
FILTER PRESS BUILDING LEVEL 2
FILTER PRESS BUILDING LEVEL 1
BETWEEN FILTER FEED TANK No. 1 AND FILTRATE TANK
BETWEEN OFFICES AND FILTER FEED TANK No. 2
FIRE WATER
FROM 135-PPF-001/002/010
225-WFP-1350211-P10C-NI
FILTER PRESS / COMPRESSOR SWITCHROOM AREA
COMPRESSORS AREA
THICKENER / 33KV SWITCHROOM AREA
150-WFP-1350214-S10L-NI
FIRE WATER
TO TRUCK LOAD-OUT
SPRINKLER SYSTEM FOR FILTER PRESS BUILDING GROUND LEVEL
SPRINKLER SYSTEM FOR FILTER PRESS BUILDING BELT FEEDER FLOOR
SPRINKLER SYSTEM FOR FILTER PRESS BUILDING FILTER PRESS FLOOR
NODE 9
NOTES
DESCRIPTION
1
SPRINKLER DESIGN TO BE IN ACCORDANCE WITH PROJECT SPECIFICATION. NOZZLES TO BE SPACED BY 3 METERS MINIMUM.
ROLE: | NAME: | SIGN: | DATE:
DESIGNED BY | L MOREIRA | NR | 20-08-21
DRAWN BY | L MOREIRA | NR | 20-08-21
CHECKED BY | L PACAGNELLA | | 20-08-21
DISCIP. ENGR | L PACAGNELLA | | 20-08-21
PROJ. DES. COORD | I WEATHERHEAD | | 20-08-21
AREA MGR | P POULIOT | | 20-08-21
ENG. MGR | W GERRITSEN | | 20-08-21
CLIENT APPR'D | | NR |
HATCH
DRG. NO. H354600-3300-270-276-0029
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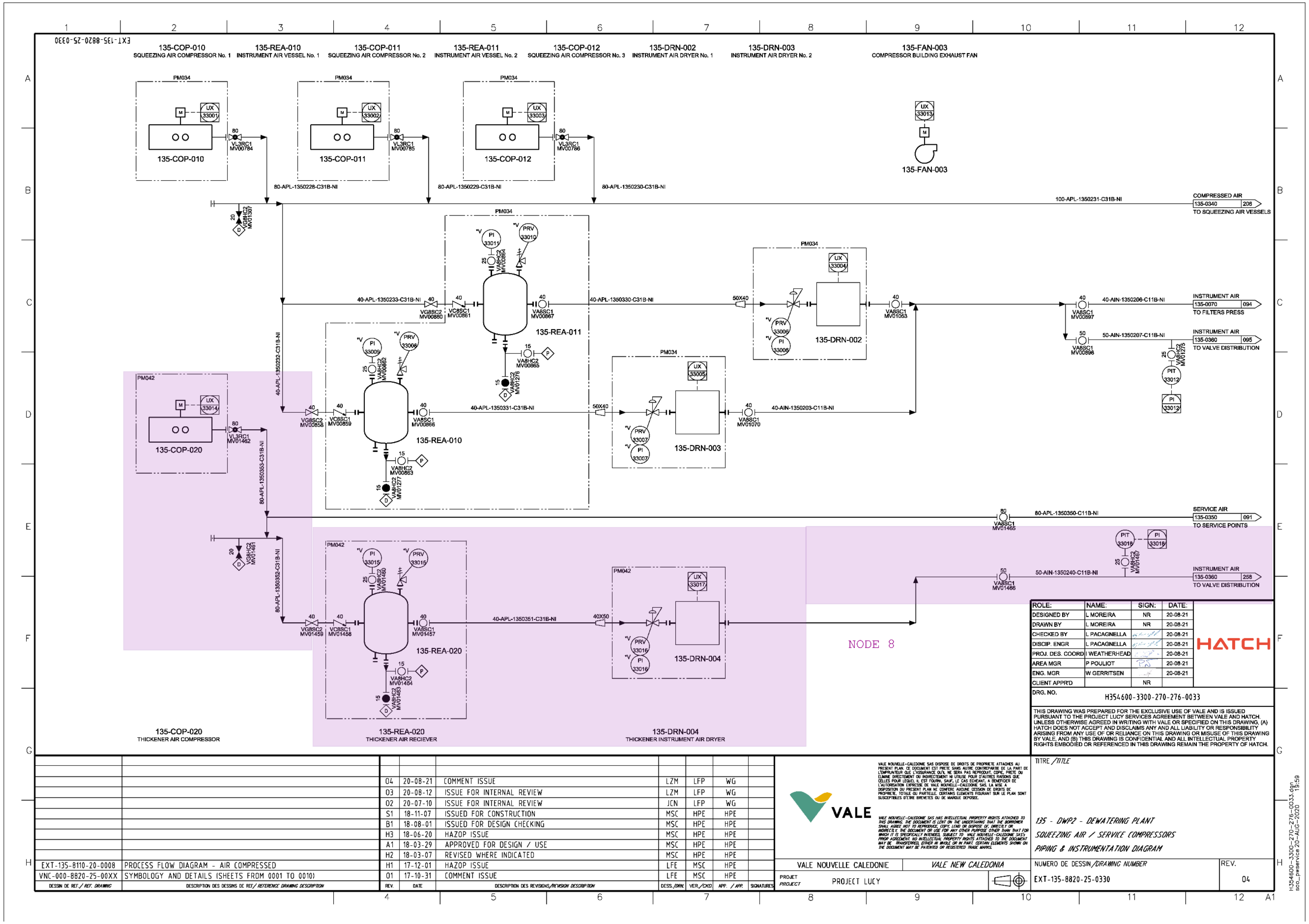
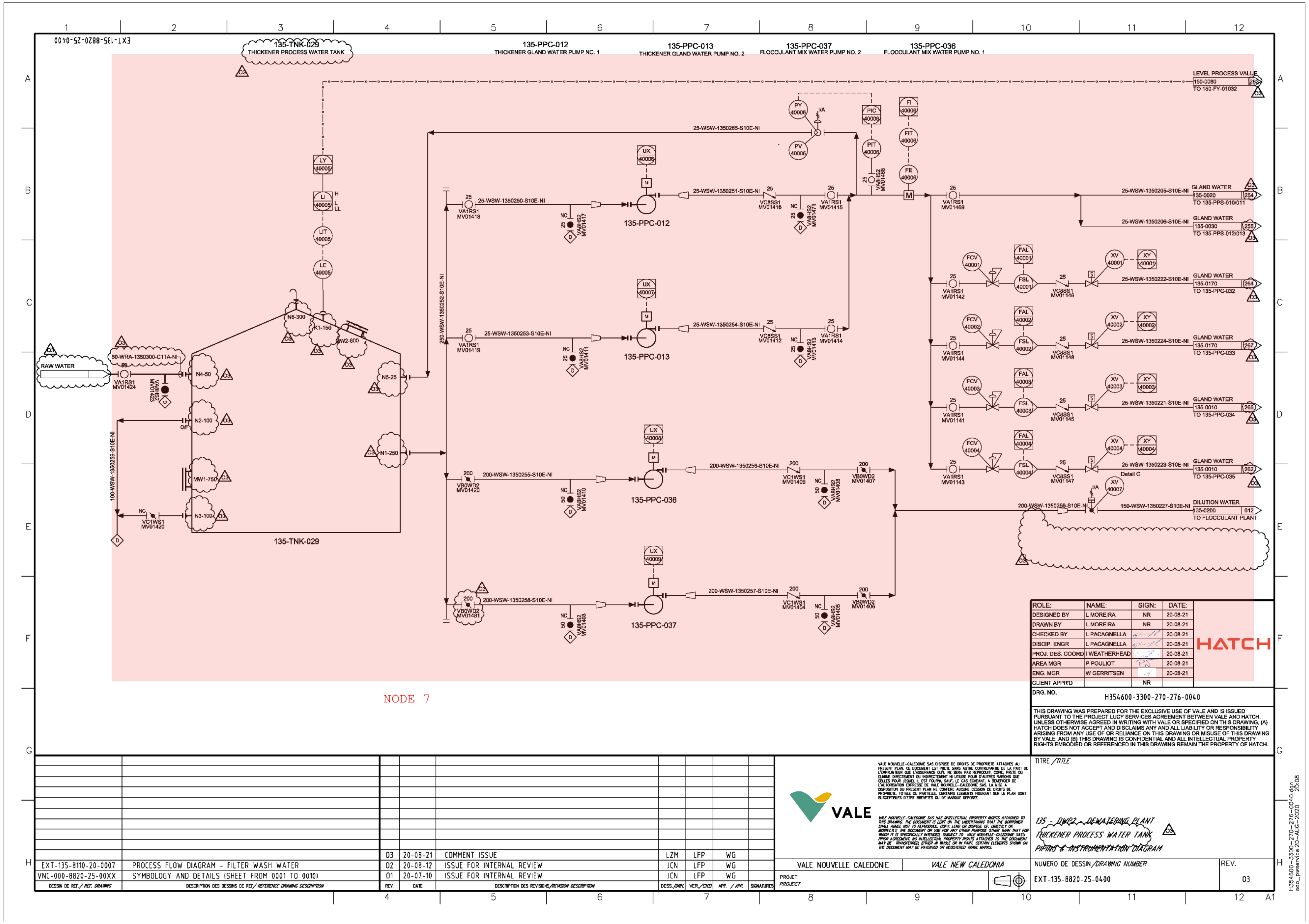
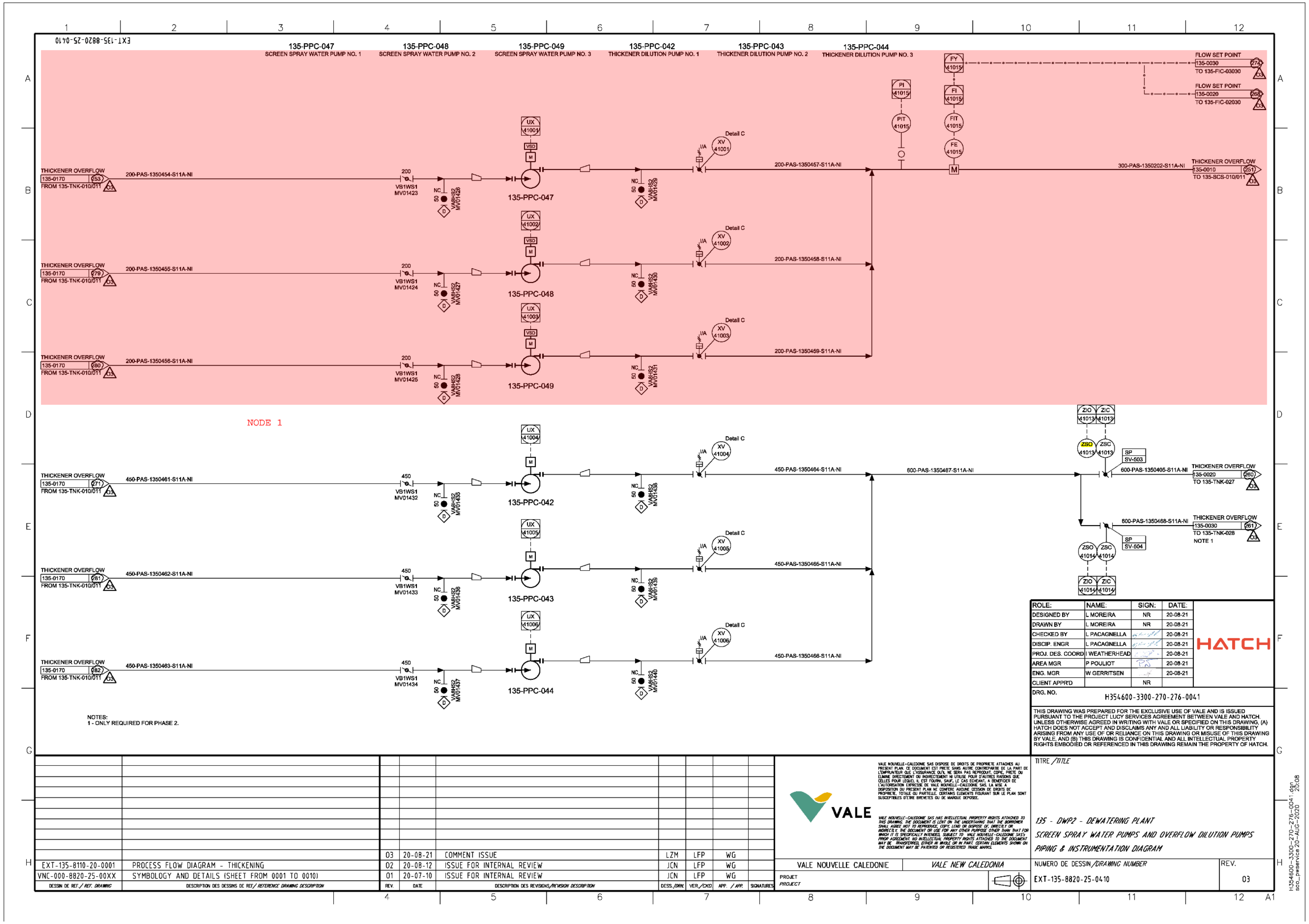
04 | 20-08-21 | COMMENT ISSUE | LZM | LFP | WG
03 | 20-08-12 | ISSUE FOR INTERNAL REVIEW | LZM | LFP | WG
02 | 20-07-10 | ISSUE FOR INTERNAL REVIEW | JCN | LFP | WG
S1 | 18-11-07 | ISSUED FOR CONSTRUCTION | MSC | HPE | HPE
B1 | 18-08-01 | ISSUED FOR DESIGN CHECKING | MSC | HPE | HPE
H3 | 18-06-20 | HAZOP ISSUE | MSC | HPE | HPE
A1 | 18-03-29 | APPROVED FOR DESIGN / USE | MSC | HPE | HPE
H2 | 18-03-07 | REVISED WHERE INDICATED | MSC | HPE | HPE
H1 | 17-12-01 | HAZOP ISSUE | LFE | MSC | HPE
01 | 17-10-31 | COMMENT ISSUE | DMS | MSC | HPE
VNC-000-8820-25-00XX | SYMBOLOGY AND DETAILS (SHEETS FROM 0001 TO 0010)
VALE
VALE NOUVELLE CALEDONIE | VALE NEW CALEDONIA
PROJET / PROJECT: PROJECT LUCY
TITRE / TITLE
135 - DWP2 - DEWATERING PLANT
FIRE WATER RING MAIN
PIPING & INSTRUMENTATION DIAGRAM
NUMERO DE DESSIN / DRAWING NUMBER: EXT-135-8820-25-0290
REV. 04


135-COP-010
SQUEEZING AIR COMPRESSOR No. 1
135-REA-010
INSTRUMENT AIR VESSEL No. 1
135-COP-011
SQUEEZING AIR COMPRESSOR No. 2
135-REA-011
INSTRUMENT AIR VESSEL No. 2
135-COP-012
SQUEEZING AIR COMPRESSOR No. 3
135-DRN-002
INSTRUMENT AIR DRYER No. 1
135-DRN-003
INSTRUMENT AIR DRYER No. 2
135-FAN-003
COMPRESSOR BUILDING EXHAUST FAN
COMPRESSED AIR
TO SQUEEZING AIR VESSELS
INSTRUMENT AIR
TO FILTERS PRESS
INSTRUMENT AIR
TO VALVE DISTRIBUTION
SERVICE AIR
TO SERVICE POINTS
INSTRUMENT AIR
TO VALVE DISTRIBUTION
NODE 8
135-COP-020
THICKENER AIR COMPRESSOR
135-REA-020
THICKENER AIR RECIEVER
135-DRN-004
THICKENER INSTRUMENT AIR DRYER
HATCH
DRG. NO. H354600-3300-270-276-0033
VALE
VALE NOUVELLE CALEDONIE
VALE NEW CALEDONIA
PROJECT LUCY
135 - DWP2 - DEWATERING PLANT
SQUEEZING AIR / SERVICE COMPRESSORS
PIPING & INSTRUMENTATION DIAGRAM
EXT-135-8820-25-0330
04
04 20-08-21 COMMENT ISSUE
03 20-08-12 ISSUE FOR INTERNAL REVIEW
02 20-07-10 ISSUE FOR INTERNAL REVIEW
S1 18-11-07 ISSUED FOR CONSTRUCTION
B1 18-08-01 ISSUED FOR DESIGN CHECKING
H3 18-06-20 HAZOP ISSUE
A1 18-03-29 APPROVED FOR DESIGN / USE
H2 18-03-07 REVISED WHERE INDICATED
H1 17-12-01 HAZOP ISSUE
01 17-10-31 COMMENT ISSUE
EXT-135-8110-20-0008 PROCESS FLOW DIAGRAM - AIR COMPRESSED
VNC-000-8820-25-00XX SYMBOLOGY AND DETAILS (SHEETS FROM 0001 TO 0010)


135-TNK-029
THICKENER PROCESS WATER TANK
135-PPC-012
THICKENER GLAND WATER PUMP NO. 1
135-PPC-013
THICKENER GLAND WATER PUMP NO. 2
135-PPC-037
FLOCCULANT MIX WATER PUMP NO. 2
135-PPC-036
FLOCCULANT MIX WATER PUMP NO. 1
LEVEL PROCESS VALUE
TO 150-FY-01032
RAW WATER
GLAND WATER
DILUTION WATER
TO FLOCCULANT PLANT
NODE 7
ROLE:
NAME:
SIGN:
DATE:
DESIGNED BY
DRAWN BY
CHECKED BY
DISCIP. ENGR
PROJ. DES. COORD
AREA MGR
ENG. MGR
CLIENT APPR'D
L MOREIRA
L PACAGNELLA
I WEATHERHEAD
P POULIOT
W GERRITSEN
DRG. NO.
H354600-3300-270-276-0040
HATCH
VALE
135 - DWP2 - DEWATERING PLANT
THICKENER PROCESS WATER TANK
PIPING & INSTRUMENTATION DIAGRAM
EXT-135-8820-25-0400
03 20-08-21 COMMENT ISSUE
02 20-08-12 ISSUE FOR INTERNAL REVIEW
01 20-07-10 ISSUE FOR INTERNAL REVIEW
EXT-135-8110-20-0007 PROCESS FLOW DIAGRAM - FILTER WASH WATER
VNC-000-8820-25-00XX SYMBOLOGY AND DETAILS (SHEET FROM 0001 TO 0010)
VALE NOUVELLE CALEDONIE
VALE NEW CALEDONIA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SCREEN SPRAY WATER PUMP NO. 1
135-PPC-048
SCREEN SPRAY WATER PUMP NO. 2
135-PPC-049
SCREEN SPRAY WATER PUMP NO. 3
135-PPC-042
THICKENER DILUTION PUMP NO. 1
135-PPC-043
THICKENER DILUTION PUMP NO. 2
135-PPC-044
THICKENER DILUTION PUMP NO. 3
THICKENER OVERFLOW
FROM 135-TNK-010/011
FLOW SET POINT
TO 135-FIC-03030
TO 135-FIC-02030
TO 135-SCS-010/011
TO 135-TNK-027
TO 135-TNK-028
NODE 1
NOTES:
1 - ONLY REQUIRED FOR PHASE 2.
DESIGNED BY L MOREIRA
DRAWN BY L MOREIRA
CHECKED BY L PACAGNELLA
DISCIP. ENGR L PACAGNELLA
PROJ. DES. COORD I WEATHERHEAD
AREA MGR P POULIOT
ENG. MGR W GERRITSEN
DRG. NO. H354600-3300-270-276-0041
03 20-08-21 COMMENT ISSUE
02 20-08-12 ISSUE FOR INTERNAL REVIEW
01 20-07-10 ISSUE FOR INTERNAL REVIEW
EXT-135-8110-20-0001 PROCESS FLOW DIAGRAM - THICKENING
VNC-000-8820-25-00XX SYMBOLOGY AND DETAILS (SHEET FROM 0001 TO 0010)
VALE NOUVELLE CALEDONIE
VALE NEW CALEDONIA
135 - DWP2 - DEWATERING PLANT
SCREEN SPRAY WATER PUMPS AND OVERFLOW DILUTION PUMPS
PIPING & INSTRUMENTATION DIAGRAM
EXT-135-8820-25-0410
REV. 03

Appendix B

Mini-HAZOP Study Worksheet

Node	Deviation	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility
1. Thickener overflow to screen spray wash	1. High Flow – High Level	1. 3 pumps running instead of 2	1. Excess fluid to screens, extra dilution		1. Ensure appropriate pump control in place.	Flore
	2. Low Flow - Low Level	1. Not enough water	1. Blocked screen, possible overflow	1. Low flow switch/alarm	2. Calculate condition-based maintenance for sprinklers. Baseline pressure/flow characteristics during commissioning and look for anomalies during operation.	Flore
			2. Damage to pumps	2. flow meter after pumps	3. Check whether screen overflow will be directed to bund or bin.	Brett
				3. Pressure transmitter after pumps	4. Consider whether limit switches are required on manual valves to interlock pump start.	Brett
				4. Pump current measurement & control, tank level above NPSH requirement.	5. Confirm pump stops on insufficient flow after 30 seconds.	Mateus
				5. CCTV		
		2. Problem with pumps				
		3. Closed suction valve (manual) (similar to not enough water)				
		4. Sprinklers blocked from solids contamination				
	3. Reverse Flow	1. Liquid will flow backwards if pumps stop.	1. Damage to pump	1. NRV has been marked up on discharge of each pump.		
				2. Automatic valves on each pump discharge. No water hammer expected.		
	4. High Pressure	1. Same as Low Flow.		1. Pipe is specified to cover max pressure from pumps.		
				2. Pump casing pressure needs to be rated above pump dead-head pressure.		
	5. Low Pressure	1. Same as Low Flow.				
		2. Leak on pump discharge	1. Low flow to screens	1. Flow meters & flow switches		
			2. Spillage into bunded area	2. Bund		
				3. Pipe rated sufficiently		
		3. Pump failure	1. Same as discussed under Low Flow	1. Redundant pumps		
	6. High Temperature	1. No foreseeable cause		1. Pump dead head will trip pump.		
	7. Low Temperature	1. No foreseeable cause				
	8. Process Control	1.		1. Pumps are fixed speed.	6. Need to ensure consistent overall approach to control of dilution (internal and external)	Brett
	9. Contamination	1. Contamination can block spray	1. Same as discussed under Low Flow	1. Materials of construction ok (stainless)		
	10. Electrical Safety	1. No specific causes related to this node				
	11. Maintenance	1. Automatic valve fails open	1. May be difficult to maintain pump	1. Valve is currently specified as "fail last".		
	12. Agitation, Rotation, Speed	1. No foreseeable cause				
	13. Volume, Mass	1. Not applicable				
	14. Tension, Current, Frequency, Power	1. Not specific to this node				
2. Screen bypass to thickener feed boxes	1. High Flow – High Level	1. Overflow thickener feed boxes. (Phase 1 has only one thickener operating.)	1. Loss of material	1. Overflow directed to bund		
				2. One thickener can take full flow		
	2. Low Flow - Low Level	1. Possible if low flow from Area 285	1. No problems identified.			
	3. Reverse Flow	1. No foreseeable cause				
	4. High Pressure	1. Blocked line or gate valve closed.	1. Low flow, potential damage to pumps in Area 285.	1. Pressure gauge and flow meter in Area 285.		
				2. Valves only need to be operated in major configuration changes.		
				3. Valve is lockable.		

Node	Deviation	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility
	5. Low Pressure	1. Leak or feed pumps not operating	1. Same as low flow			
	6. High Temperature	1. No foreseeable cause				
	7. Low Temperature	1. No foreseeable cause				
	8. Process Control	1.		1. This is a manual operation - there is no control.		
	9. Contamination	1. Little rocks/sand/gypsum may reach thickener		1. Reason for bypass: limited power available at the beginning. Screens are primarily to protect filters. Since thickened slurry goes to KO2, screens are not essential. Screen wash pumps use significant power. Gives flexibility to operate without filters.		
	10. Electrical Safety	1. Not specific to this node				
	11. Maintenance	1. Could the line be blocked due to slurry solids settling, especially if a valve is left closed for a long time (especially in phase 2)		1. Flush line using the same procedure as Area 285 lines.	7. Review possibility of blockage of this node (and also existing KO2 line) and flush methods.	Brett
				2. Difficult to block a 600mm line.	8. Standard operating procedure should avoid closing the valve when line is full of slurry - should clean/flush first.	PRNC
				3. Already a connection from KO2 line at Antenna Pass.	9. Review dead legs as part of design review, and consider flushing capability for gate valves.	Parking Lot
3. Thickener underflow to southern slurry pipeline tie-in	1. High Flow – High Level	1. Siphon		1. There are vacuum breakers in the line	10. Show vacuum breakers on P&ID	Brett
	2. Low Flow - Low Level	1. Pump failure. All these causes are similar to Lucy 1.0 - only difference now is that there are two destinations.		1. Flow and pressure transmitters		
		2. Blocked line		1. P&IDs do not currently show all flush points, but they have been added.	12. Verify that KO2 barge pump can provide sufficient flow for flushing.	Brett
					13. Review of next P&ID version to identify flushing configurations	Brett
		3. Slurry too thick		1. Maximum solids% is 42-45	11. Confirm thickener underflow pumps can handle this level of solids.	Brett
		4. Thickener cone blocked		1. Covered in previous hazop - flush points on thickener cone.		
	3. Reverse Flow	1. No foreseeable cause				
	4. High Pressure	1. Same as Low Flow.				
		2. What if all valves are closed	1. Dead head pump	1. Flow measurement - Pump will trip		
	5. Low Pressure	1. Leak	1. Not entirely in bunded area, but in the pipeline corridor	1. Same risk as current situation.		
				2. Flow transmitter will make this apparent		
		2. Pump failure	1. Same as discussed under Low Flow			
	6. High Temperature	1. No foreseeable cause				
	7. Low Temperature	1. No foreseeable cause				
	8. Process Control	1. No foreseeable cause				
	9. Contamination	1. No foreseeable cause				
	10. Electrical Safety	1. No specific causes related to this node				
	11. Maintenance	1. Same as Low Flow.				
4. Removal of runoff water line to thickener overflow tanks	1. High Flow – High Level					
	2. Low Flow - Low Level					
	3. Reverse Flow					
	4. High Pressure					
	5. Low Pressure					
	6. High Temperature					
	7. Low Temperature					

Node	Deviation	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility
	8. Process Control					
	9. Contamination					
	10. Electrical Safety					
	11. Maintenance					
5. Thickener overflow to KO2	1. High Flow – High Level	1. Total flow to 285 is limited.		1. Reason for this node: to enhance temperature control of fluid going to 285, we can divert some overflow to KO2 if required. 2. Water balance shows no KO2 overflow.	14. Confirm that control strategy is adequate to cope with capacity. Will require changes to existing assets.	Brett
		2. Weather event may increase flow to KO2	1. Overflow KO2		15. Identify strategy for dealing with excess water in KO2 area.	Brett
		3. Flow may be too high for gravity to empty line from Antenna Pass.	1. Slurry may come out vent at Antenna Pass		16. Confirm that pipeline can handle sufficient pressure and pumping arrangement. Consider removing vent. May require pressure measurement (Antenna Pass modifications).	Brett
		4. Temperature control may lead to too much flow to KO2.		1. Calculations indicate that this will not be a problem when operating in design parameters. Not foreseeable.		
	2. Low Flow - Low Level	1. Pump failure, blocked valve, etc.	1. No problems identified. 2. Extra capacity in KO2			
	3. Reverse Flow	1. New tie in may allow for reverse flow		1. Existing pressure balance and NRVs have been designed to prevent this.		
	4. High Pressure	1. Valve misconfiguration	1. Pump failure	1. Flow monitoring on all pumps		
	5. Low Pressure	1. Same as Low Flow.				
	6. High Temperature	1.			17. Ensure temperature transmitters are shown at pump discharges and thickener overflow and barge discharge as required.	Mateus
					18. Ensure that automatic valves are used to select destination. (Currently in markups)	Mateus
	7. Low Temperature	1. No foreseeable cause	1. Happy.			
	8. Process Control	1. Same as for High Temperature.			19. Ensure functional description integrates existing and new systems well (noting separate DCS, the two DCS systems do not communicate). 285 will need to control the water that goes to 285. 285 will need information about what is coming from DWP2 - not necessarily with a DCS interface.	Mateus, Flore
	9. Contamination	1. No foreseeable cause				
	10. Electrical Safety	1. No specific causes related to this node				
	11. Maintenance					
6. Flocculant make-up water source	1. High Flow – High Level	1. Loss of control on pump	1. Over dilution, bad flocculant batch	1. Flow is controlled.		
	2. Low Flow - Low Level	1. Pump failure	1. High concentration of flocculant - lumps.	1. Batch process - don't use the batch if it is bad. 2. The change from overflow water to raw water reduces the chance of solids.		
	3. Reverse Flow	1. Pump failure	1. Damage to pump	1. NRV installed.		
	4. High Pressure	1. Overpressure - closed valves	1. Pipe rupture	1. Pipe rated sufficiently		
	5. Low Pressure	1. Pump failure	1. Same as discussed under Low Flow			
	6. High Temperature					
	7. Low Temperature					
	8. Process Control	1.		1. Batch process. Same as previous hazop.		
	9. Contamination	1.		1. Reduced by using raw water.		
	10. Electrical Safety					
	11. Maintenance					

Node	Deviation	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility
7. Thickener process water tank	1. High Flow – High Level	1. Failure to control incoming water	1. Overflow	1. Overflows to concrete pad, then to bund		
		2. Gland water pumps over pumping	1. No problems identified.	1. Recirculation line	20. Ensure pump 36/37 start is interlocked to control valve.	Mateus
				2. Control pressure & flow for gland water		
				3. Single duty pumps for flocculant dilution water.		
	2. Low Flow - Low Level	1. Suction valve closed, pump has no water.	1. Burn mechanical seal	1. Gland water flow switches will protect pumps.	21. Add flow switch on common discharge to protect pump.	Mateus
			2. Insufficient gland water			
	3. Reverse Flow					
	4. High Pressure	1. Same as for High Flow				
	5. Low Pressure	1. Same as for Low Flow				
	6. High Temperature					
	7. Low Temperature					
	8. Process Control					
	9. Contamination	1. Algae in tank	1. Block pumps		22. Add spool for basket strainer at suction of pumps 012, 013.	Brett
	10. Electrical Safety					
	11. Maintenance					
8. Thickener air compressor	1. High Flow – High Level					
	2. Low Flow - Low Level	1. Compressor failure	1. Lack of instrument air	1. Pressure instrumentation		
		2. Service air comes directly from compressor	1. Compressor always running	1. P&ID has been marked up. Service air now comes from accumulator.	23. Verify P&ID updated correctly.	Brett
	3. Reverse Flow					
	4. High Pressure	1. Compressor may not shut off	1. Overpressure in accumulator	1. Relief valve in place	24. Check valve to be removed upstream of accumulator	Brett
	5. Low Pressure	1. Compressor failure	1. As for low flow			
	6. High Temperature	1. High temperature air from compressor		1. Accumulator will lower temperature.		
				2. Compressor has thermal cutout.		
	7. Low Temperature					
	8. Process Control					
	9. Contamination	1. Possibility of oil in condensate		1. Automatic alarms when oil is full.	25. Ensure we purchase a oil/water separator for the condensate system (already specified.)	Brett
					26. Once equipment has been purchased, ensure that condensate from dryer and accumulator are routed to compressor.	Brett
	10. Electrical Safety					
	11. Maintenance	1. Outdoor equipment may deteriorate		1. System has been specified for outdoor location.		
		2. May need to bypass dryer		1. System is a single vendor package	27. Clarify with vendor(s) whether bypass is available.	Brett
		3. Compressor failure			28. Incorporate point for external compressed air source	Brett
					29. Verify that external source pressure is not too high, else include pressure control valve.	Brett
					30. Confirm pressure requirement for instrument and service air	PRNC
9. Fire water						
10. Overall system	1. Toxicity	1. Slurry may not be adequately neutralized	1. This is normal operation.	1. pH control on the line entering the thickeners		
				2. Safety showers in place		
	2. Physical Damage	1. No new causes foreseeable.		1. Plant is located to avoid interactions with DWP1 activities		
				2. Design minimizes possibilities of pipe damage due to traffic at road crossings		

Node	Deviation	Cause	Consequence	Effective Safeguards	Recommendations	Responsibility
				3. Mobile equipment moving grits, but layout allows for better movement. Not a new risk.		
	3. Fire/Explosion	1. Screens - hydraulic units, screen deck is polyurethane - static electricity		1. Hydraulic unit should have temperature sensors.	31. Ensure that fire detection is in place	Brett
				2. Previous requirement for fire/smoke detection		
		2. Hot work causes spark on polyurethane		1. Permit & administrative controls require separate controls.		
	4. Environment impact	1. Tank leaks, overflows		1. Contained by bund		
				2. Piping corridor risk is not increased.		
	5. Materials of construction	1. Corrosion		1. Using existing materials - stainless or HDPE.		
	6. Access	1.		1. Access is improved over the previous DWP2 design.		
	7. Utilities and services	1. Loss of electricity	1. Bypass thickeners and go to KO2	1. None required. Automated (motorized) valves.	32. Confirm P&ID revision shows that valves going to thickener will fail closed on loss of power, and valves to KO2 will fail open.	Mateus
					33. Assess the possibility of water hammer as valves operate on electrical failure.	Brett
					34. Confirm that valves fail correctly, and that suitable services (e.g. accumulator) are included.	Brett
	8. Start up / Shut down	1.		1. Already captured requirement to flush lines that may contain solids	35. Consider supplying emergency power to thickener area air compressor.	Cledson
				2. Can operate with or without screens	36. Ensure that thickener underflow pump has emergency power.	Cledson
				3. Backup generator to supply filter feed tank agitators, flocculant tanks, and filter rakes (part of design for Lucy 1.0)		
	9. Safety Equipment	1. Electrical overload			37. Revisit load shedding plan - this area may no longer be a priority for power. To be determined.	PRNC
		2. No new causes foreseeable.				
	10. Natural Hazards	1. Heavy rain, cyclone (move to Environmental guideword)	1. Thickeners, bunds overflow, potential environmental discharge.	1. Contact water on the hill or the pad takes water by gravity drain (open culvert) to KO2.		
	11. Inspection & Testing	1. No new causes foreseeable.				
	12. Procedures Development & Documentation					
	13. Quality Control					