Coloured P&ID for TFF System Rev1.0

Based on P&ID Drawing 05.000976-PID Rev1.1

Your Journey. Your Way.

Revision History

Revision	Description	Date
1.0	First issue	22 Oct 2020

Phase list

Phase 1: Drain Vessel
Phase 2: Fill vessel with media
Phase 3: Re-circulation filtration loop
Phase 4: Re-circulation vessel spray ball
Phase 5: CIP Inlets
Phase 6: Blow down pipe work
Phase 7: Flush membrane cassettes
Phase 8: Temperature control
Phase 9: NWP-Test
Phase 10: Concentration
Phase 11: Diafiltration with tank level control.
Phase 12: Product Recovery
Phase 13: Retentate re-circulation
Phase 14: System pressure hold test
Phase 15: Integrity test filter cassettes
Phase 16: Concentration with tank level control.
Phase 17: Tank SIP

Phase 1: Drain vessel

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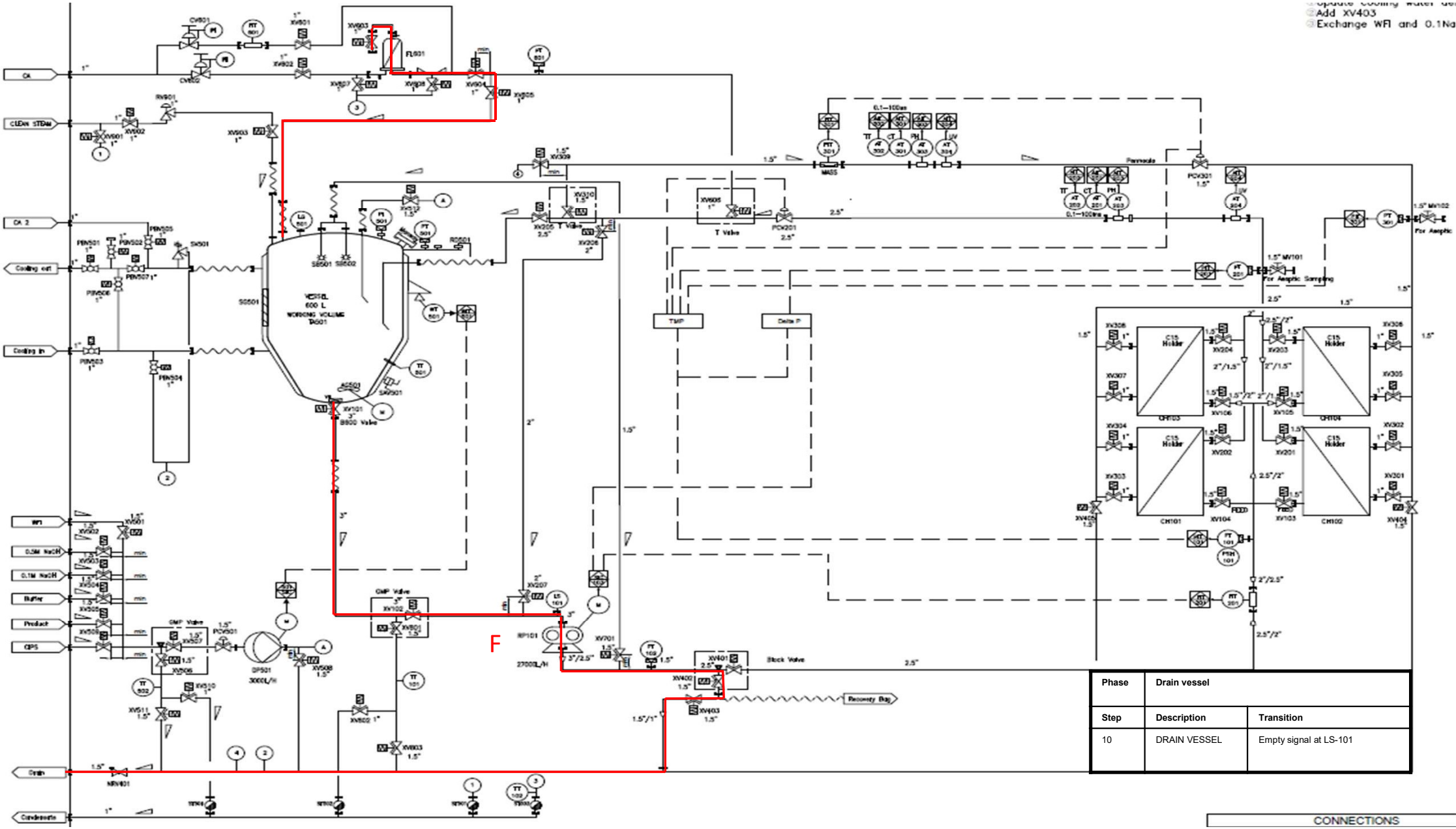
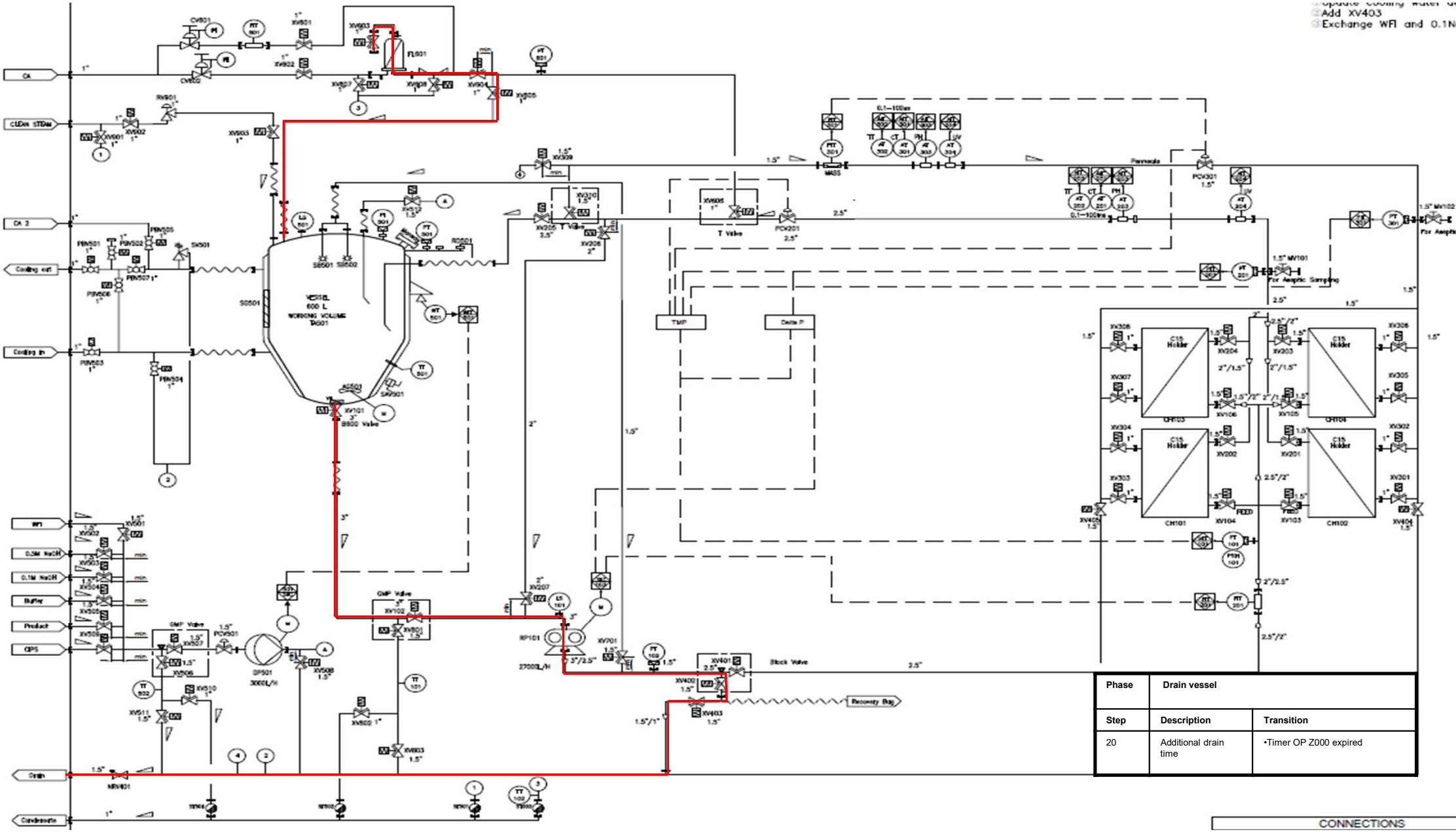


Phase	Drain vessel	
Step	**Description**	**Transition**
10	DRAIN VESSEL	Empty signal at LS-101

CONNECTIONS



Phase	Drain vessel	
Step	**Description**	**Transition**
20	Additional drain time	•Timer OP Z000 expired

Phase 2: Fill vessel with media

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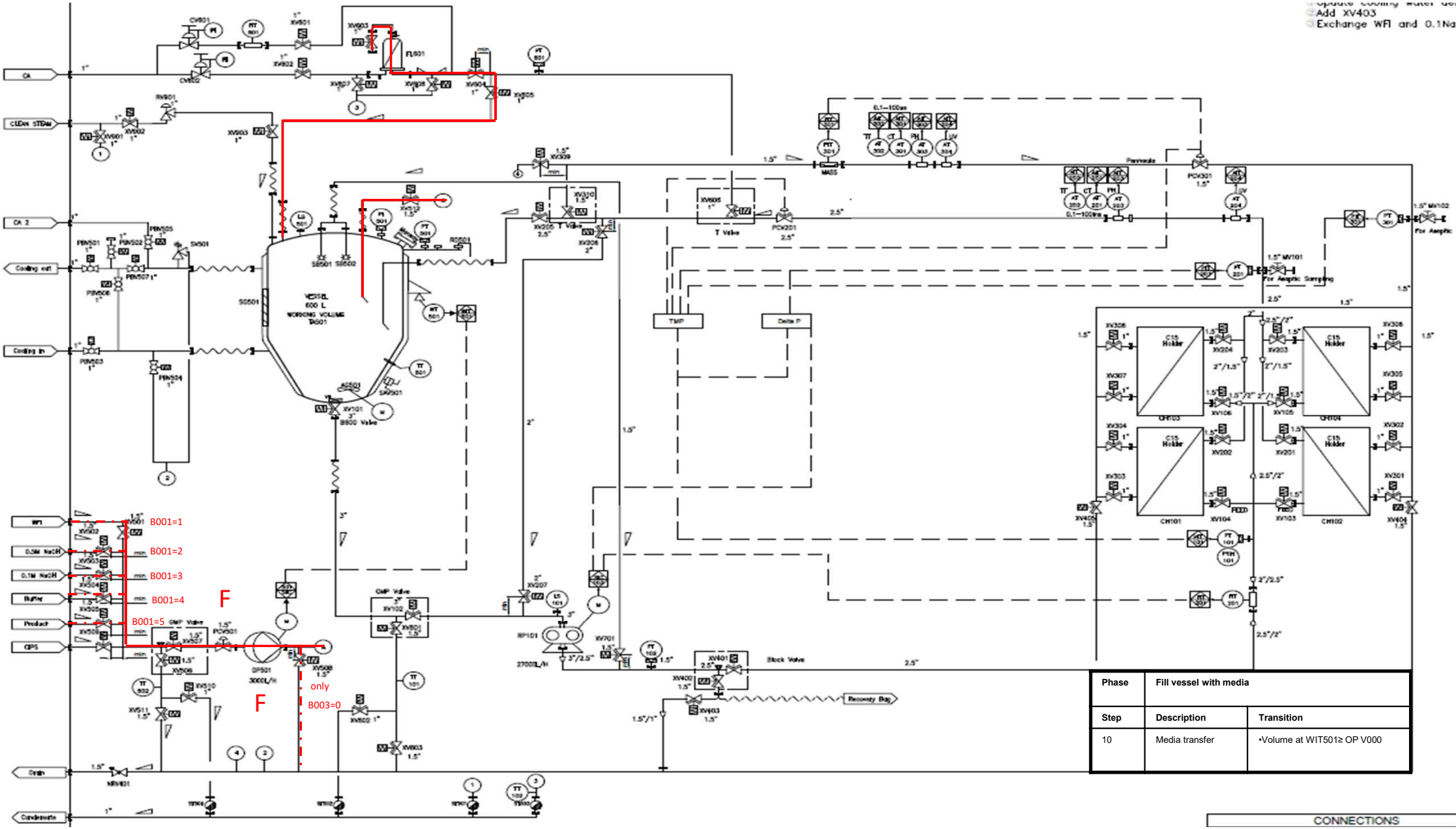
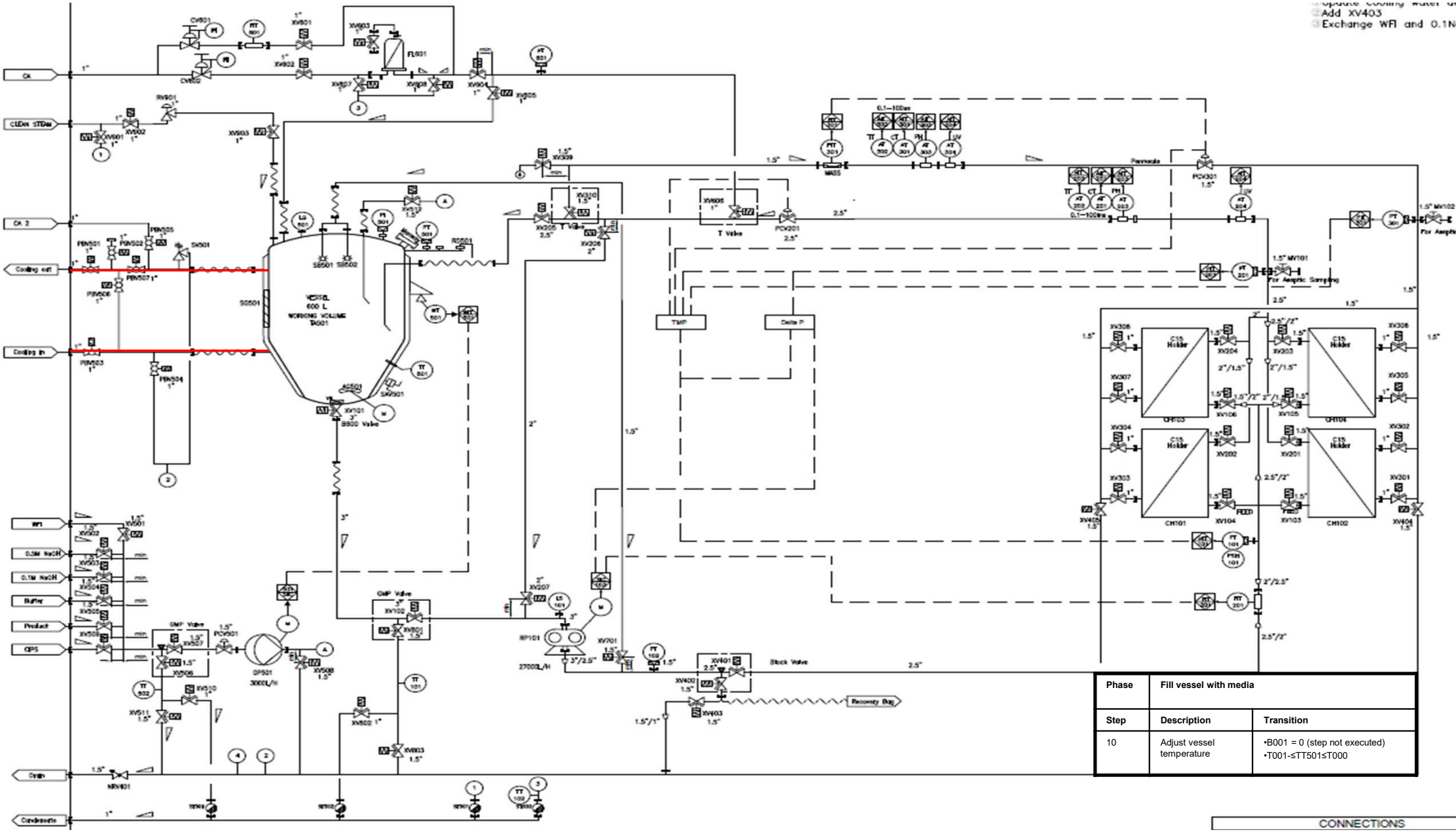

Add XV403
Exchange WFI and 0.1Na
B001=1
B001=2
B001=3
B001=4
B001=5
F
F
only
B003=0
Phase
Fill vessel with media
Step
Description
Transition
10
Media transfer
•Volume at WIT501≥ OP V000
CONNECTIONS



Phase	Fill vessel with media	
Step	**Description**	**Transition**
10	Adjust vessel temperature	•B001 = 0 (step not executed) •T001-≤TT501≤T000

Phase 3: Re-circulation filtration loop

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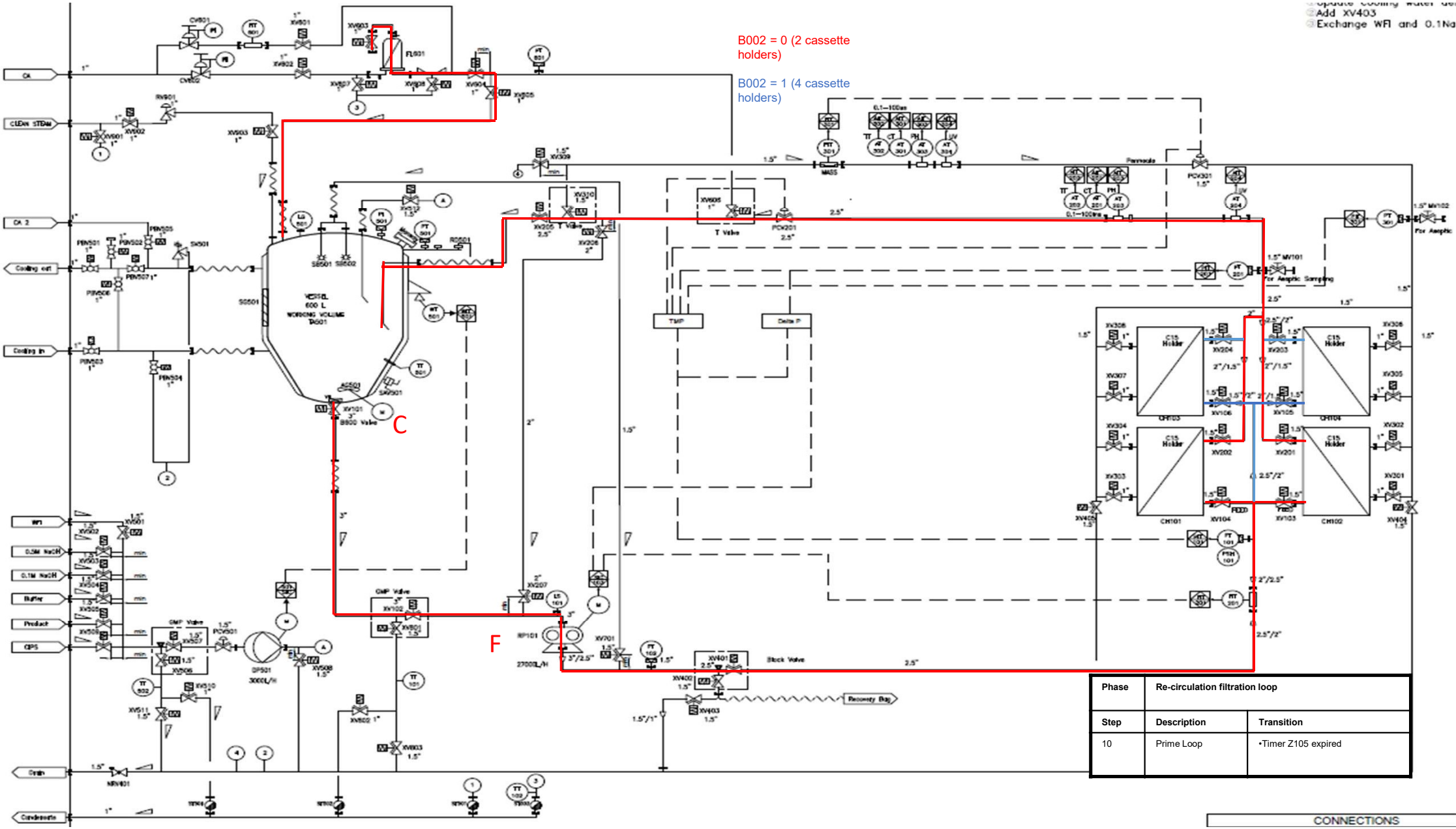
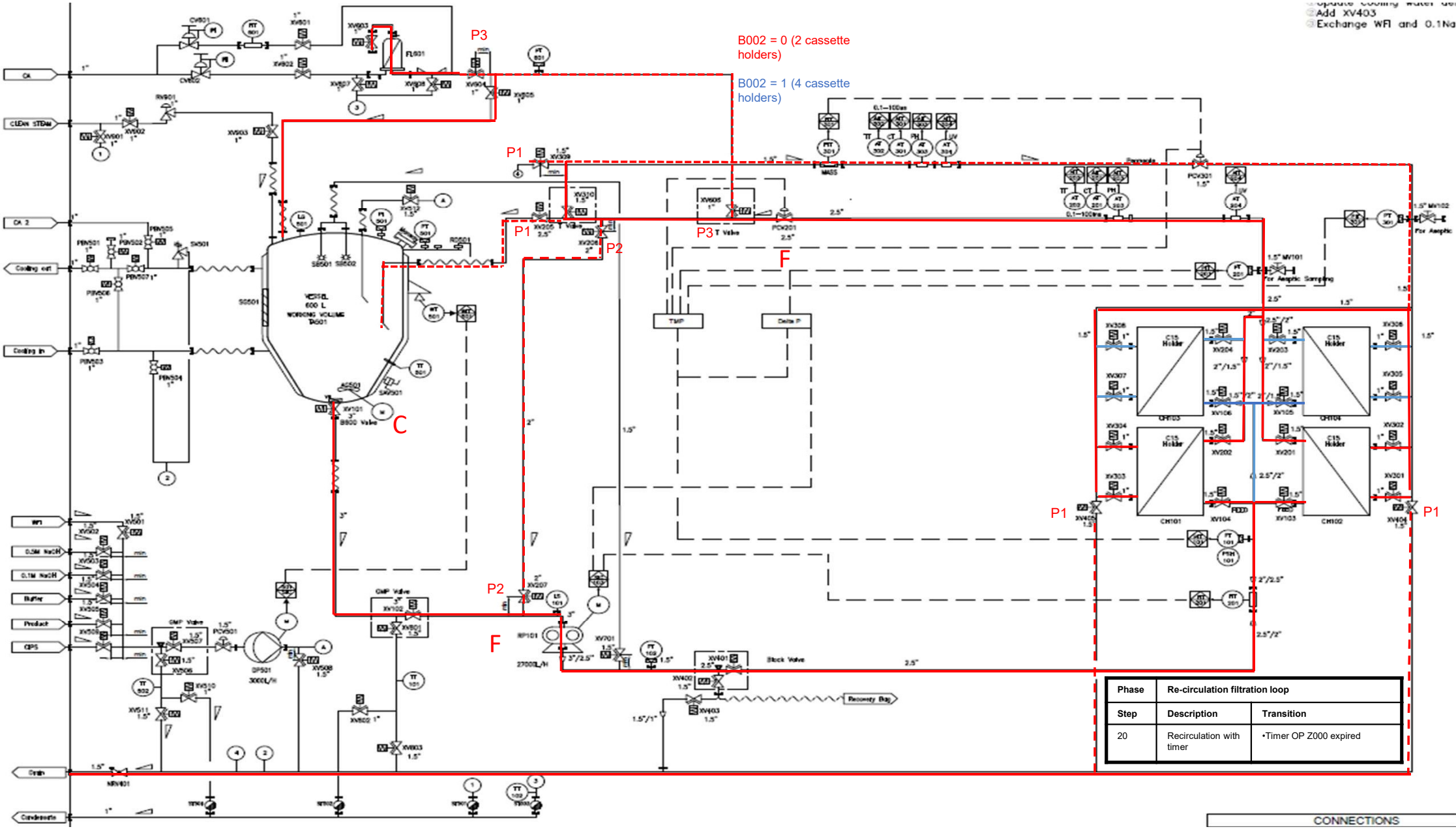


Phase	Re-circulation filtration loop	
Step	**Description**	**Transition**
10	Prime Loop	•Timer Z105 expired



Phase	Re-circulation filtration loop	
Step	Description	Transition
20	Recirculation with timer	•Timer OP Z000 expired

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Phase 4: Re-circulation vessel spray ball

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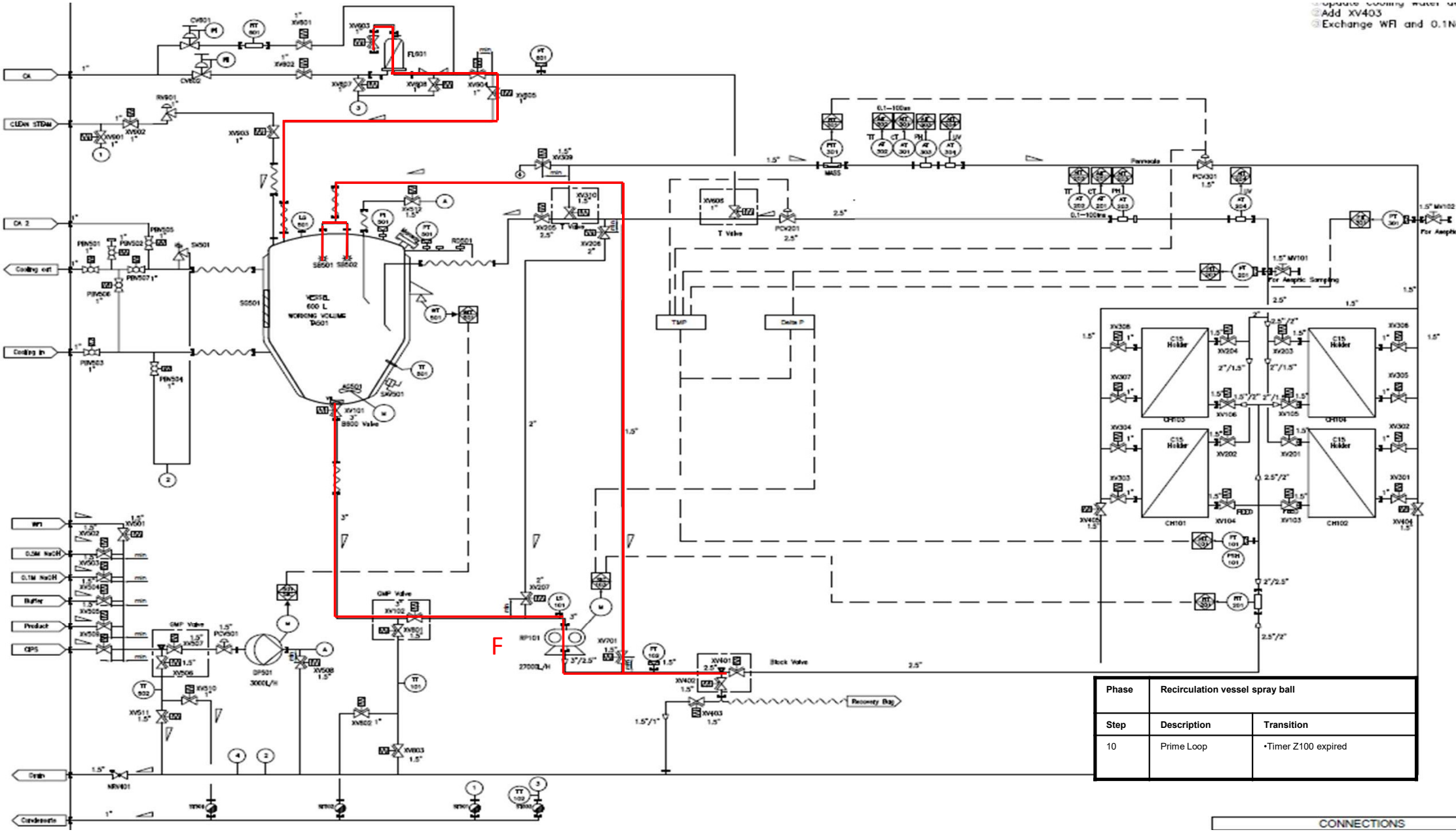
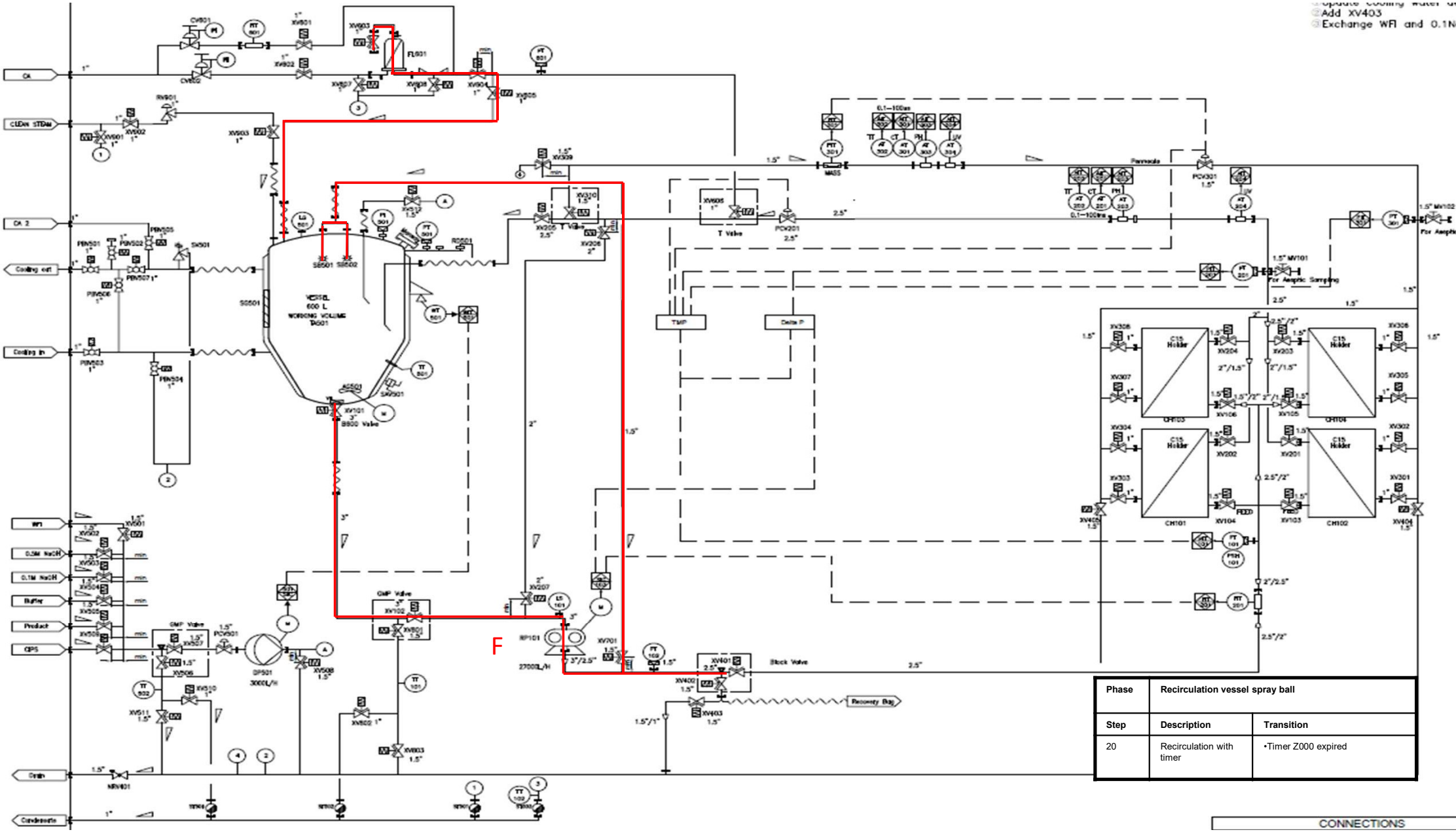


Phase	Recirculation vessel spray ball	
Step	**Description**	**Transition**
10	Prime Loop	•Timer Z100 expired

CONNECTIONS



F

Phase	Recirculation vessel spray ball	
Step	**Description**	**Transition**
20	Recirculation with timer	•Timer Z000 expired

Phase 5: CIP Inlet

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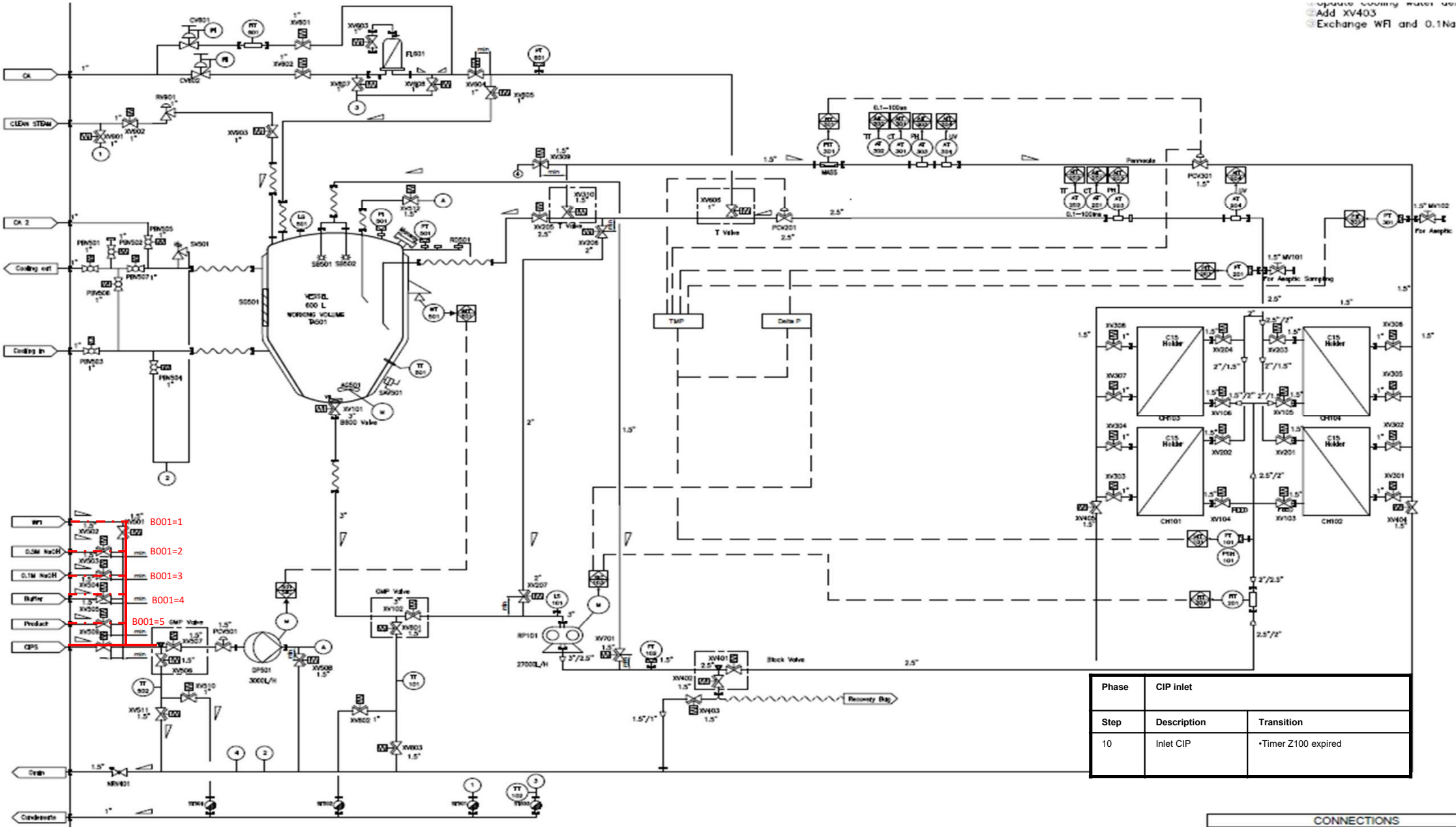
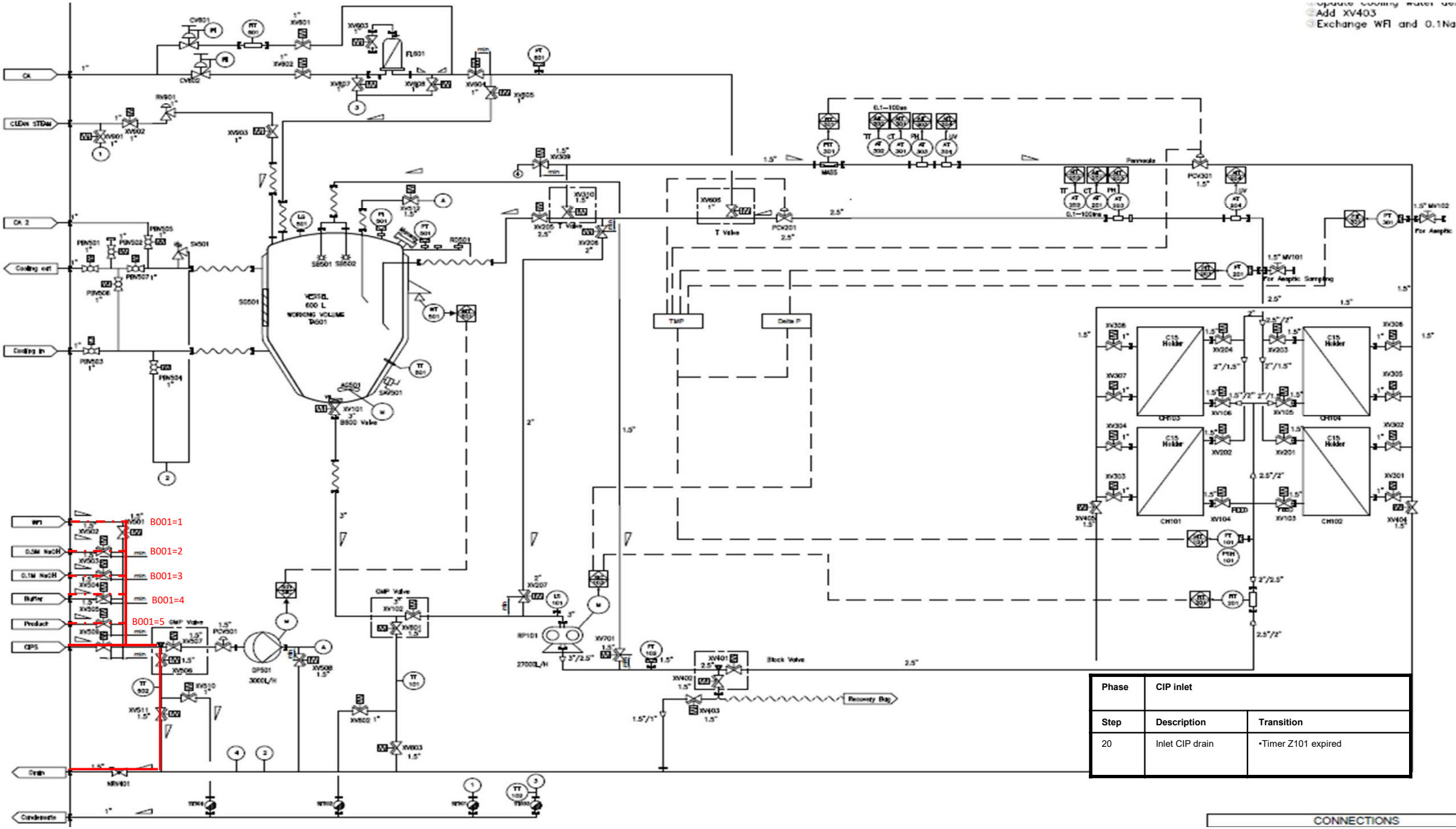
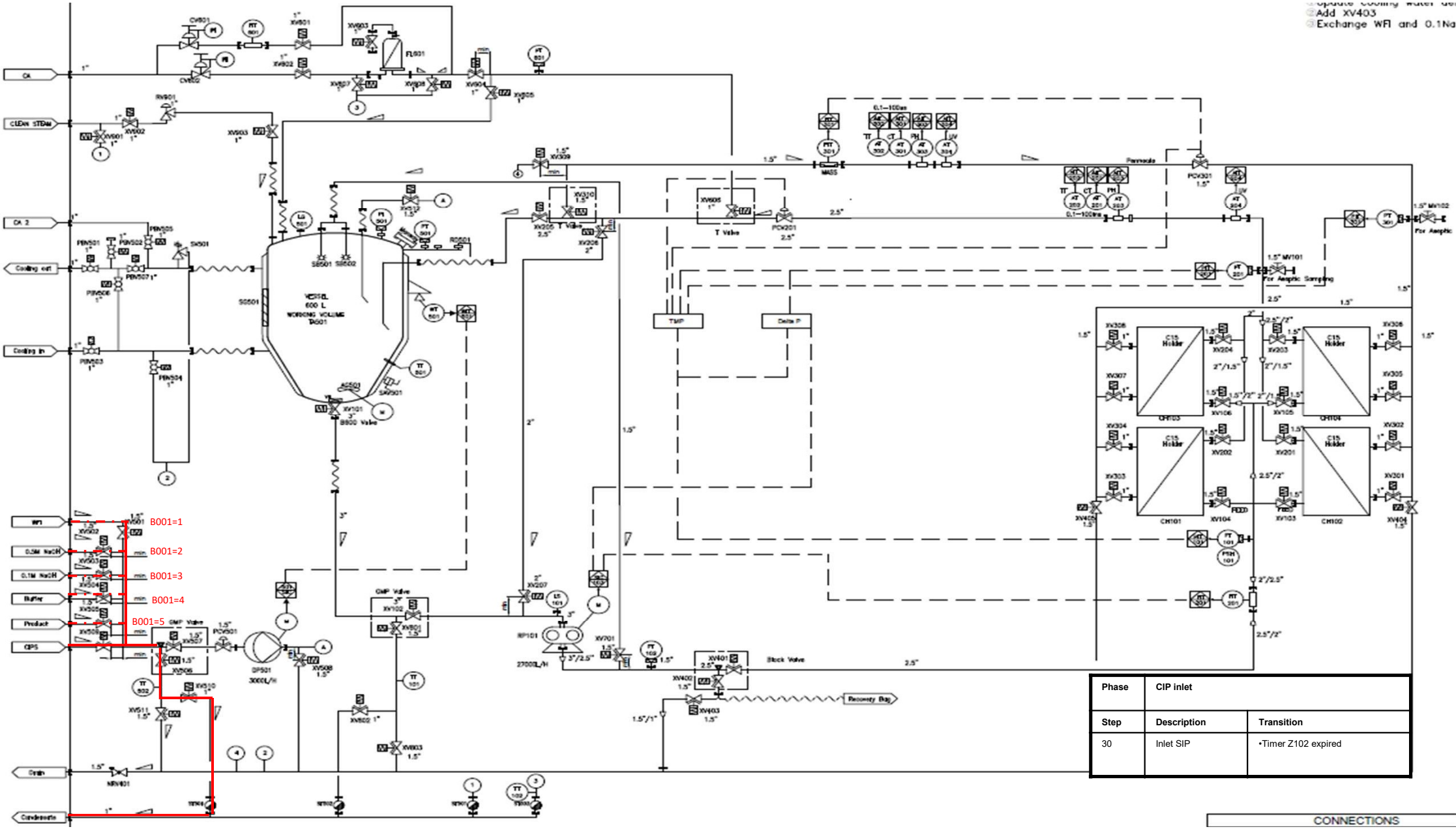


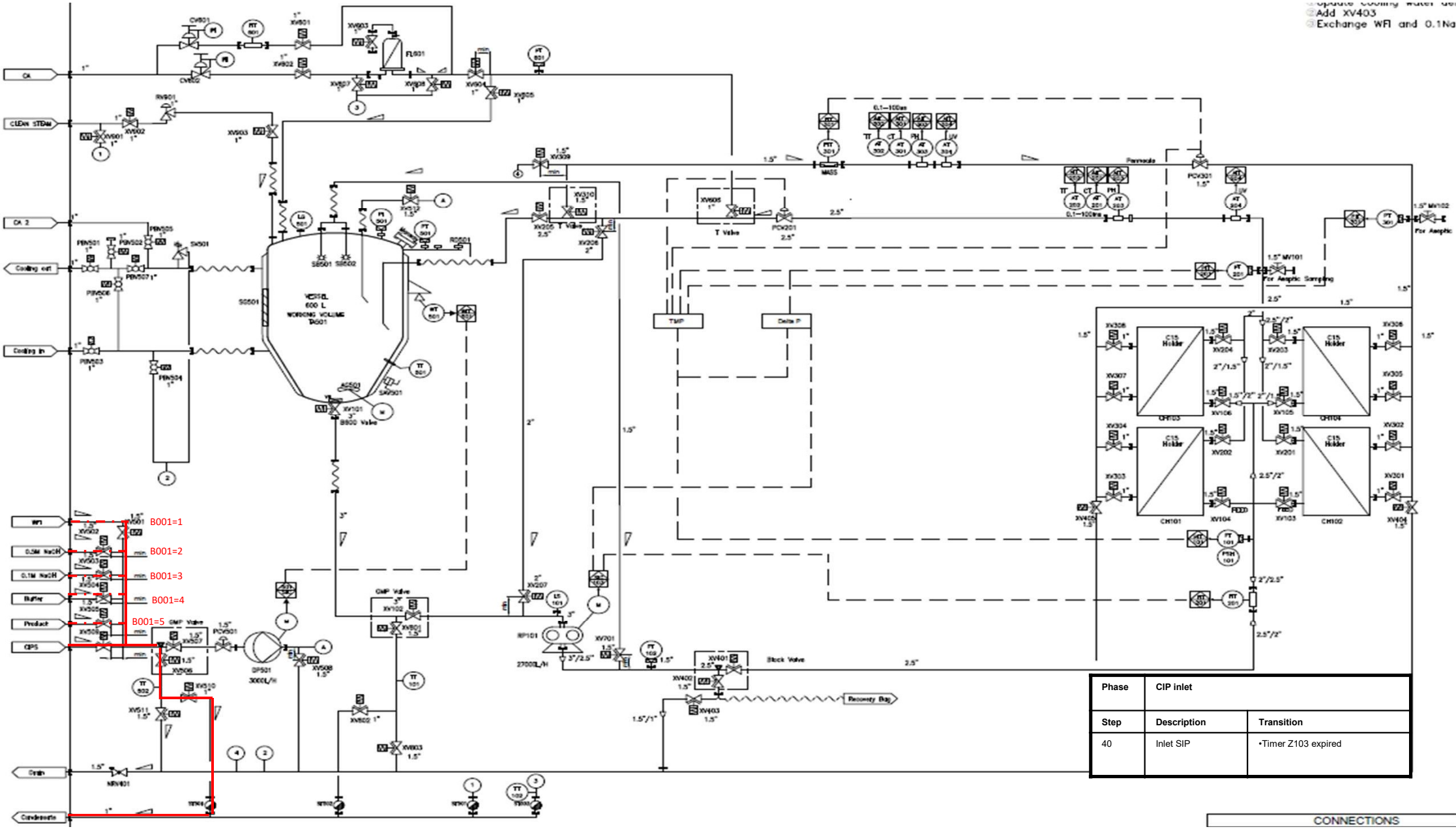
Phase	CIP inlet	
Step	**Description**	**Transition**
10	Inlet CIP	•Timer Z100 expired



Phase	CIP inlet	
Step	**Description**	**Transition**
20	Inlet CIP drain	•Timer Z101 expired



Phase	CIP inlet	
Step	**Description**	**Transition**
30	Inlet SIP	•Timer Z102 expired



Phase	CIP inlet	
Step	**Description**	**Transition**
40	Inlet SIP	•Timer Z103 expired

Phase 6: Blow-down pipe work

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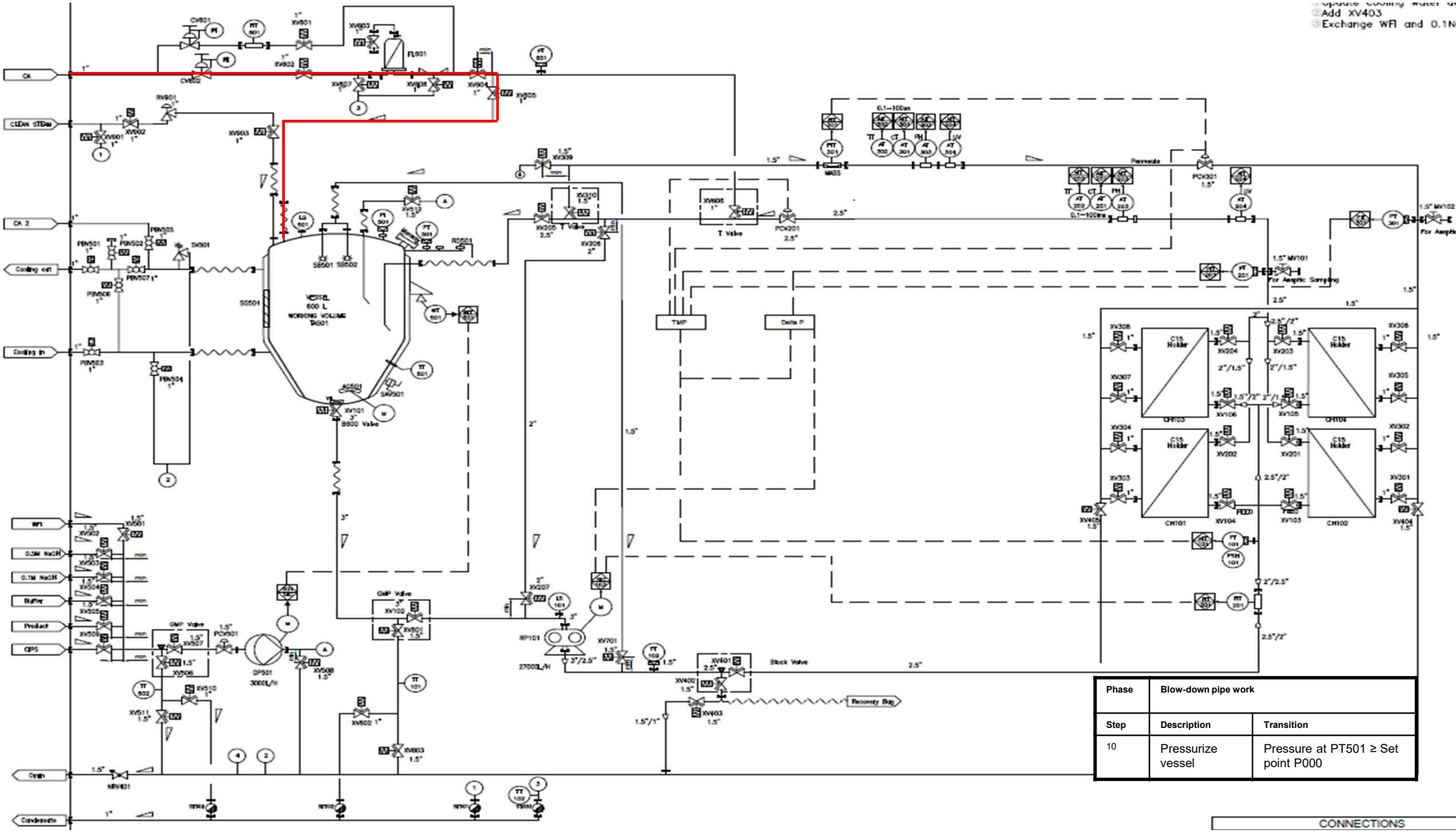
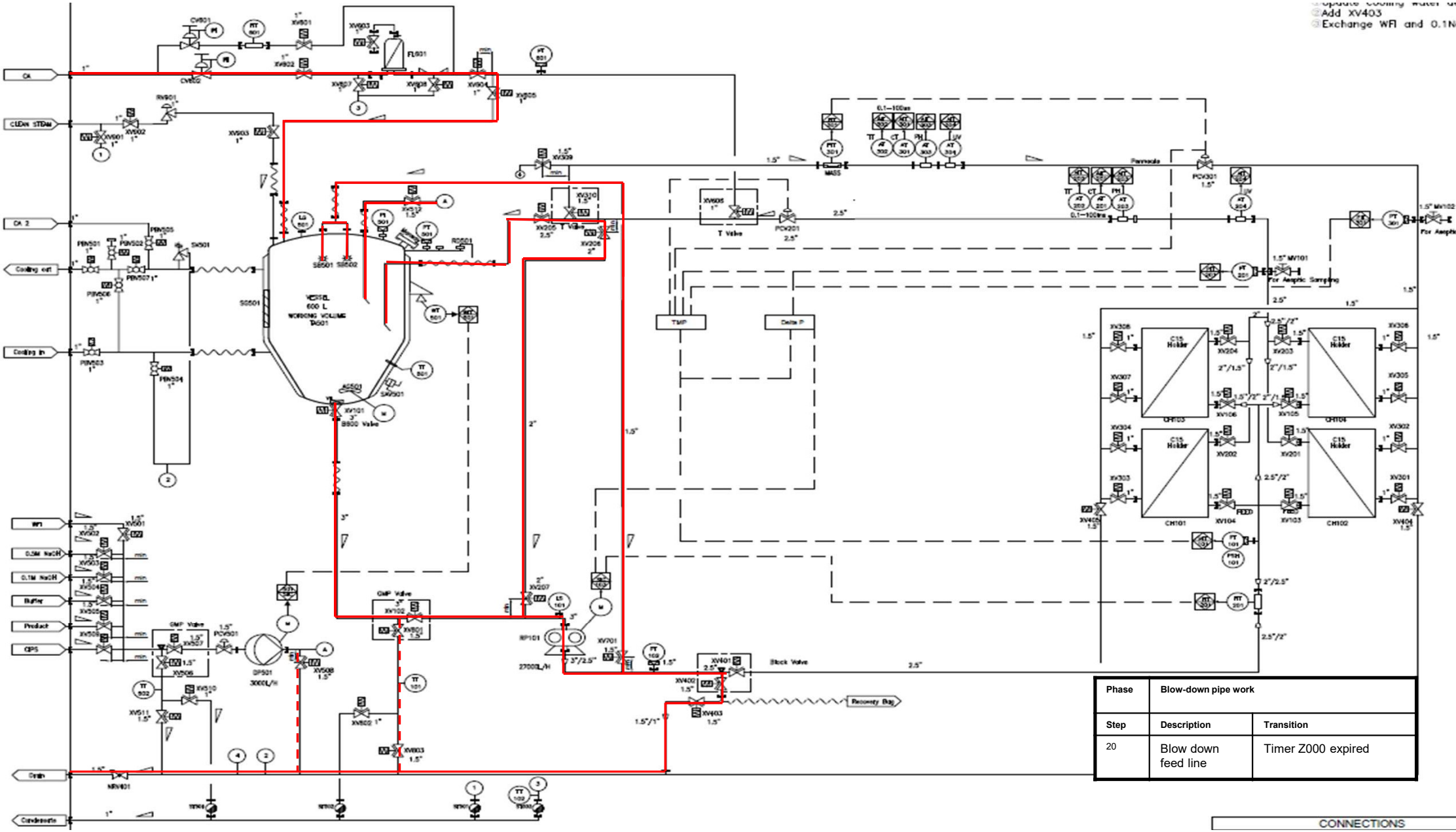
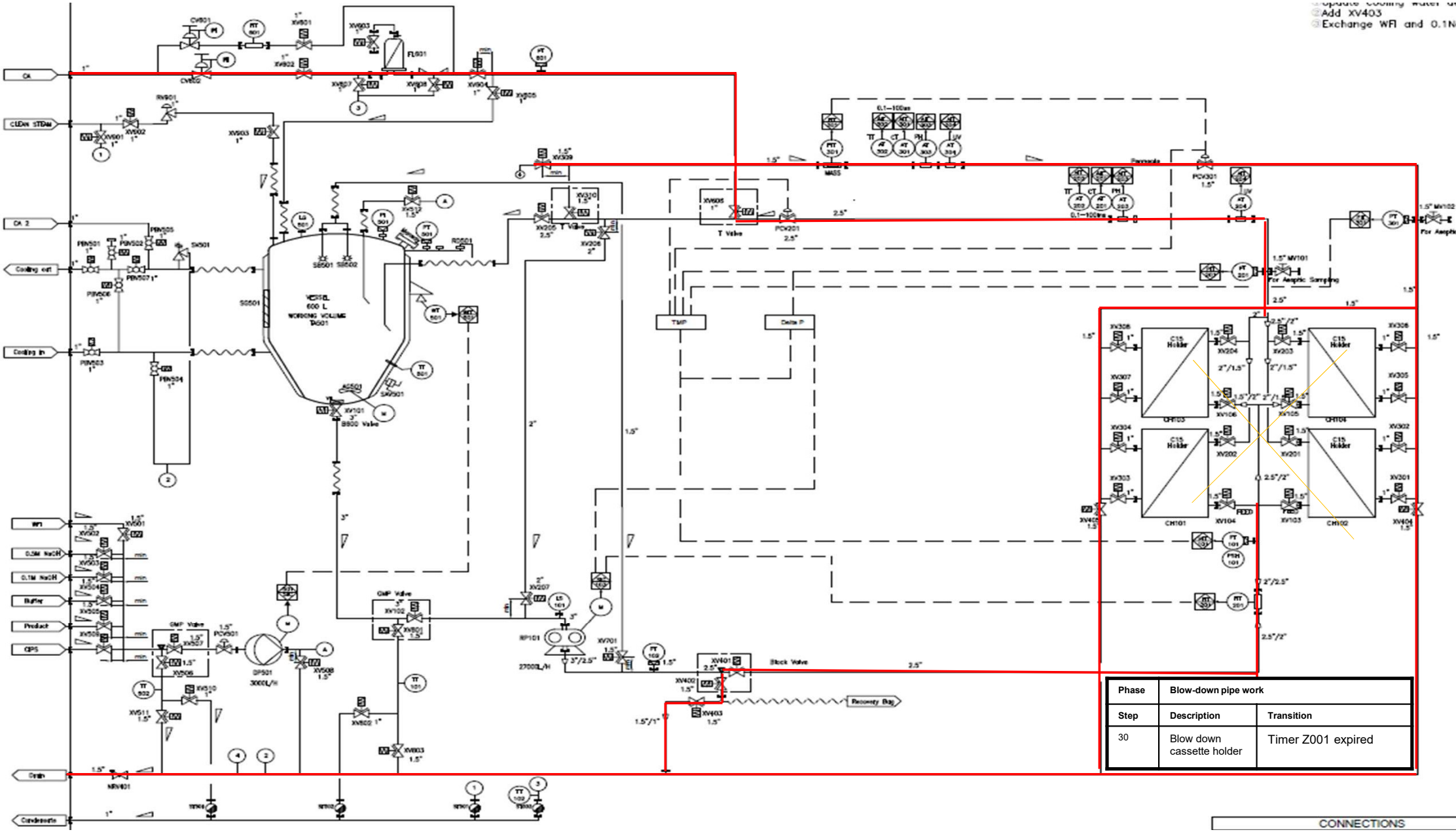


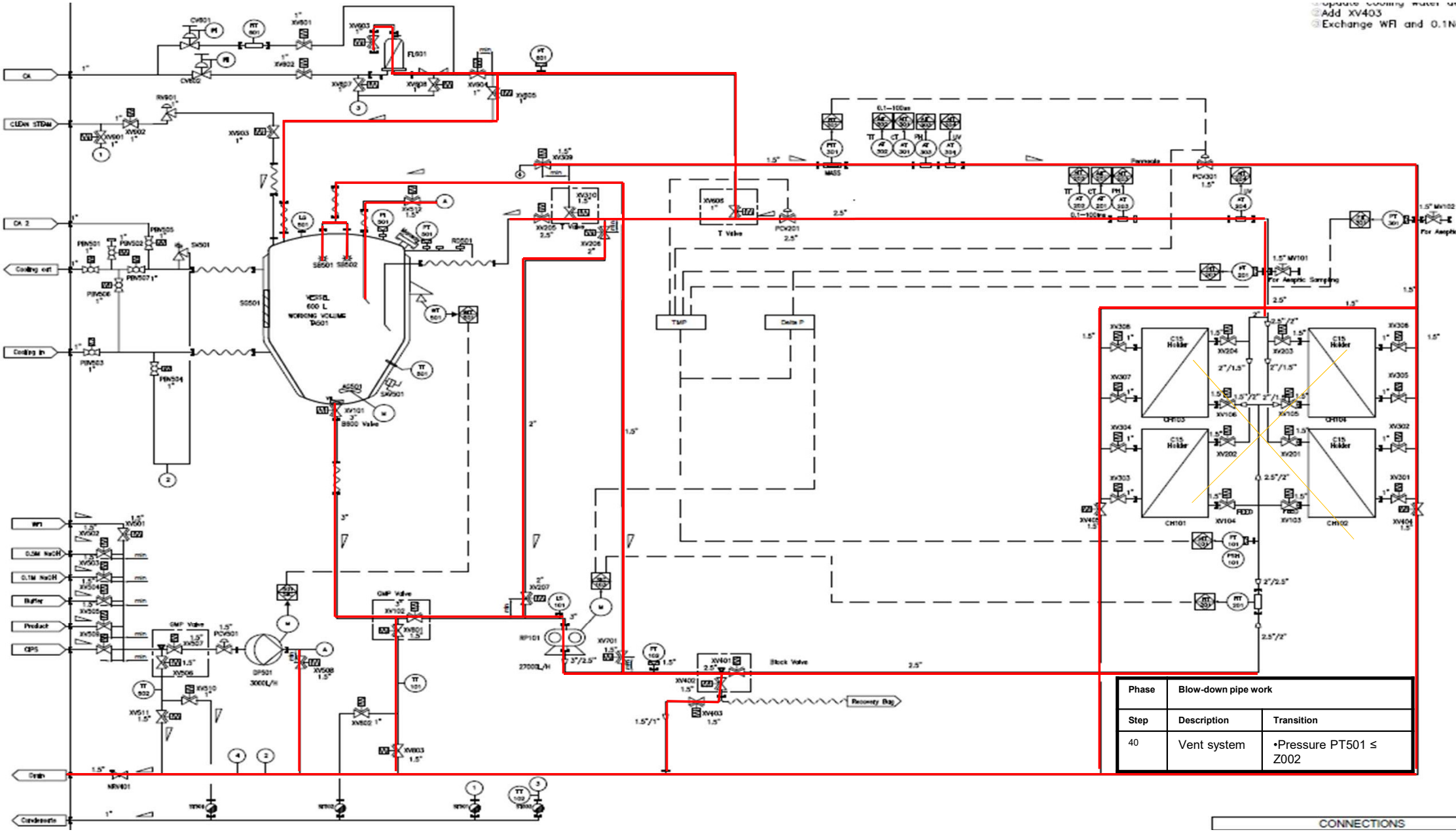
Phase	Blow-down pipe work	
Step	Description	Transition
10	Pressurize vessel	Pressure at PT501 ≥ Set point P000



Phase	Blow-down pipe work	
Step	**Description**	**Transition**
20	Blow down feed line	Timer Z000 expired



Phase	Blow-down pipe work	
Step	Description	Transition
30	Blow down cassette holder	Timer Z001 expired



Phase	Blow-down pipe work	
Step	Description	Transition
40	Vent system	•Pressure PT501 ≤ Z002

Phase 7: Flush membrane cassettes

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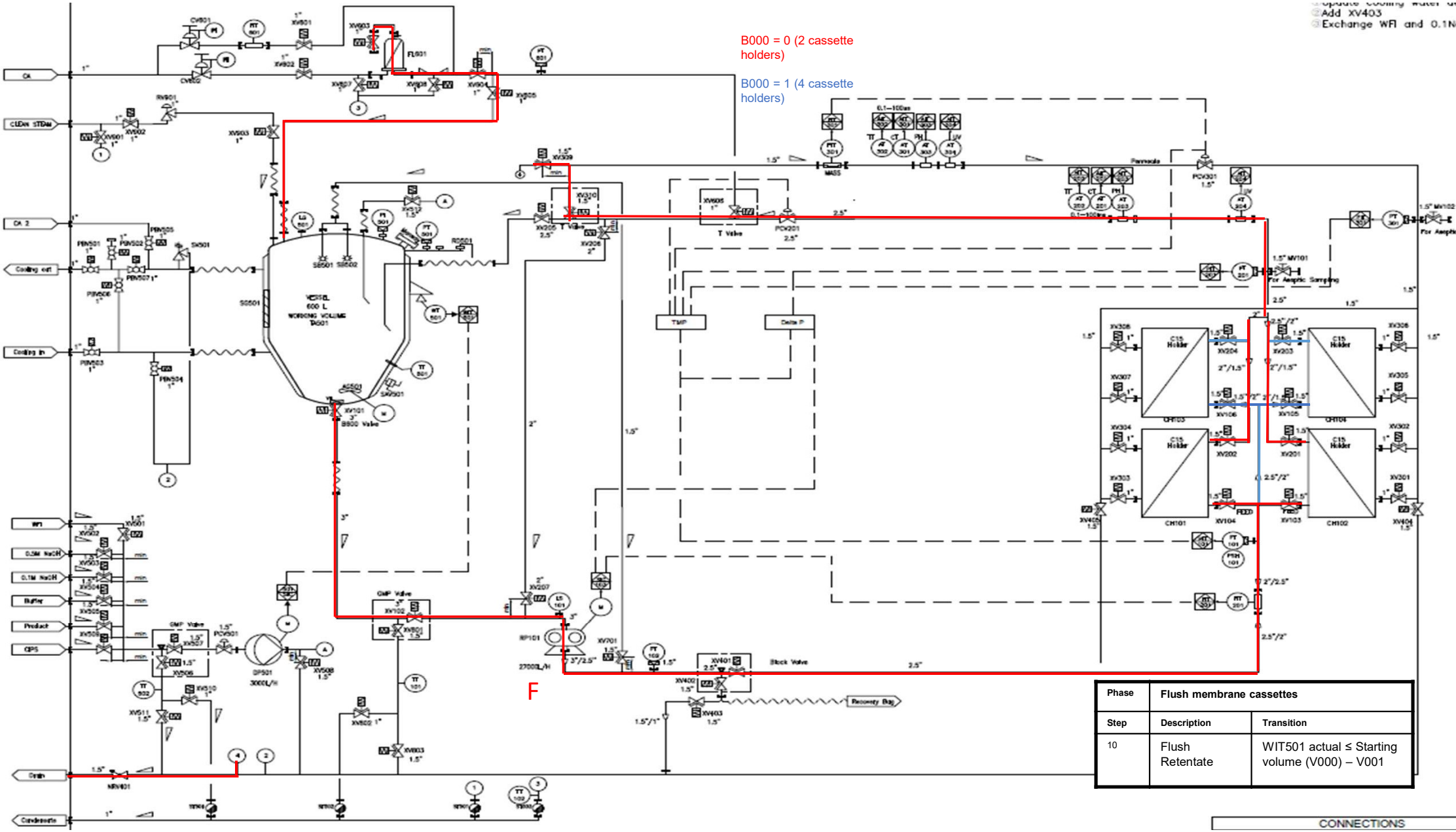
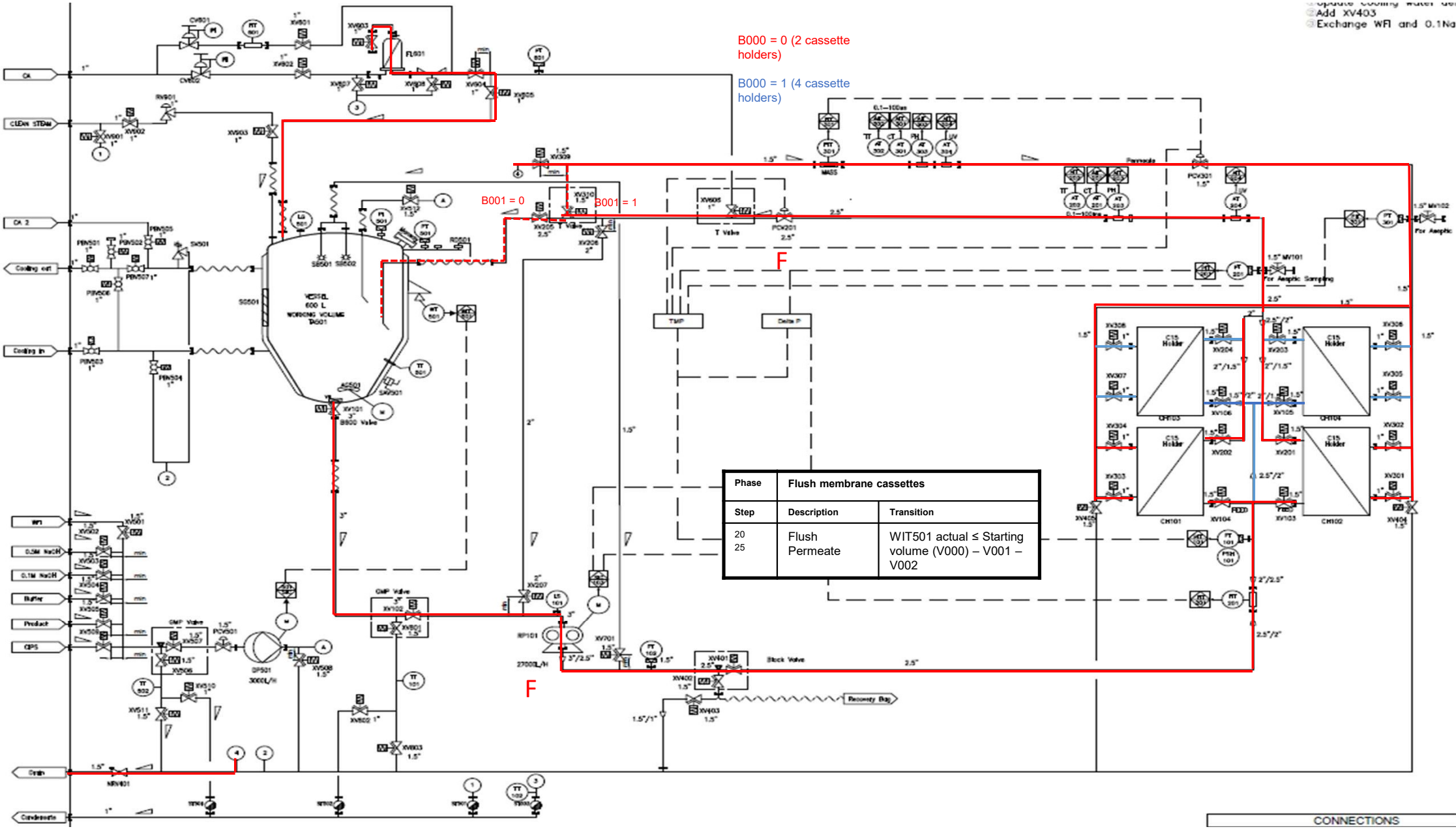


Phase	Flush membrane cassettes	
Step	Description	Transition
10	Flush Retentate	WIT501 actual ≤ Starting volume (V000) – V001



Phase	Flush membrane cassettes	
Step	Description	Transition
20 25	Flush Permeate	WIT501 actual ≤ Starting volume (V000) – V001 – V002

Phase 8: Temperature control

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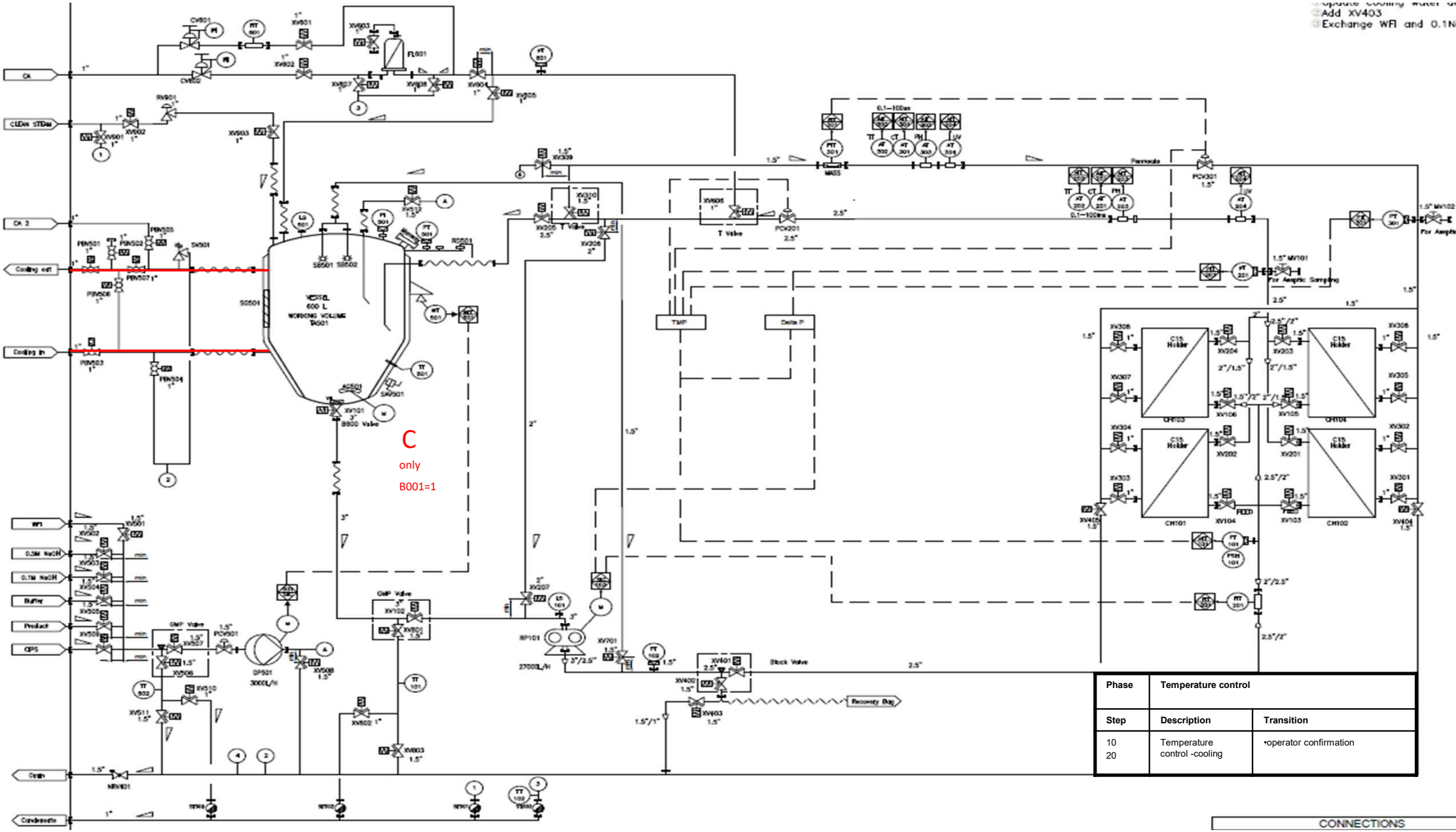
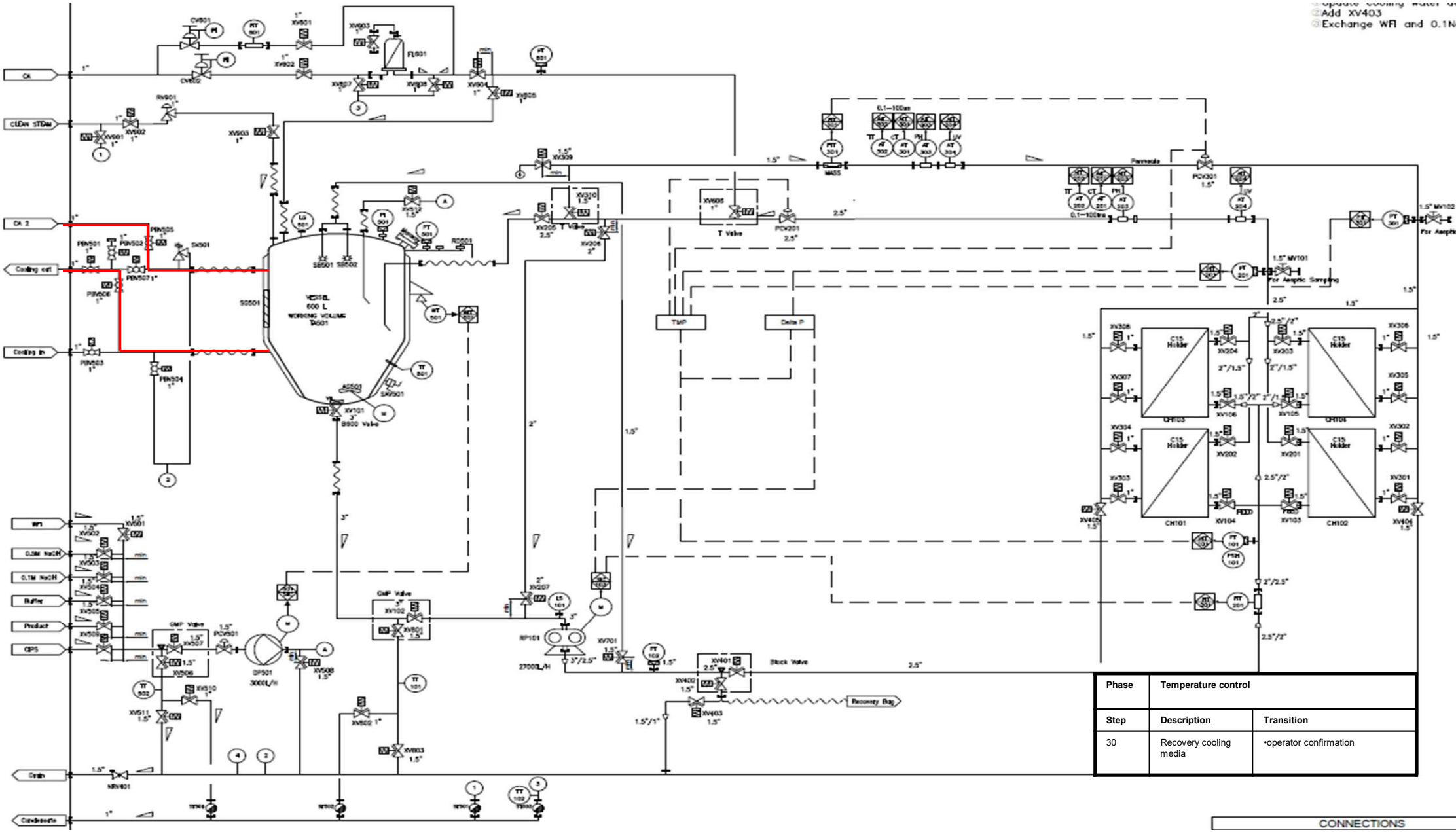
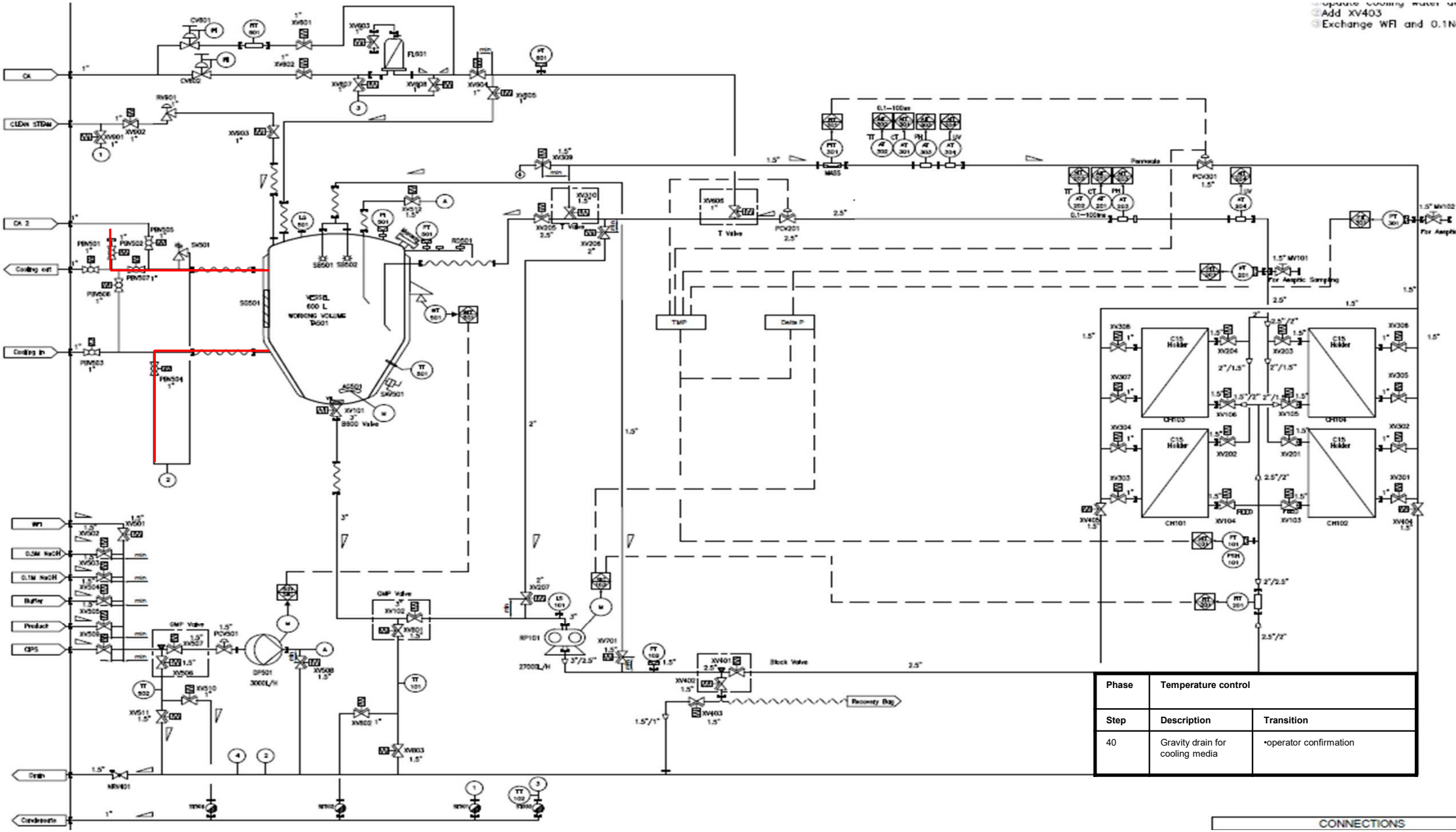


Phase	Temperature control	
Step	**Description**	**Transition**
10 20	Temperature control -cooling	•operator confirmation



Phase	Temperature control	
Step	**Description**	**Transition**
30	Recovery cooling media	•operator confirmation



Phase	Temperature control	
Step	**Description**	**Transition**
40	Gravity drain for cooling media	•operator confirmation

CONNECTIONS

Phase 9: NWP test

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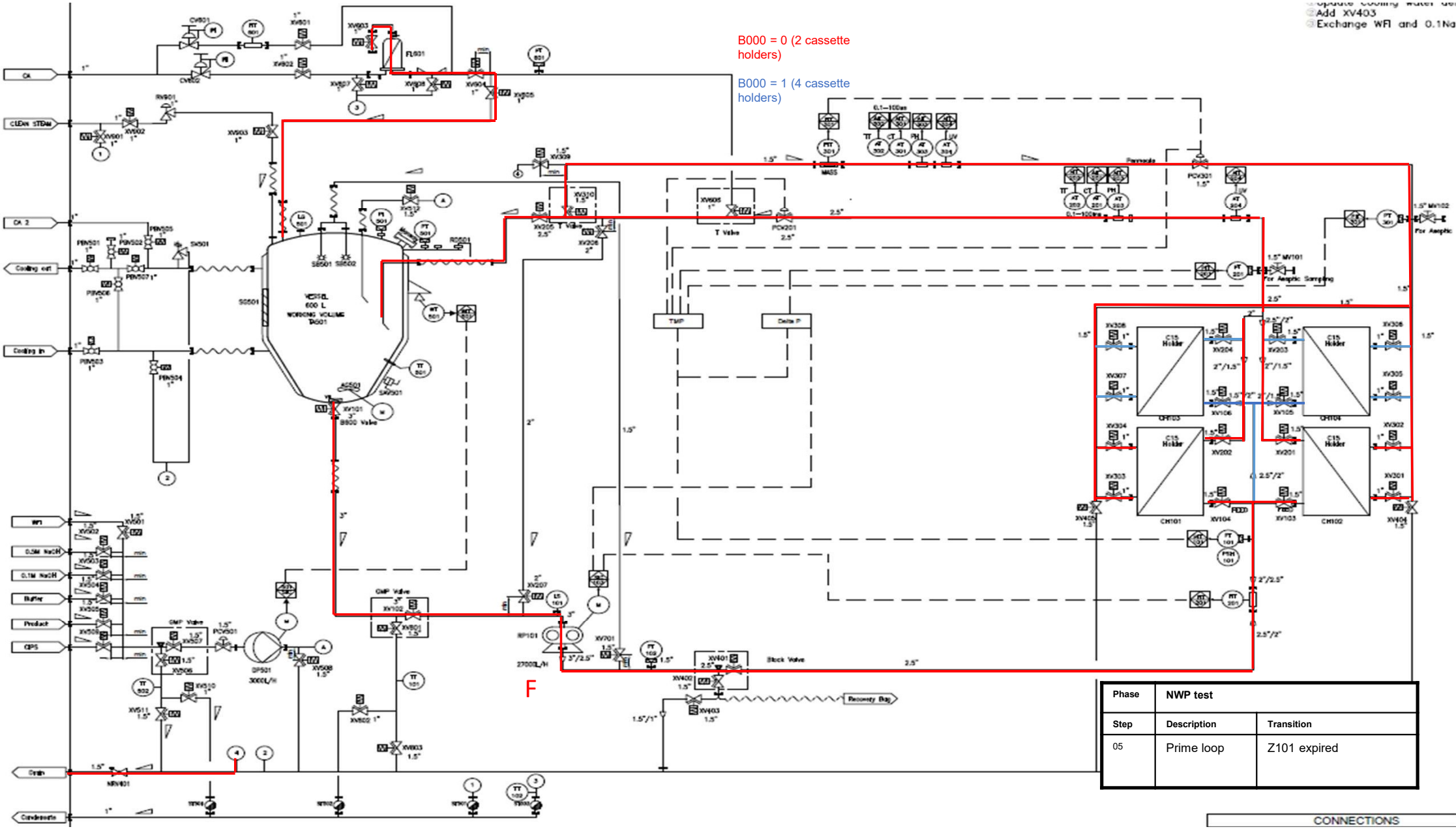
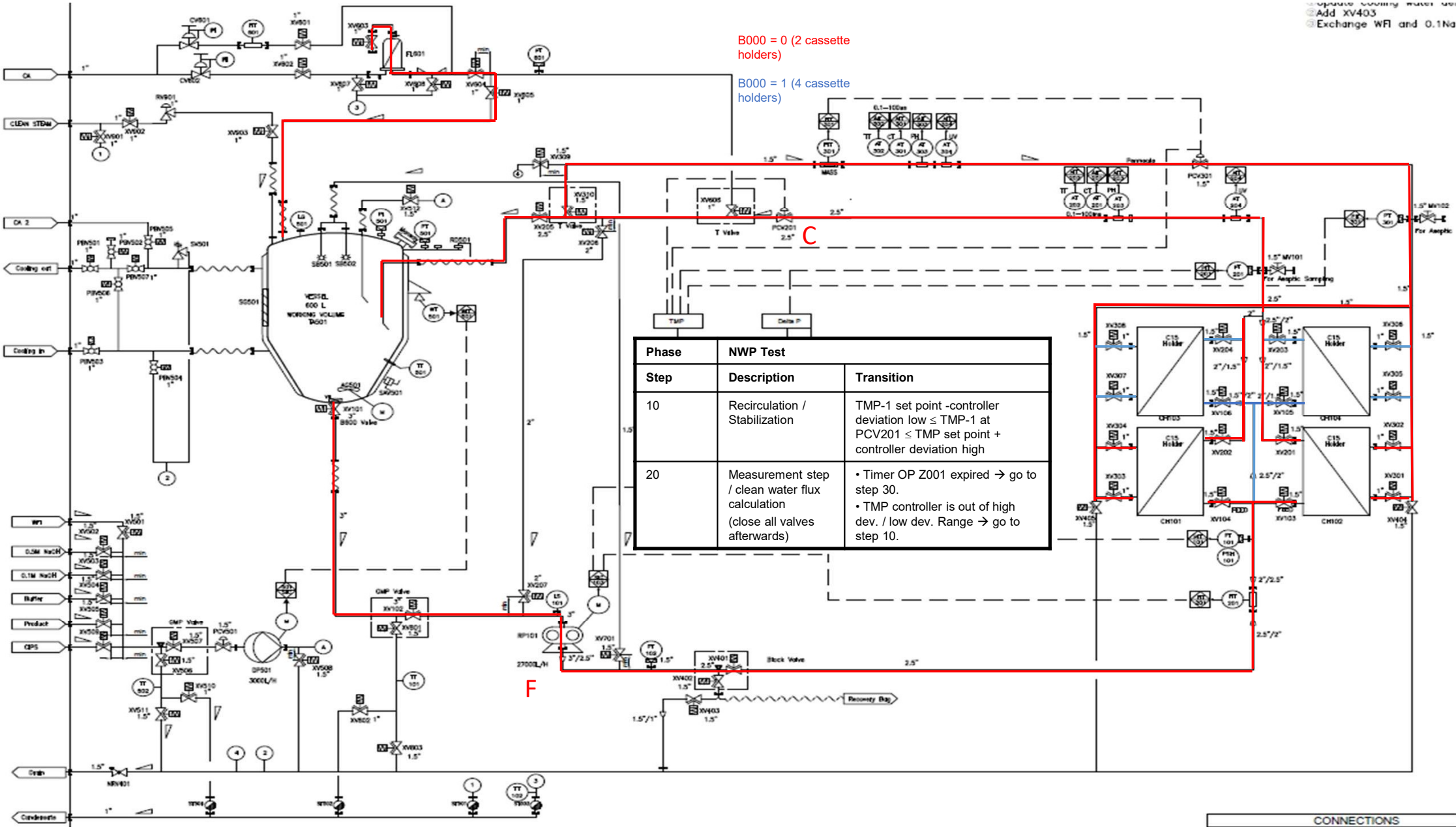


Phase	NWP test	
Step	**Description**	**Transition**
05	Prime loop	Z101 expired



Phase	NWP Test	
Step	**Description**	**Transition**
10	Recirculation / Stabilization	TMP-1 set point -controller deviation low ≤ TMP-1 at PCV201 ≤ TMP set point + controller deviation high
20	Measurement step / clean water flux calculation (close all valves afterwards)	• Timer OP Z001 expired → go to step 30. • TMP controller is out of high dev. / low dev. Range → go to step 10.

Phase 10: Concentration

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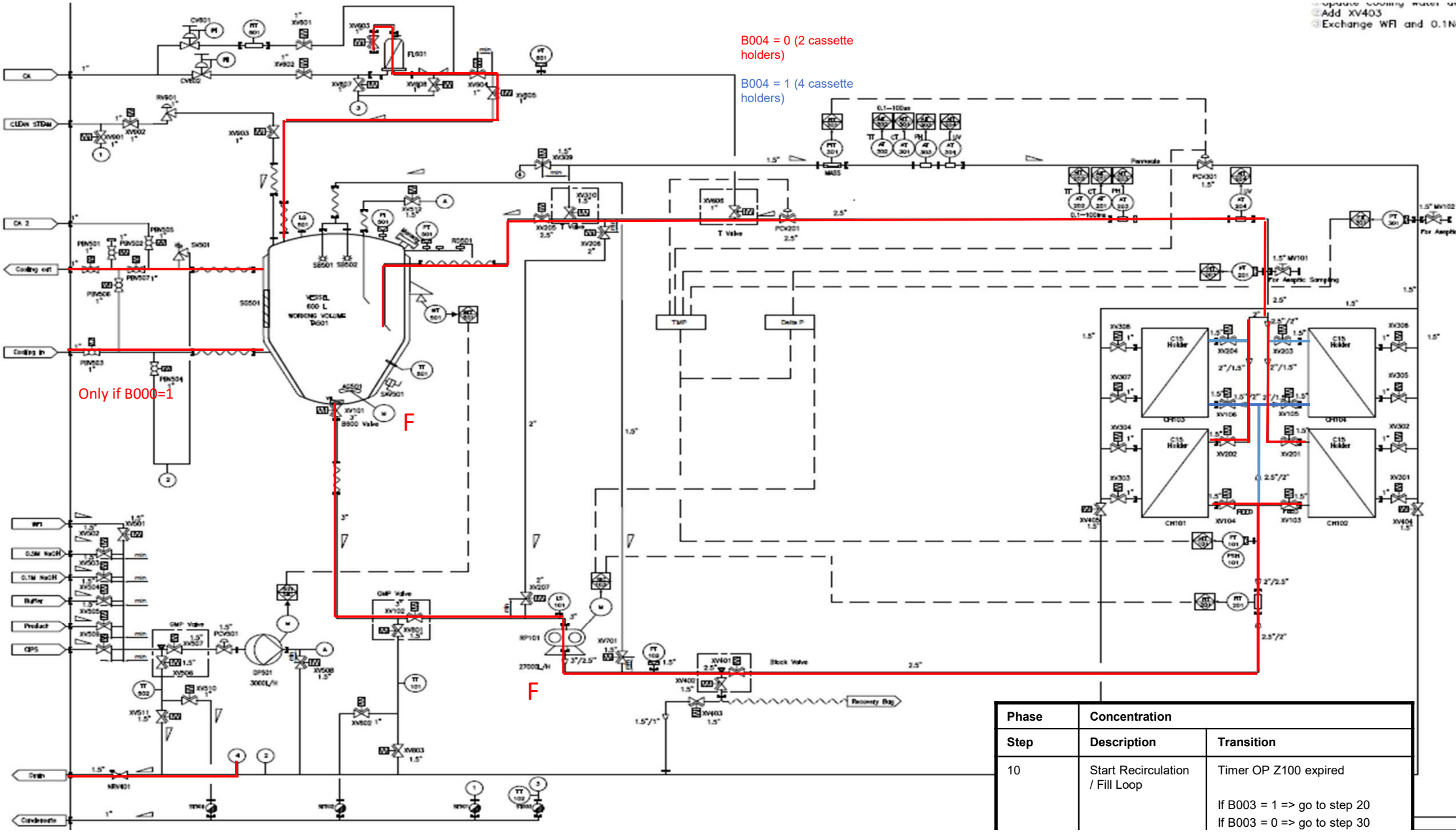
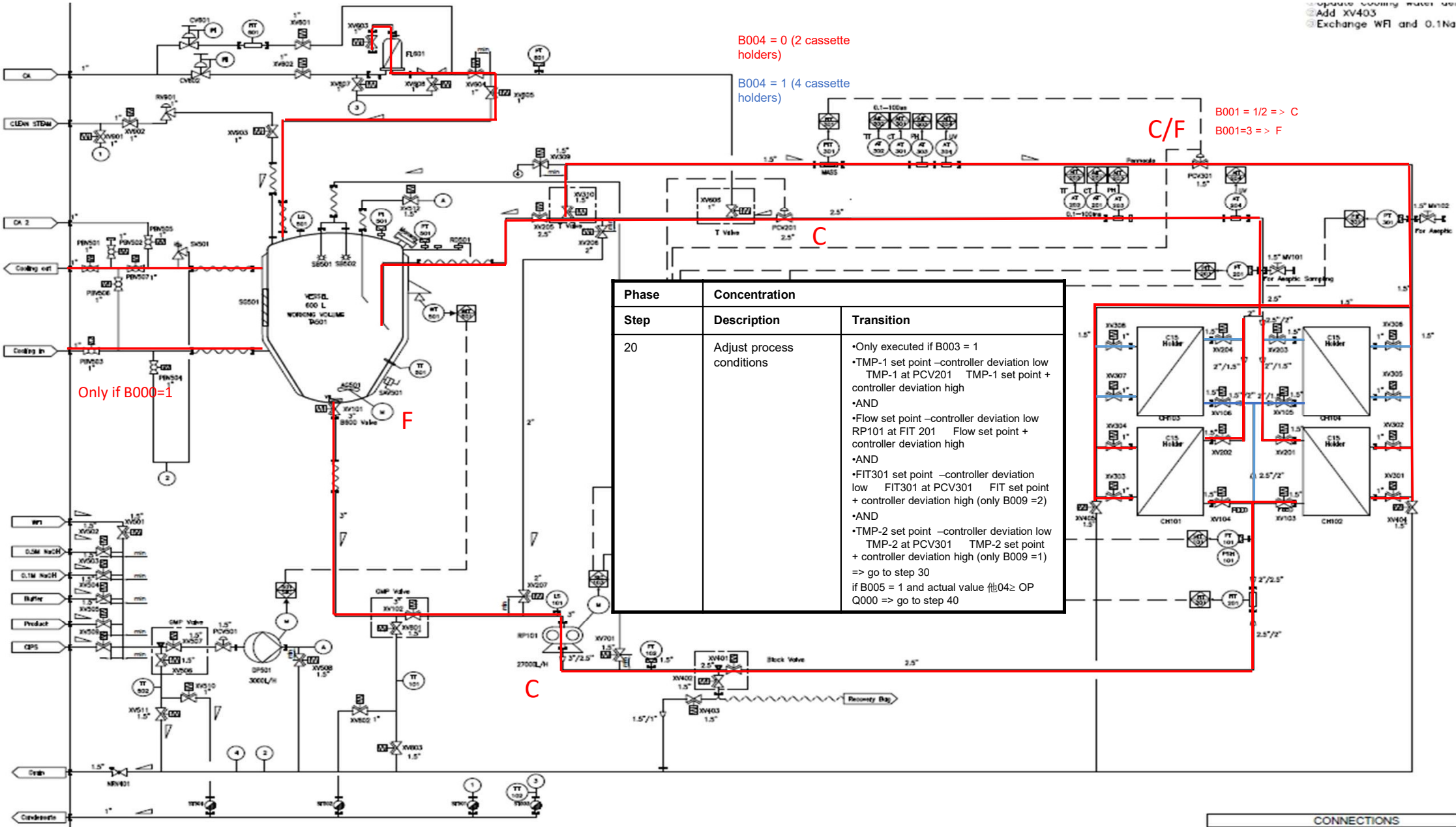
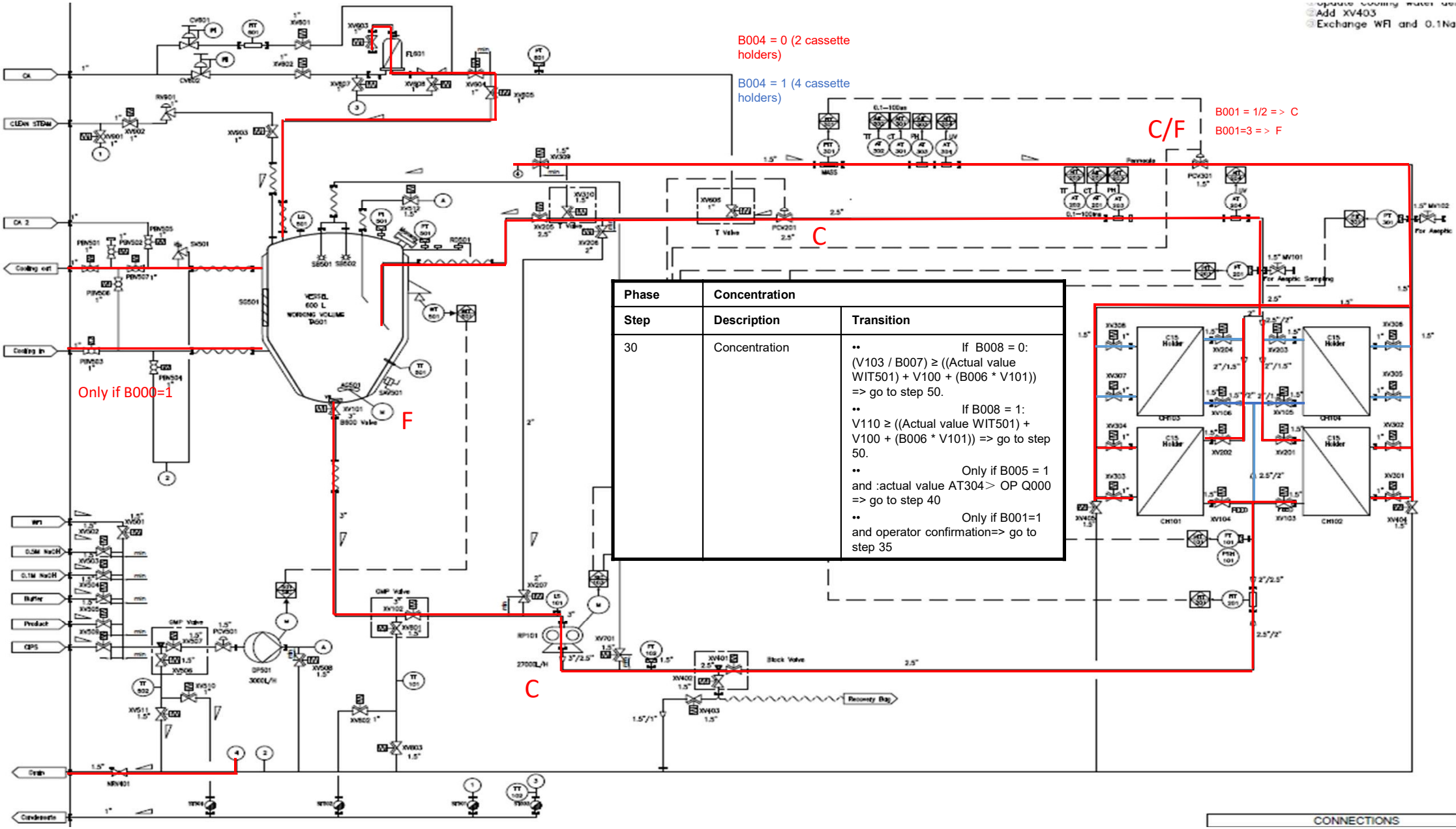


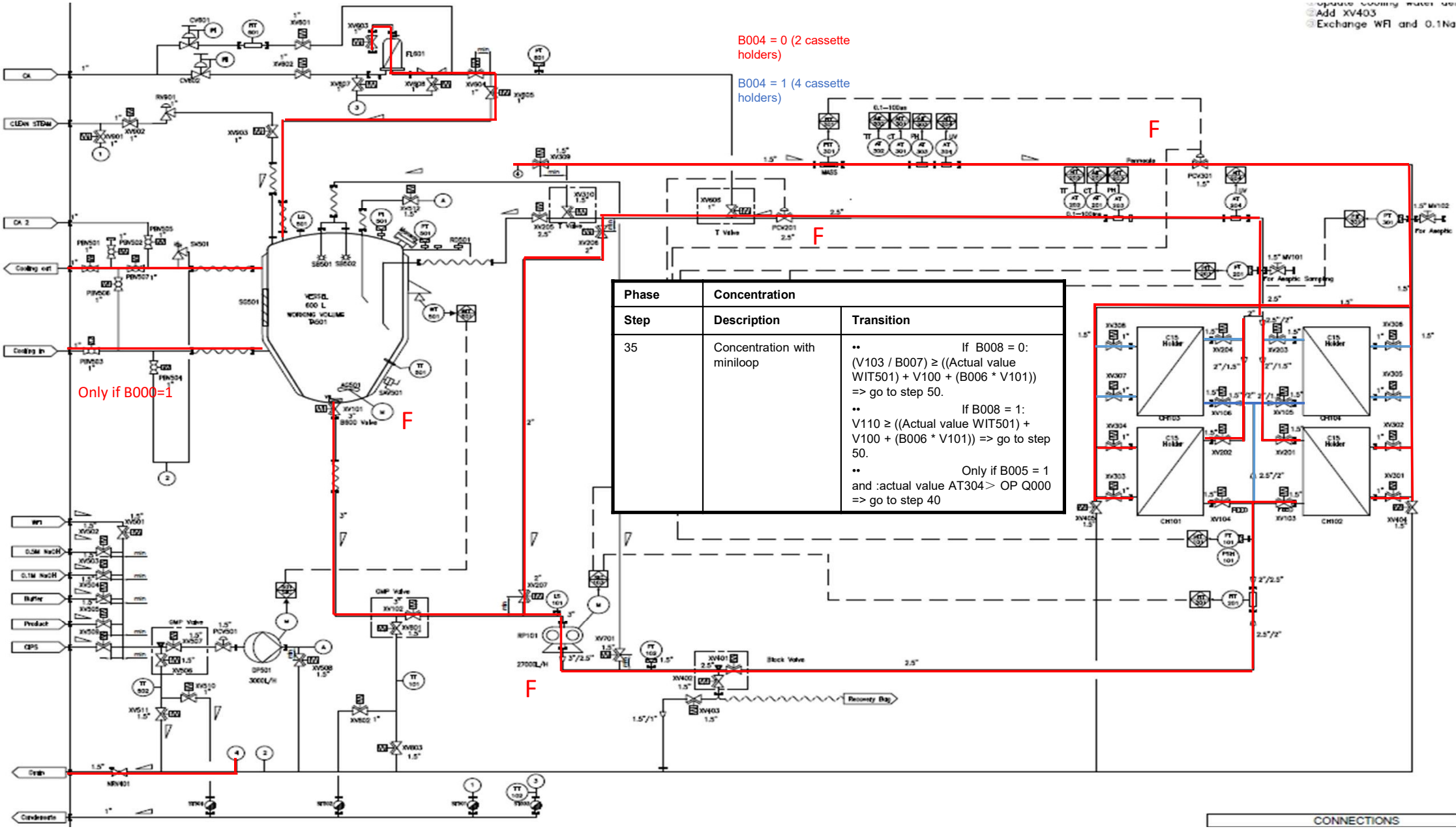
Phase	Concentration	
Step	**Description**	**Transition**
10	Start Recirculation / Fill Loop	Timer OP Z100 expired If B003 = 1 => go to step 20 If B003 = 0 => go to step 30



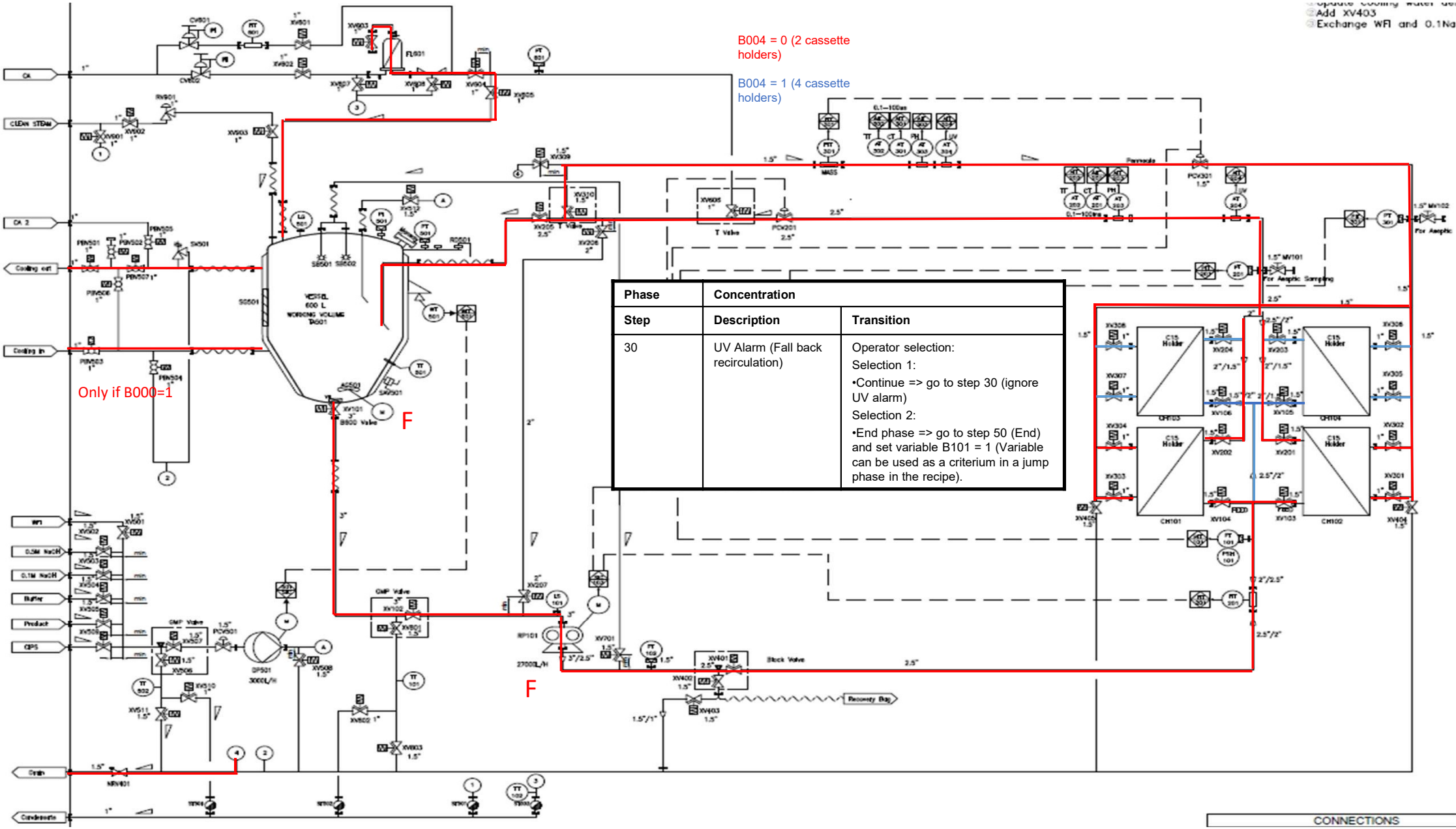
Phase	Concentration	
Step	**Description**	**Transition**
20	Adjust process conditions	•Only executed if B003 = 1 •TMP-1 set point –controller deviation low TMP-1 at PCV201 TMP-1 set point + controller deviation high •AND •Flow set point –controller deviation low RP101 at FIT 201 Flow set point + controller deviation high •AND •FIT301 set point –controller deviation low FIT301 at PCV301 FIT set point + controller deviation high (only B009 =2) •AND •TMP-2 set point –controller deviation low TMP-2 at PCV301 TMP-2 set point + controller deviation high (only B009 =1) => go to step 30 if B005 = 1 and actual value 他04≥ OP Q000 => go to step 40



Phase	Concentration	
Step	**Description**	**Transition**
30	Concentration	•• If B008 = 0: (V103 / B007) ≥ ((Actual value WIT501) + V100 + (B006 * V101)) => go to step 50. •• If B008 = 1: V110 ≥ ((Actual value WIT501) + V100 + (B006 * V101)) => go to step 50. •• Only if B005 = 1 and :actual value AT304> OP Q000 => go to step 40 •• Only if B001=1 and operator confirmation=> go to step 35



Phase	Concentration	
Step	**Description**	**Transition**
35	Concentration with miniloop	•• If B008 = 0: (V103 / B007) ≥ ((Actual value WIT501) + V100 + (B006 * V101)) => go to step 50. •• If B008 = 1: V110 ≥ ((Actual value WIT501) + V100 + (B006 * V101)) => go to step 50. •• Only if B005 = 1 and :actual value AT304> OP Q000 => go to step 40



Phase	Concentration	
Step	**Description**	**Transition**
30	UV Alarm (Fall back recirculation)	Operator selection: Selection 1: •Continue => go to step 30 (ignore UV alarm) Selection 2: •End phase => go to step 50 (End) and set variable B101 = 1 (Variable can be used as a criterium in a jump phase in the recipe).

Phase 11: Diafiltration with tank level control

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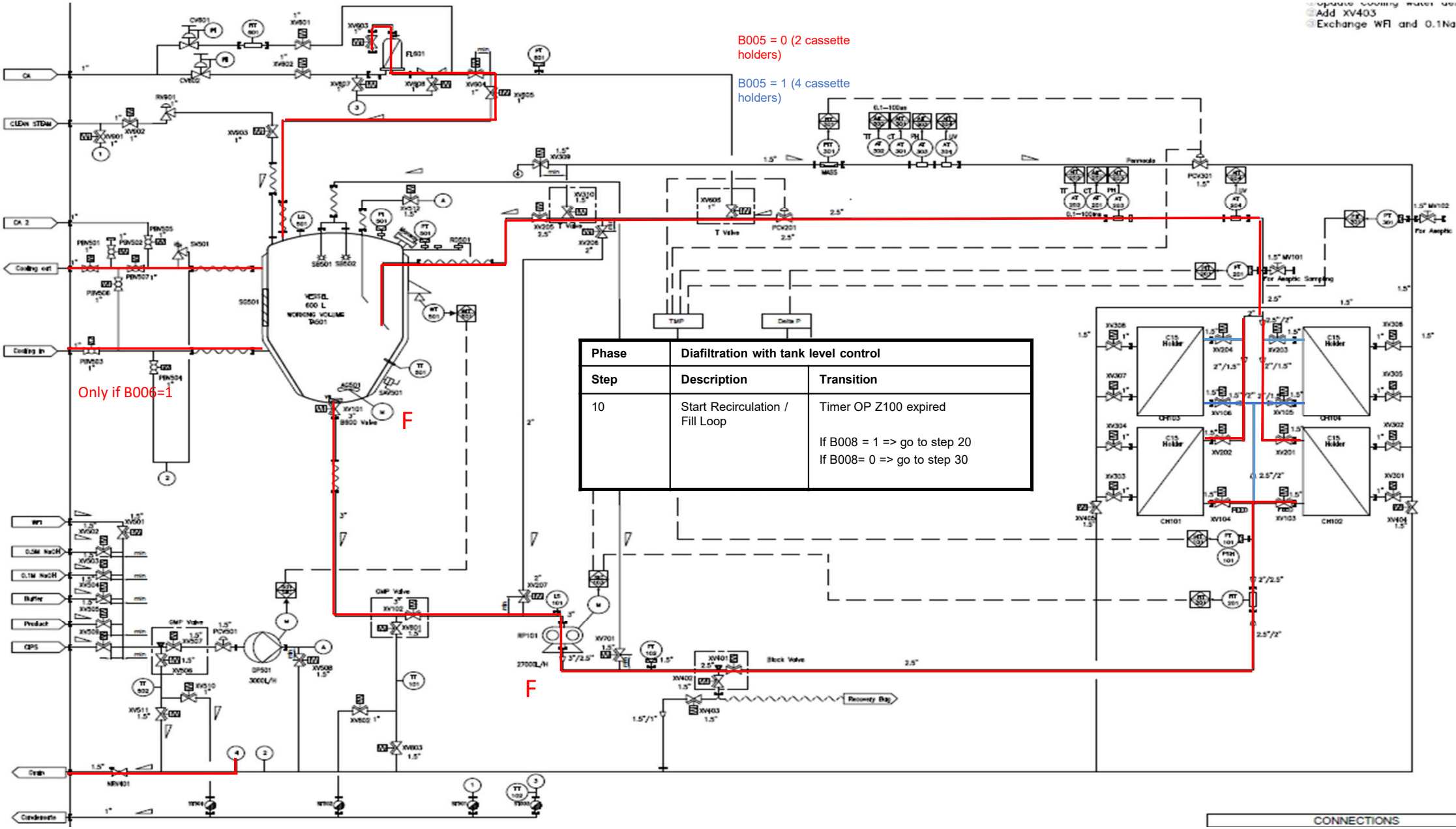
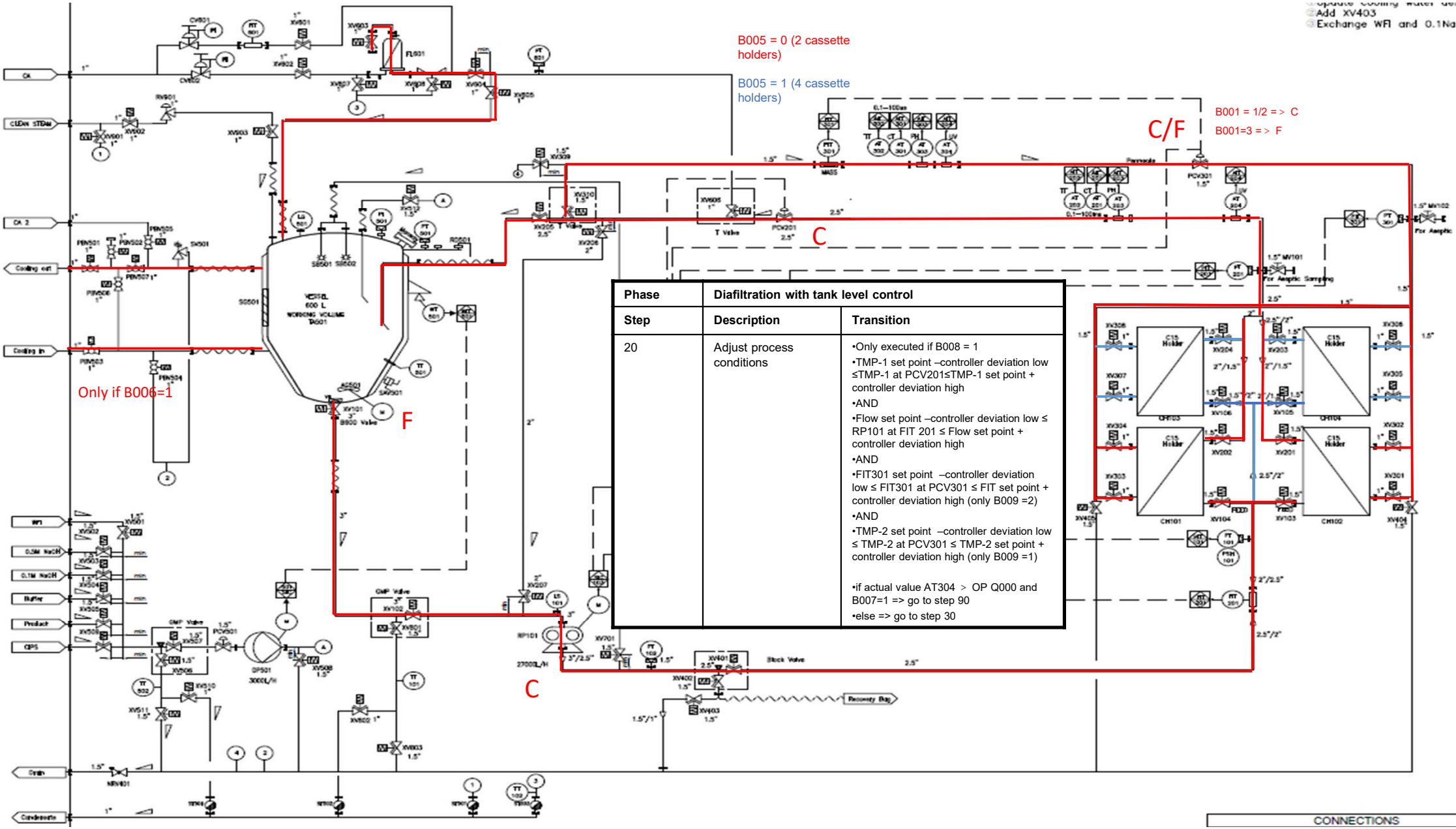
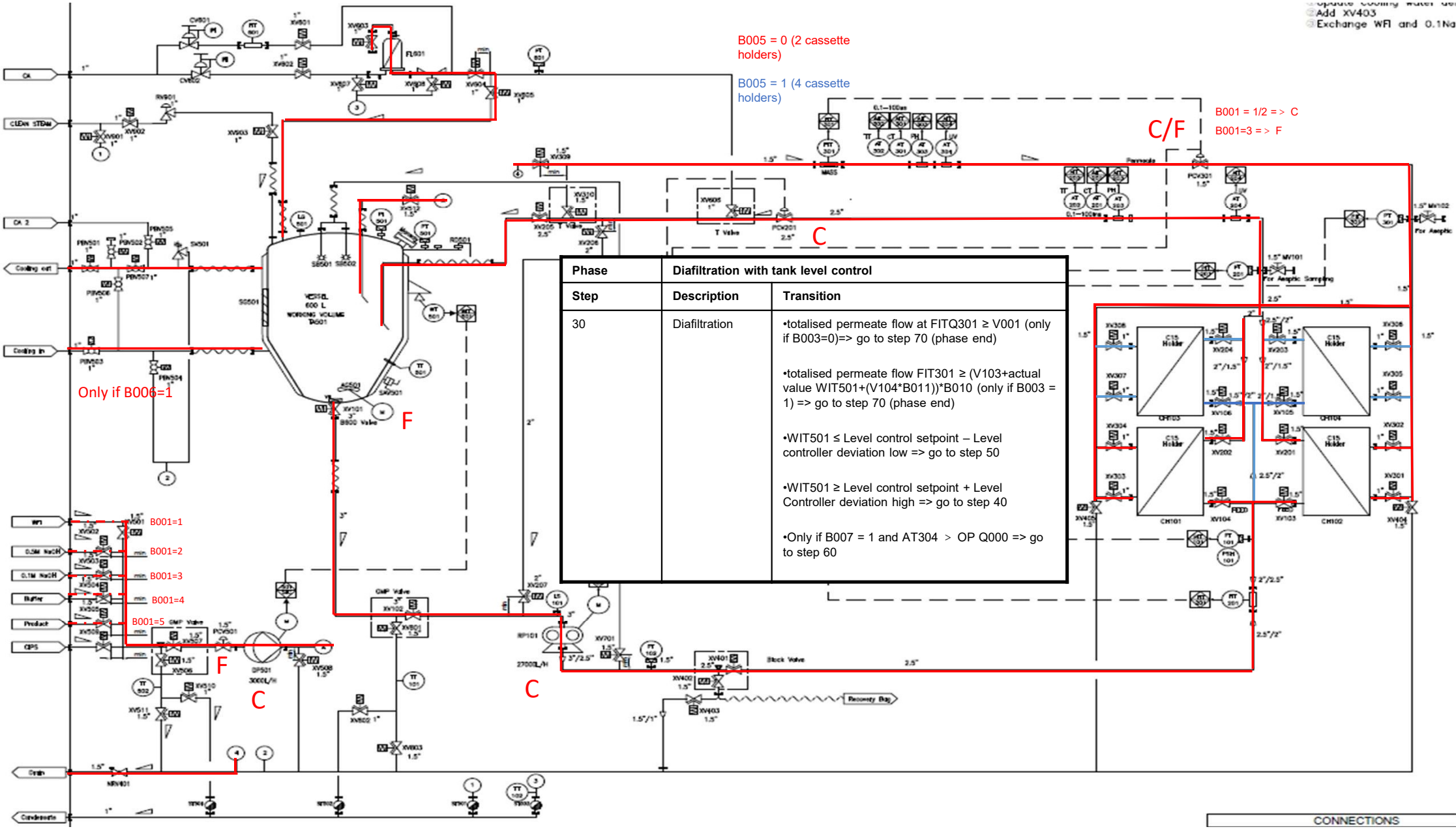


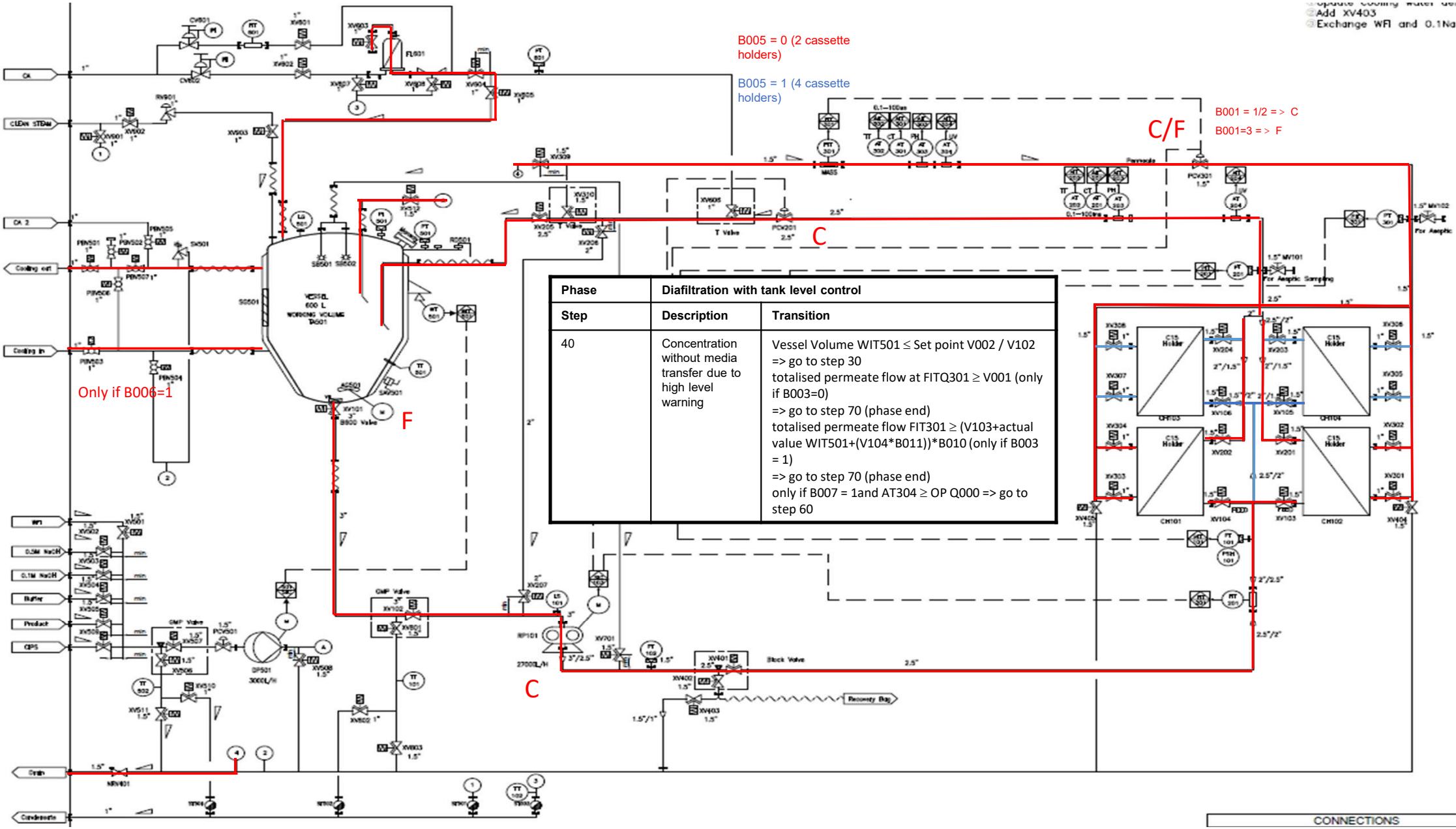
Phase	Diafiltration with tank level control	
Step	**Description**	**Transition**
10	Start Recirculation / Fill Loop	Timer OP Z100 expired If B008 = 1 => go to step 20 If B008= 0 => go to step 30



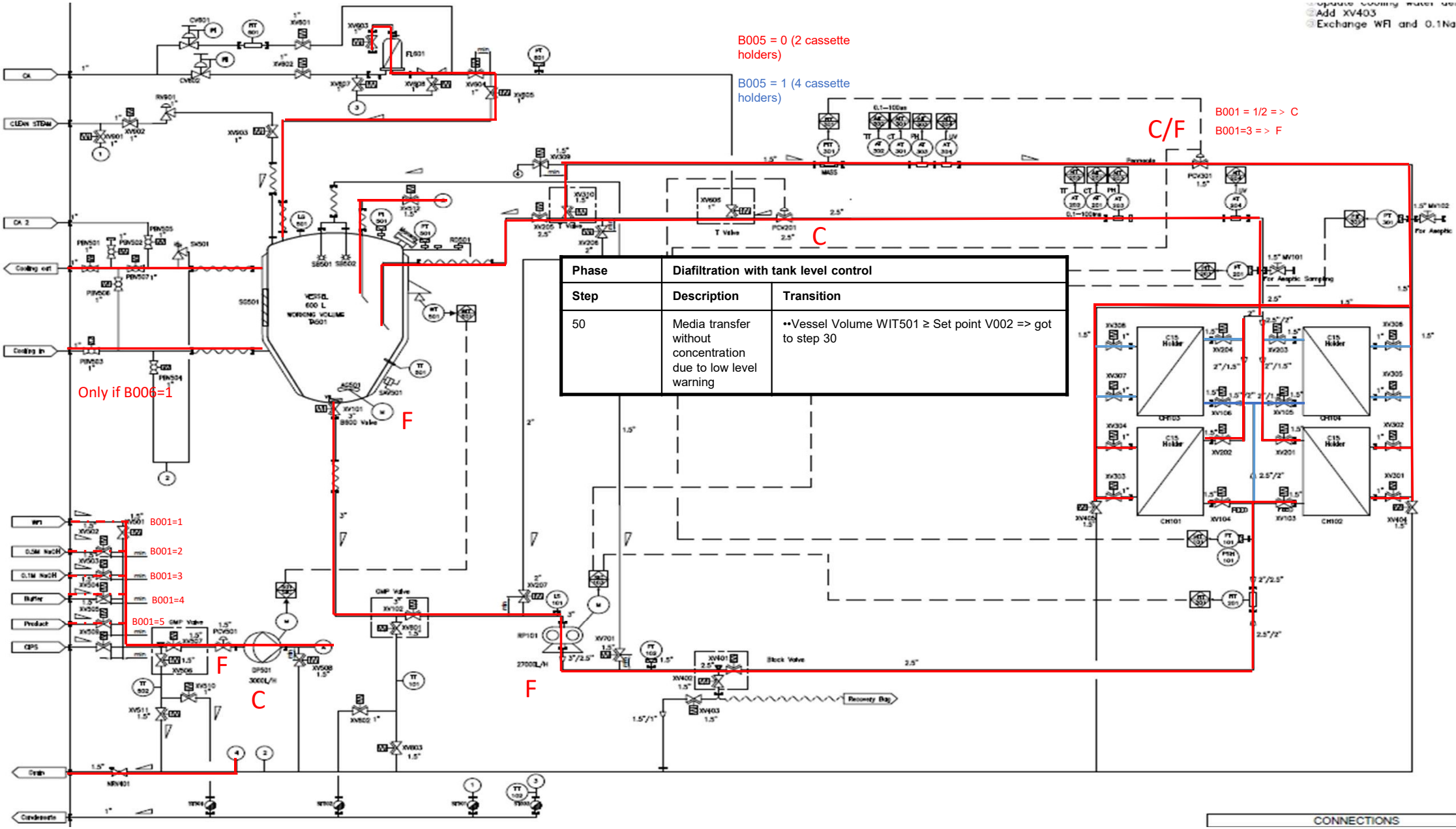
Phase	Diafiltration with tank level control	
Step	**Description**	**Transition**
20	Adjust process conditions	•Only executed if B008 = 1 •TMP-1 set point –controller deviation low ≤TMP-1 at PCV201≤TMP-1 set point + controller deviation high •AND •Flow set point –controller deviation low ≤ RP101 at FIT 201 ≤ Flow set point + controller deviation high •AND •FIT301 set point –controller deviation low ≤ FIT301 at PCV301 ≤ FIT set point + controller deviation high (only B009 =2) •AND •TMP-2 set point –controller deviation low ≤ TMP-2 at PCV301 ≤ TMP-2 set point + controller deviation high (only B009 =1) •if actual value AT304 > OP Q000 and B007=1 => go to step 90 •else => go to step 30



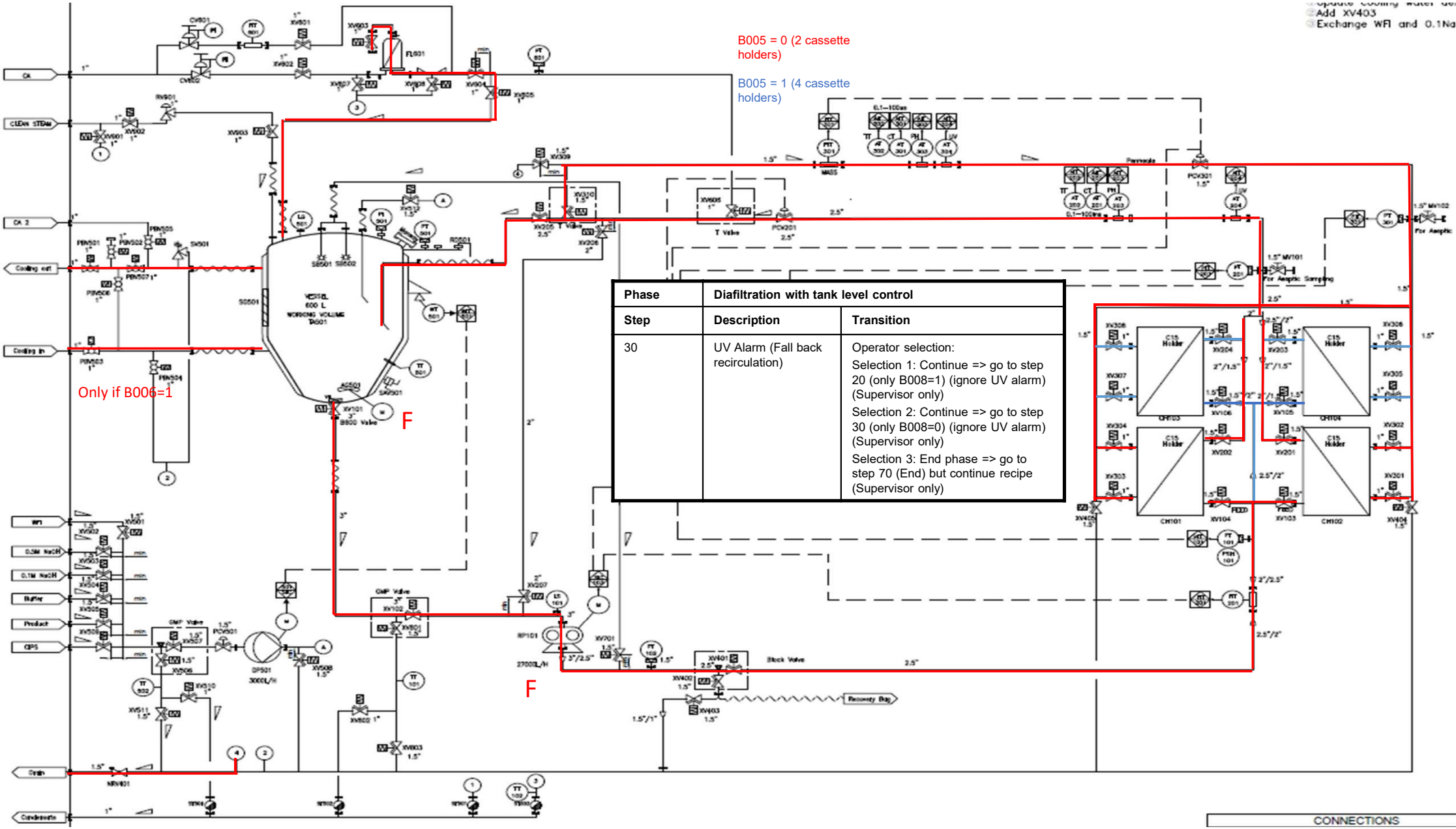
Phase	Diafiltration with tank level control	
Step	**Description**	**Transition**
30	Diafiltration	•totalised permeate flow at FITQ301 ≥ V001 (only if B003=0)=> go to step 70 (phase end) •totalised permeate flow FIT301 ≥ (V103+actual value WIT501+(V104*B011))*B010 (only if B003 = 1) => go to step 70 (phase end) •WIT501 ≤ Level control setpoint – Level controller deviation low => go to step 50 •WIT501 ≥ Level control setpoint + Level Controller deviation high => go to step 40 •Only if B007 = 1 and AT304 > OP Q000 => go to step 60



Phase	Diafiltration with tank level control	
Step	**Description**	**Transition**
40	Concentration without media transfer due to high level warning	Vessel Volume WIT501 ≤ Set point V002 / V102 => go to step 30 totalised permeate flow at FITQ301 ≥ V001 (only if B003=0) => go to step 70 (phase end) totalised permeate flow FIT301 ≥ (V103+actual value WIT501+(V104*B011))*B010 (only if B003 = 1) => go to step 70 (phase end) only if B007 = 1and AT304 ≥ OP Q000 => go to step 60



Phase	Diafiltration with tank level control	
Step	**Description**	**Transition**
50	Media transfer without concentration due to low level warning	••Vessel Volume WIT501 ≥ Set point V002 => got to step 30



Phase	Diafiltration with tank level control	
Step	**Description**	**Transition**
30	UV Alarm (Fall back recirculation)	Operator selection: Selection 1: Continue => go to step 20 (only B008=1) (ignore UV alarm) (Supervisor only) Selection 2: Continue => go to step 30 (only B008=0) (ignore UV alarm) (Supervisor only) Selection 3: End phase => go to step 70 (End) but continue recipe (Supervisor only)

Phase 12: Product Recovery

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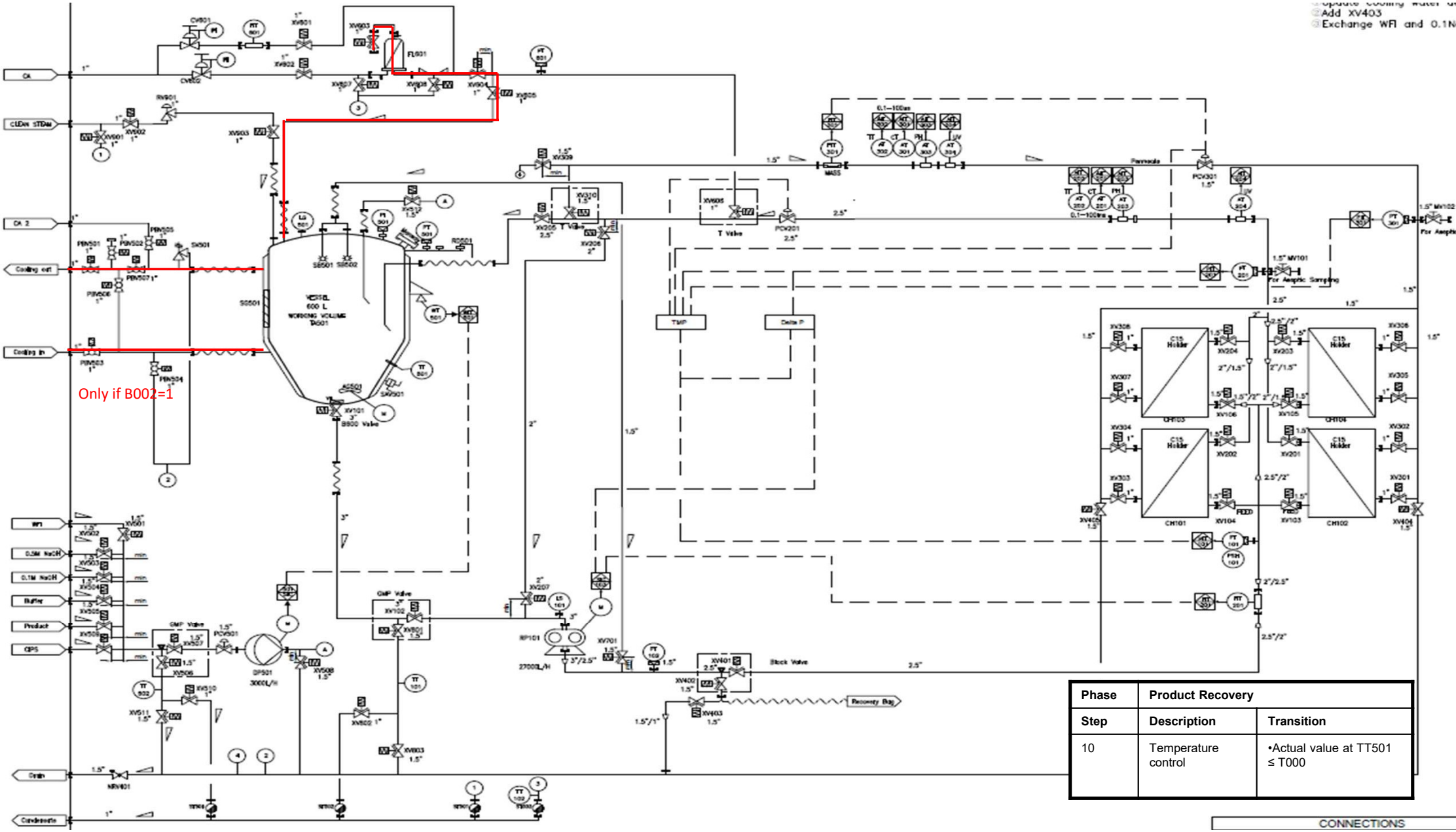
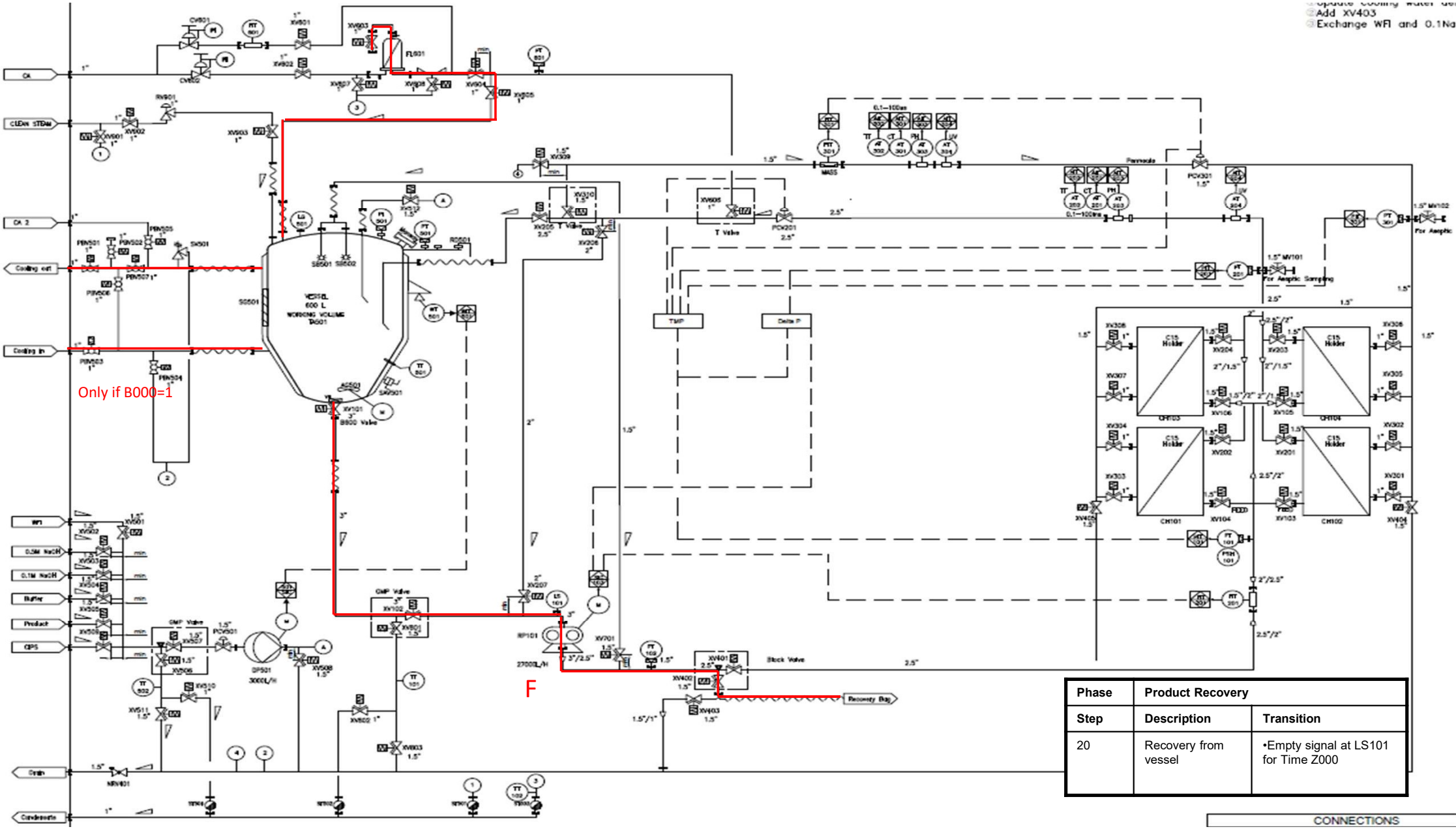
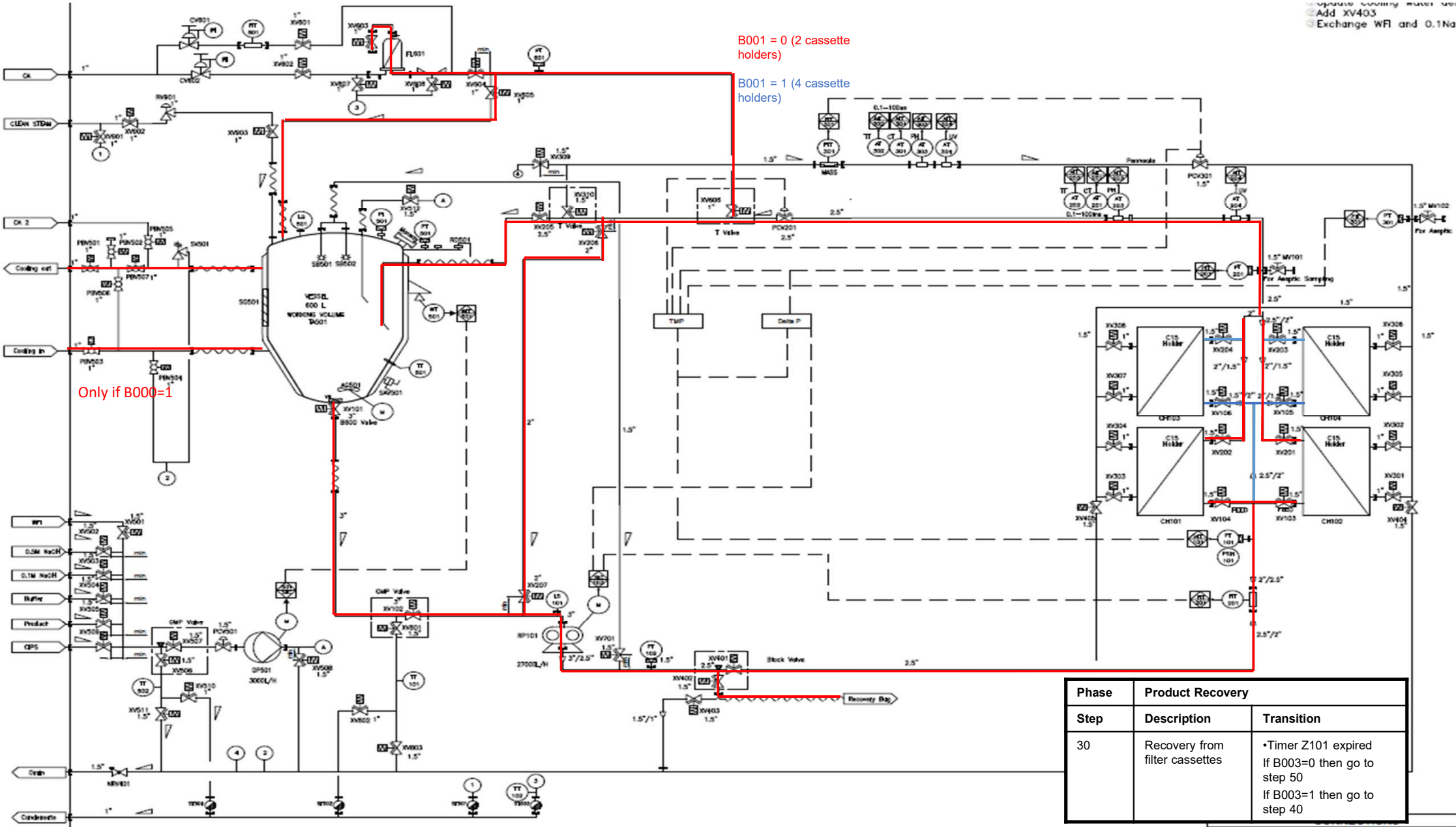


Phase	Product Recovery	
Step	**Description**	**Transition**
10	Temperature control	•Actual value at TT501 ≤ T000



Phase	Product Recovery	
Step	**Description**	**Transition**
20	Recovery from vessel	•Empty signal at LS101 for Time Z000



Phase	Product Recovery	
Step	**Description**	**Transition**
30	Recovery from filter cassettes	•Timer Z101 expired If B003=0 then go to step 50 If B003=1 then go to step 40

Phase 13: Retentate re-circulation

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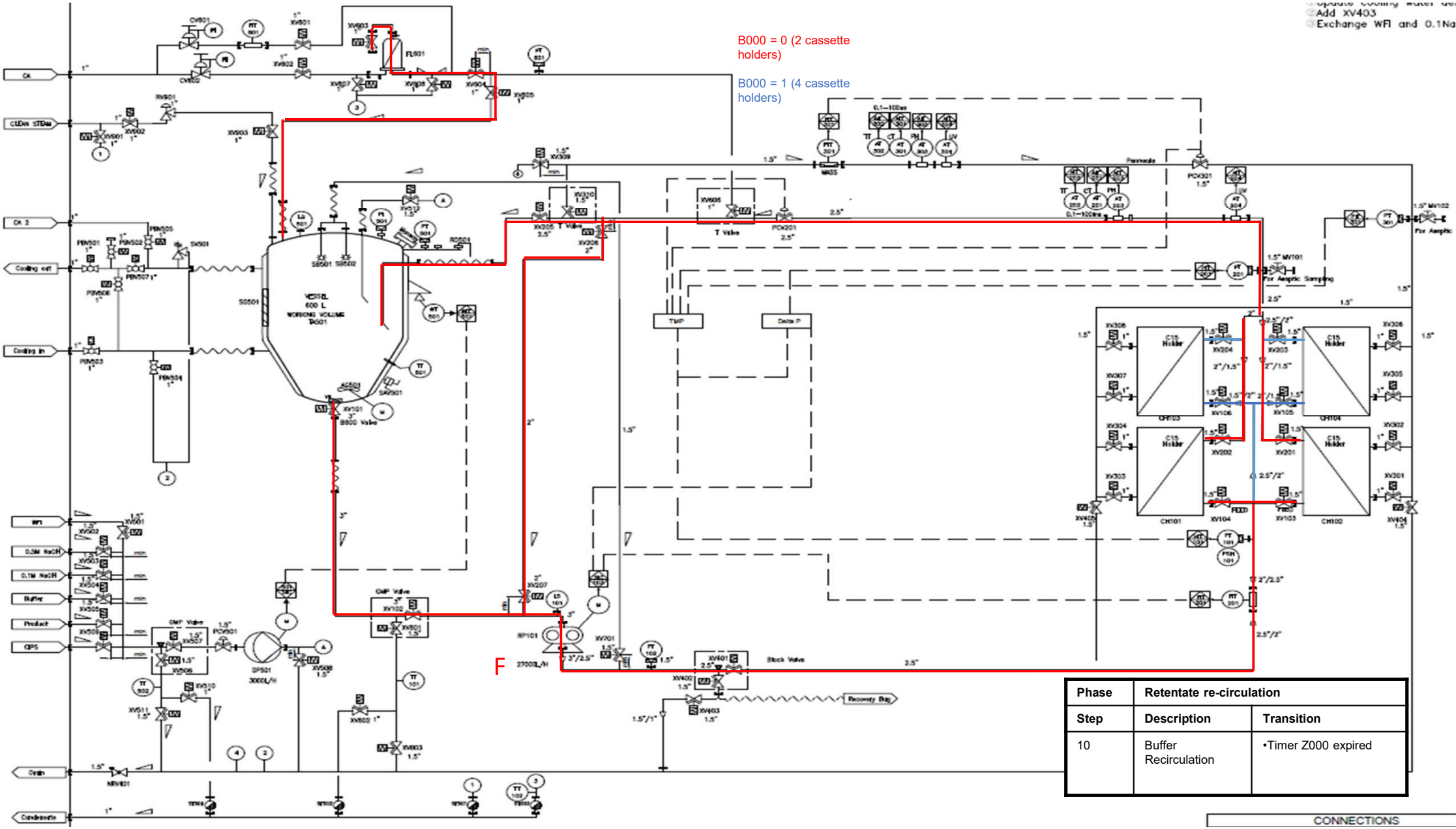

Phase	Retentate re-circulation	
Step	**Description**	**Transition**
10	Buffer Recirculation	•Timer Z000 expired

Phase 14: System pressure hold test

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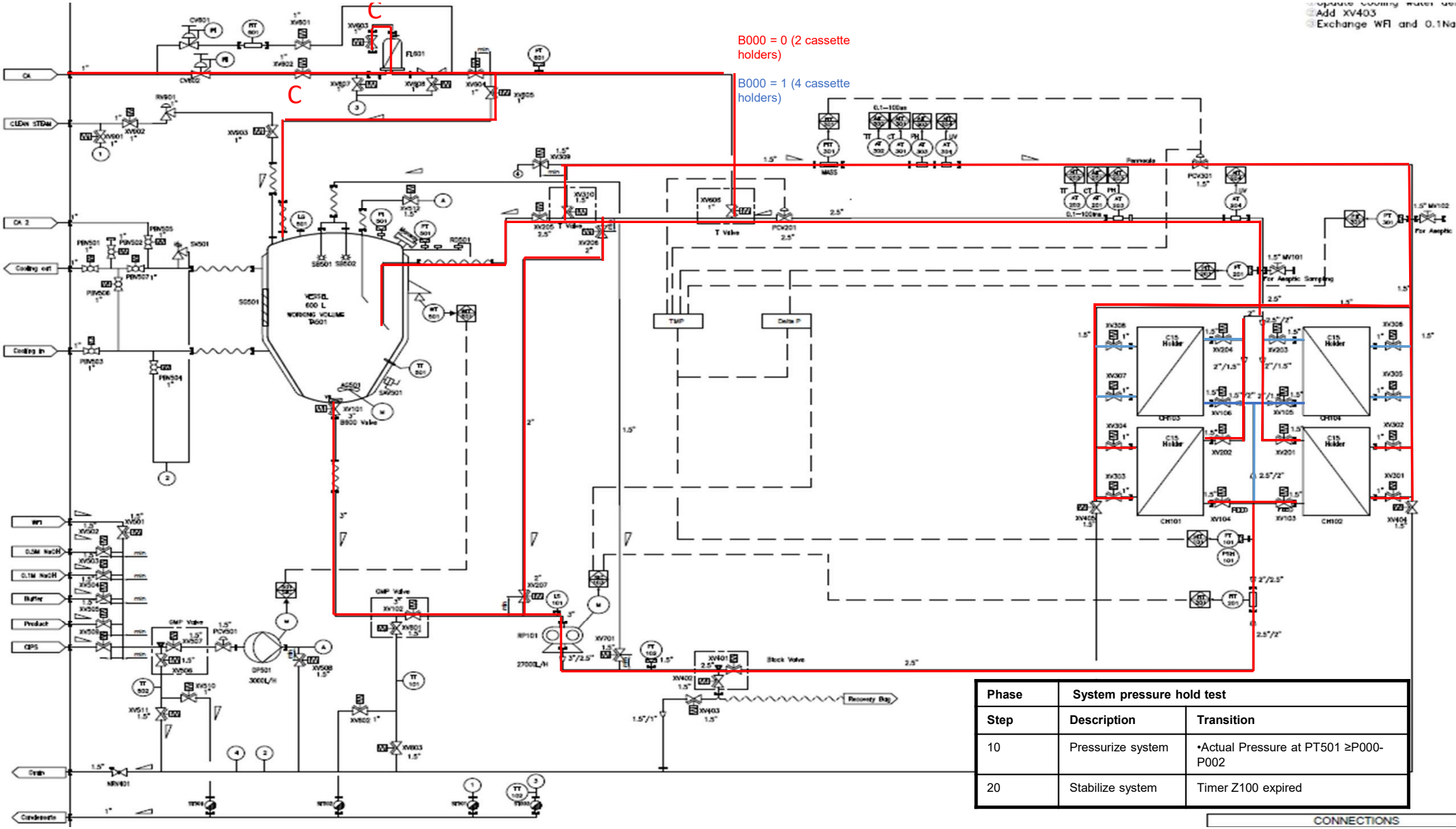
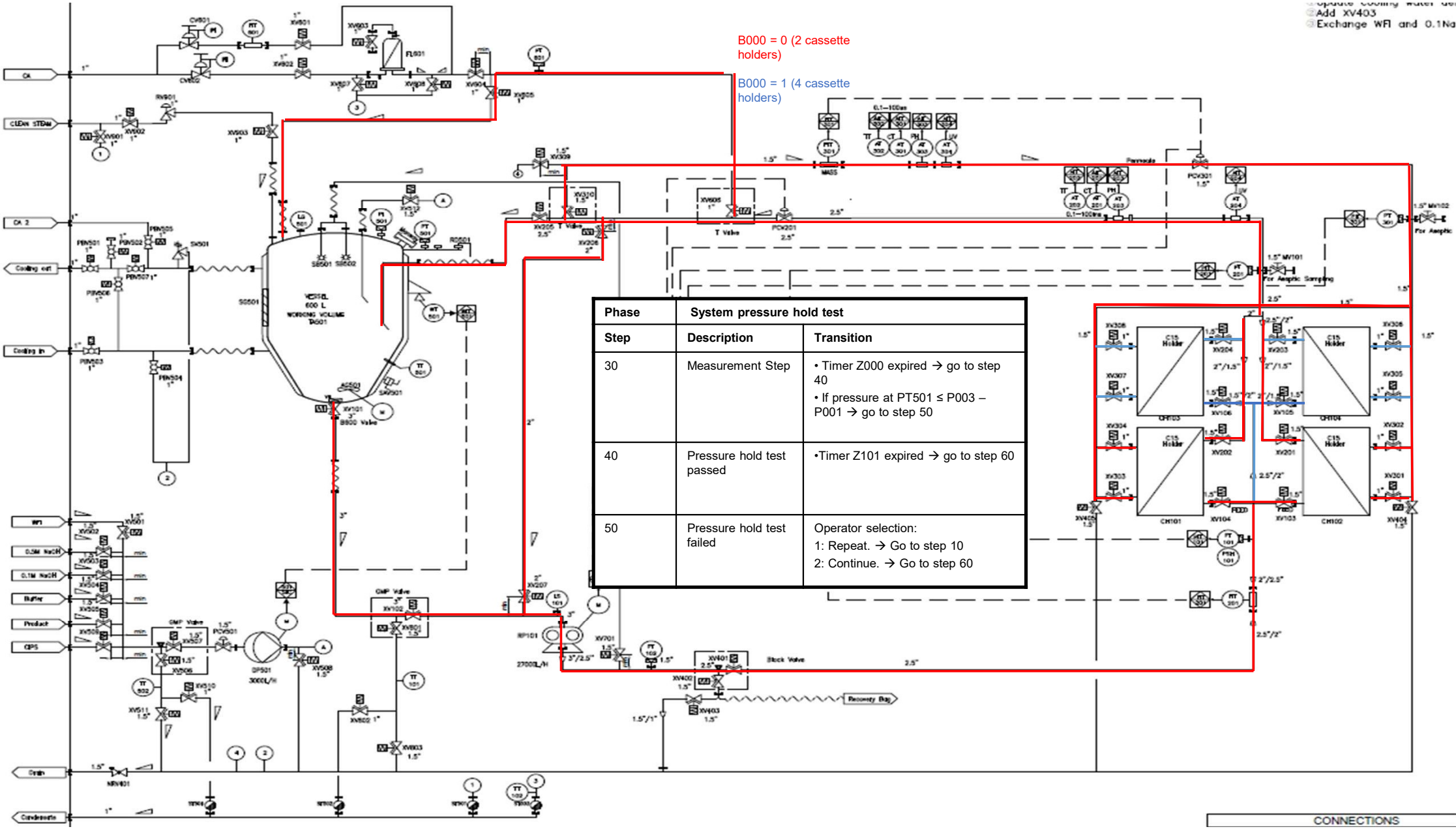
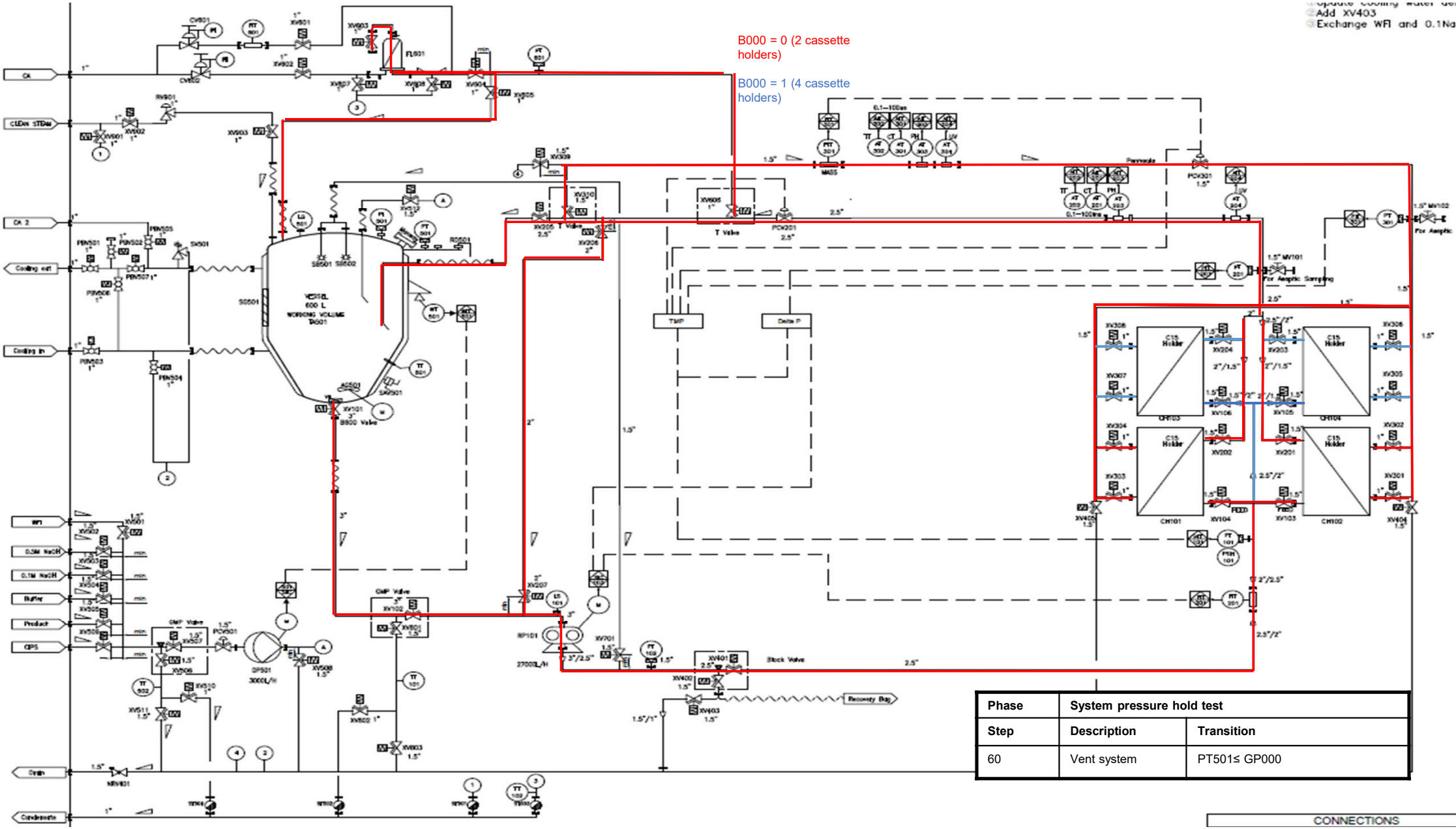


Phase	System pressure hold test	
Step	**Description**	**Transition**
10	Pressurize system	•Actual Pressure at PT501 ≥P000-P002
20	Stabilize system	Timer Z100 expired



Phase	System pressure hold test	
Step	**Description**	**Transition**
30	Measurement Step	• Timer Z000 expired → go to step 40 • If pressure at PT501 ≤ P003 – P001 → go to step 50
40	Pressure hold test passed	•Timer Z101 expired → go to step 60
50	Pressure hold test failed	Operator selection: 1: Repeat. → Go to step 10 2: Continue. → Go to step 60



Phase	System pressure hold test	
Step	**Description**	**Transition**
60	Vent system	PT501≤ GP000

Phase 15: Integrity test filter cassettes

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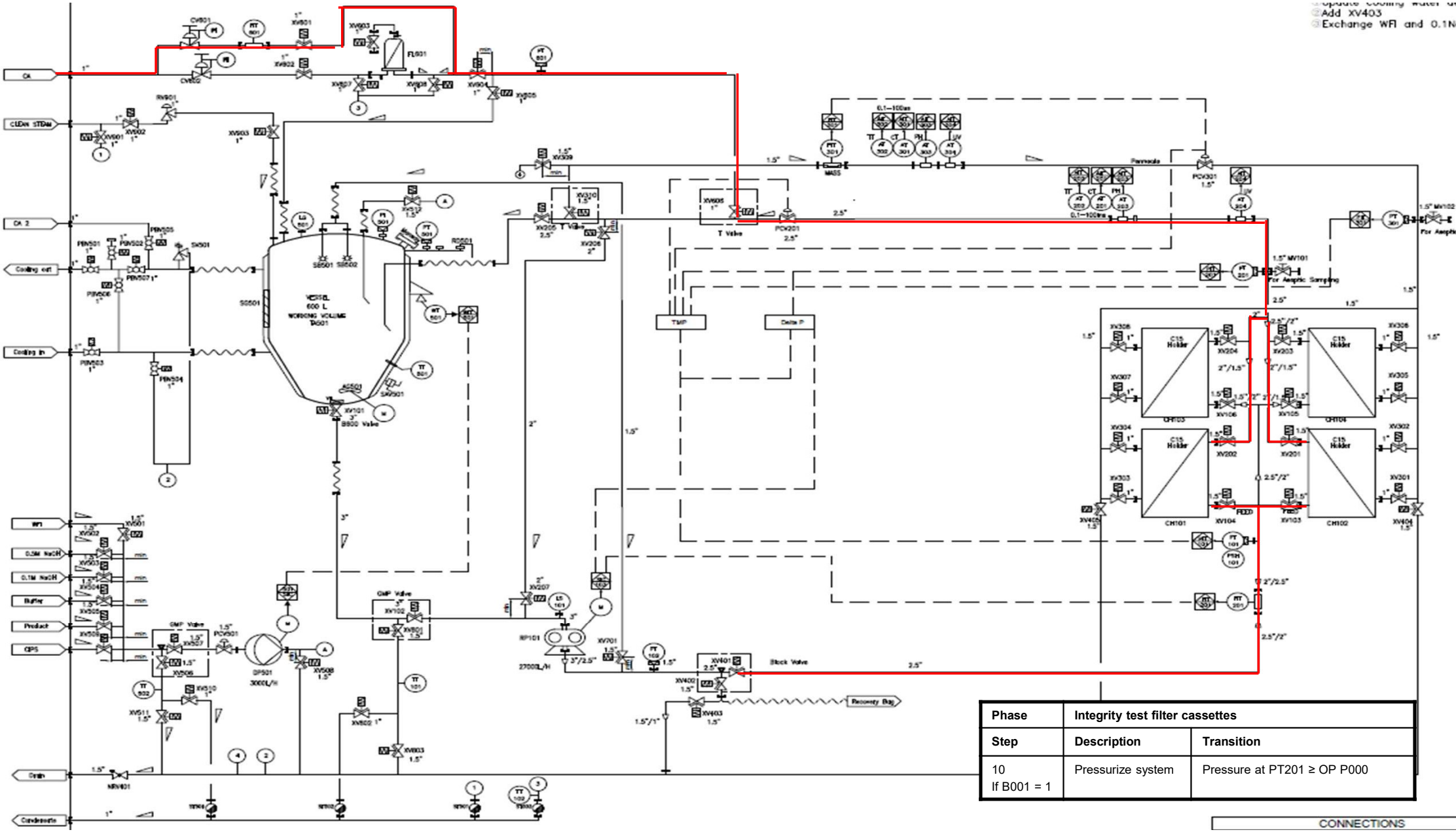
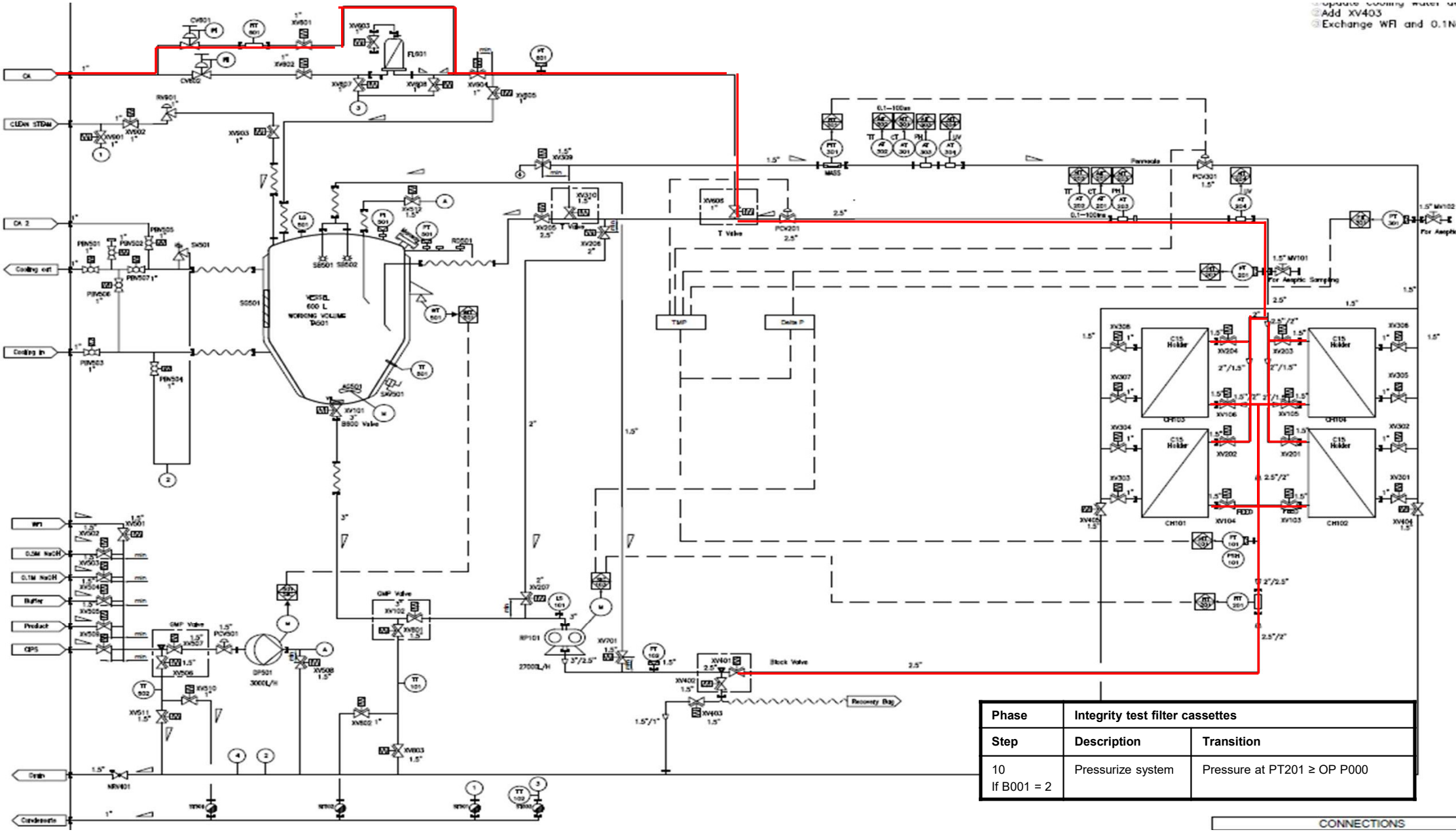
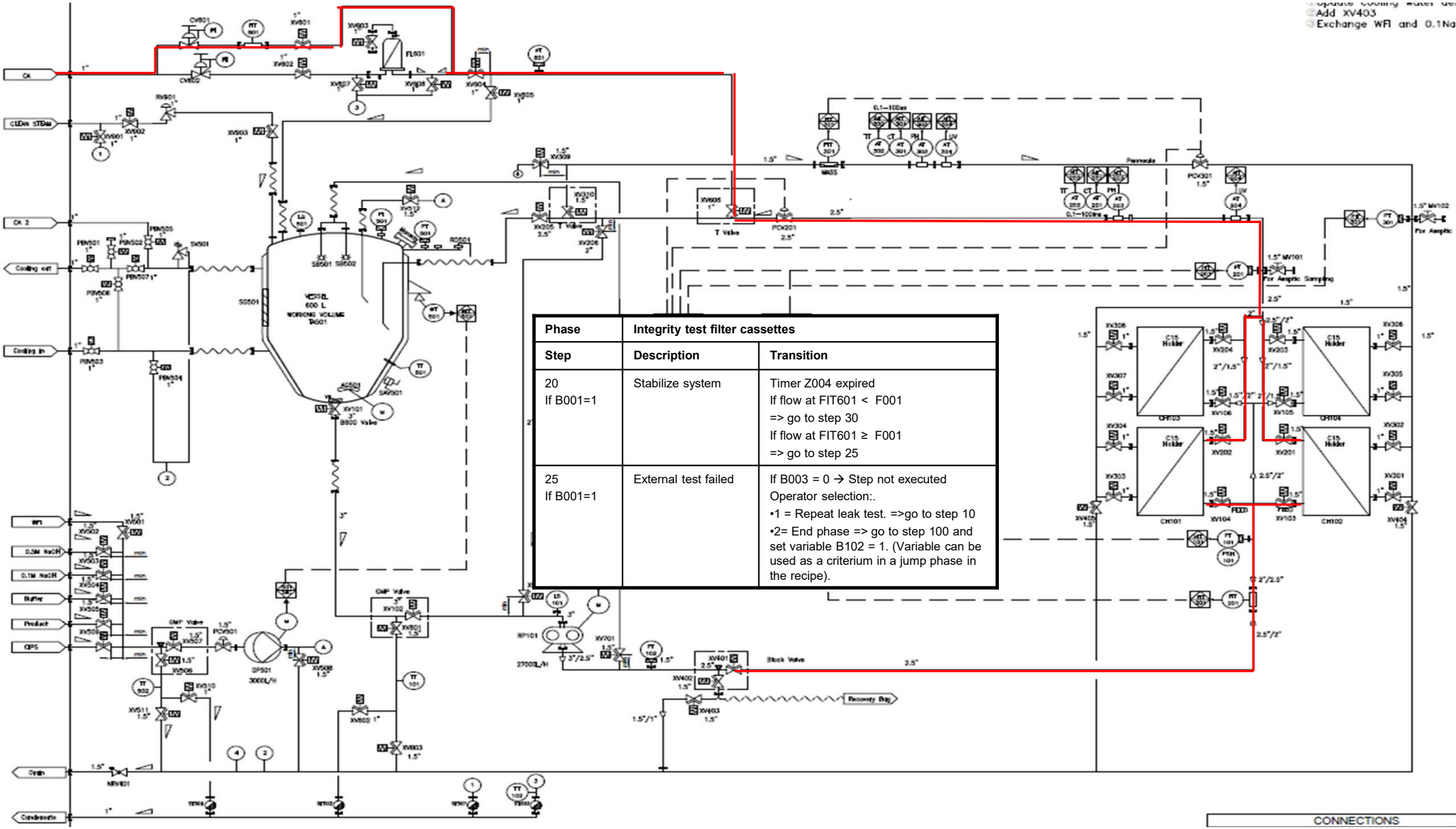


Phase	Integrity test filter cassettes	
Step	Description	Transition
10 If B001 = 1	Pressurize system	Pressure at PT201 ≥ OP P000

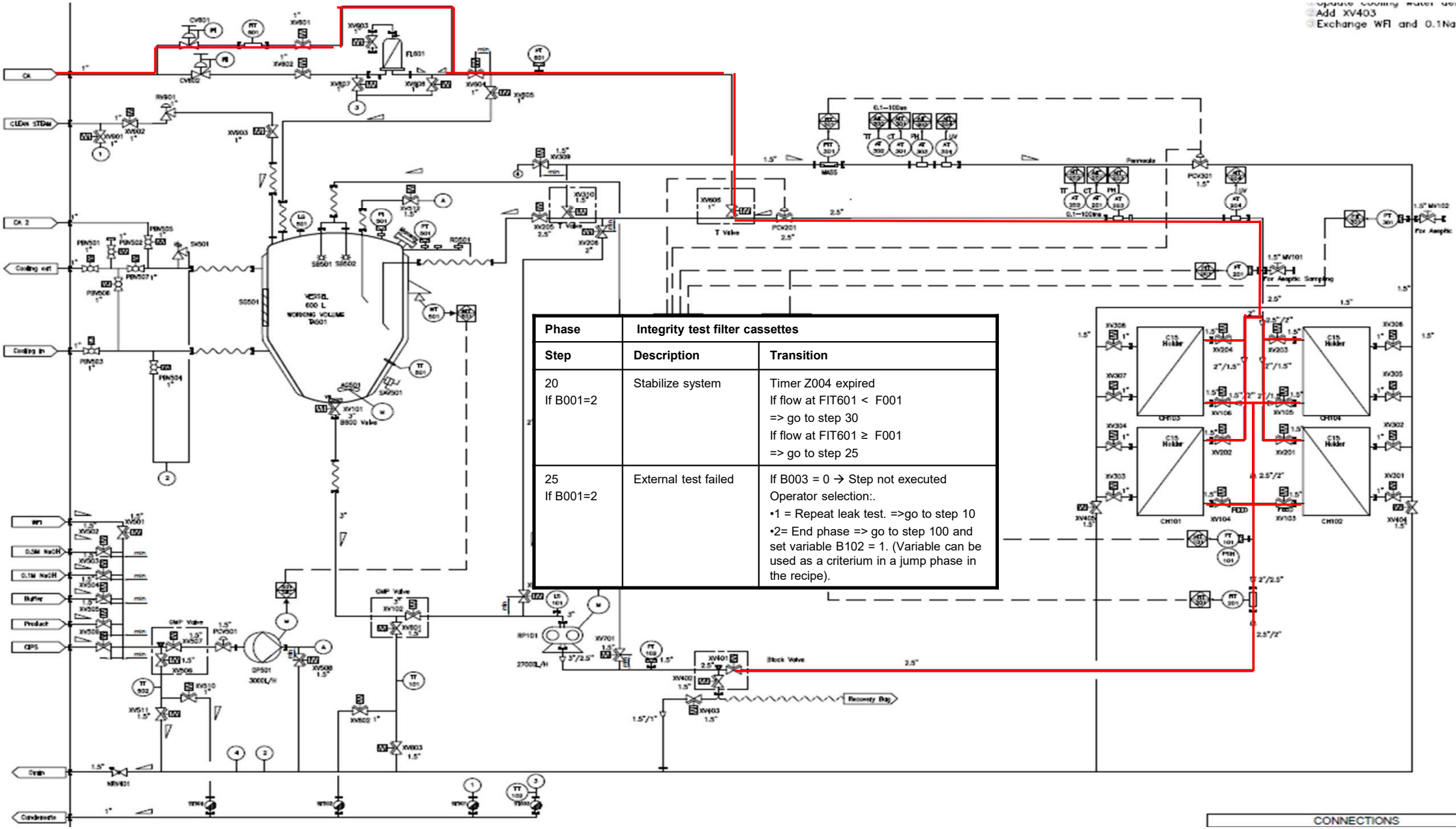
CONNECTIONS



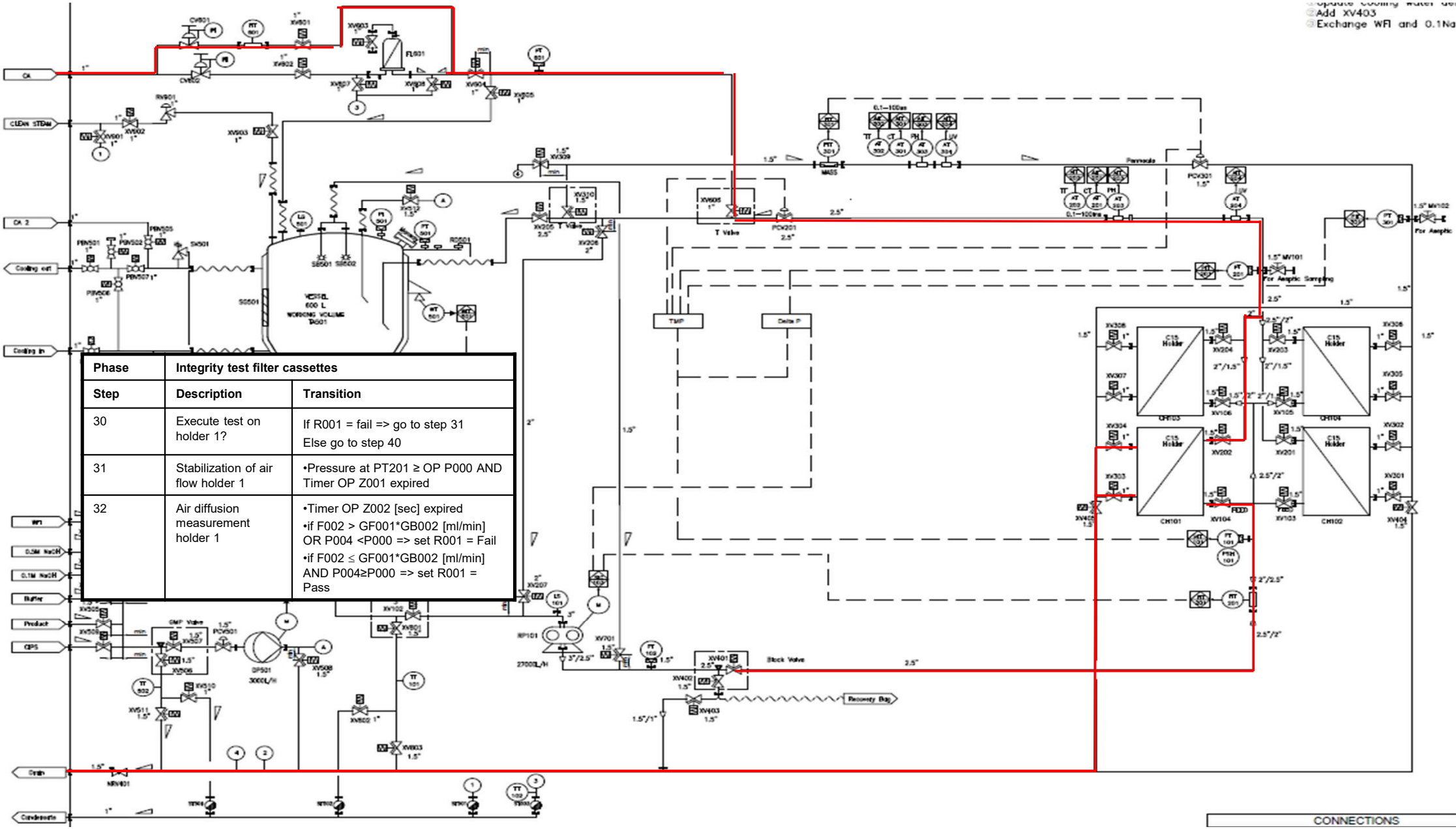
Phase	Integrity test filter cassettes	
Step	**Description**	**Transition**
10 If B001 = 2	Pressurize system	Pressure at PT201 ≥ OP P000



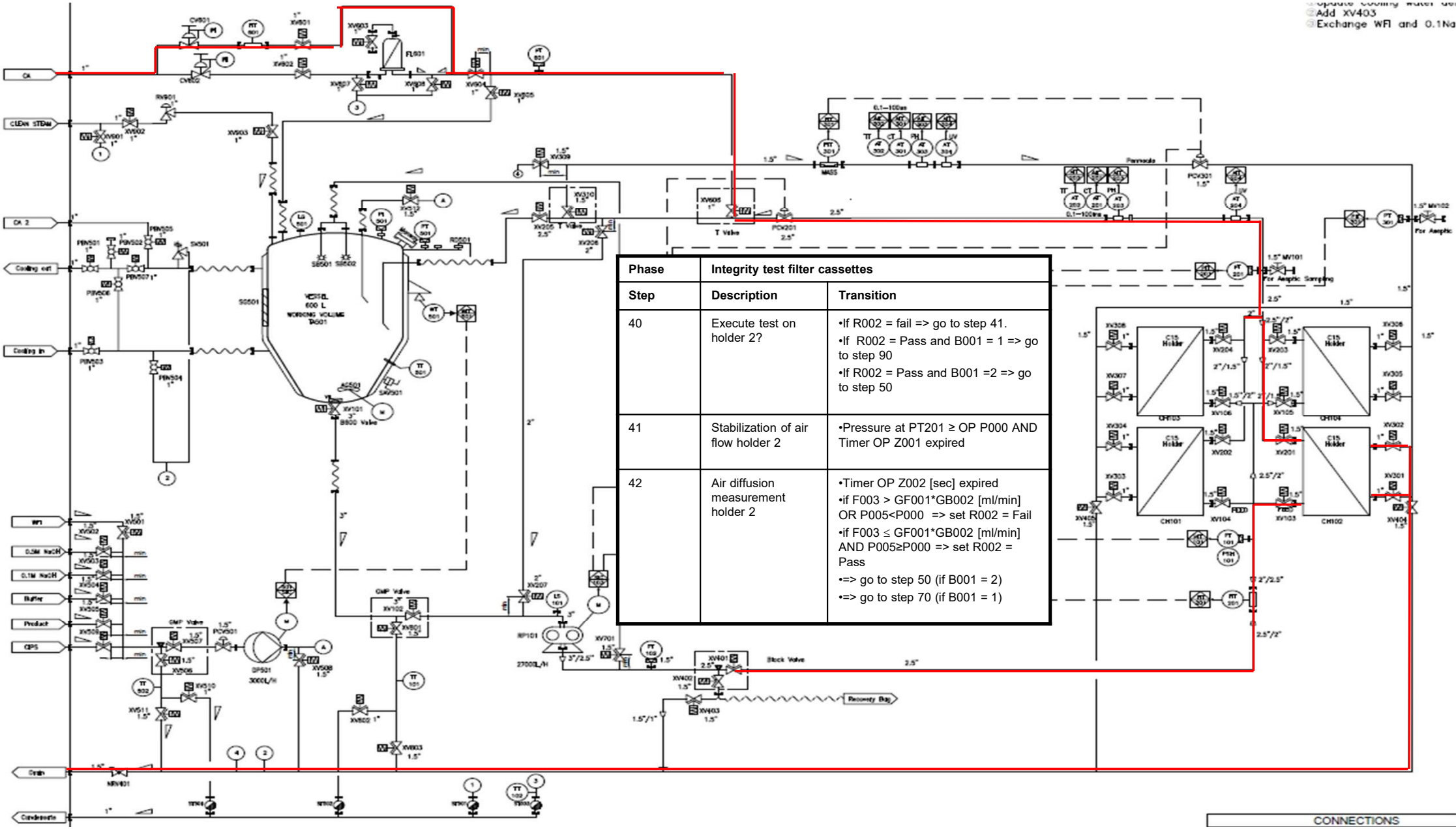
Phase	Integrity test filter cassettes	
Step	**Description**	**Transition**
20 If B001=1	Stabilize system	Timer Z004 expired If flow at FIT601 < F001 => go to step 30 If flow at FIT601 ≥ F001 => go to step 25
25 If B001=1	External test failed	If B003 = 0 → Step not executed Operator selection:. •1 = Repeat leak test. =>go to step 10 •2= End phase => go to step 100 and set variable B102 = 1. (Variable can be used as a criterium in a jump phase in the recipe).



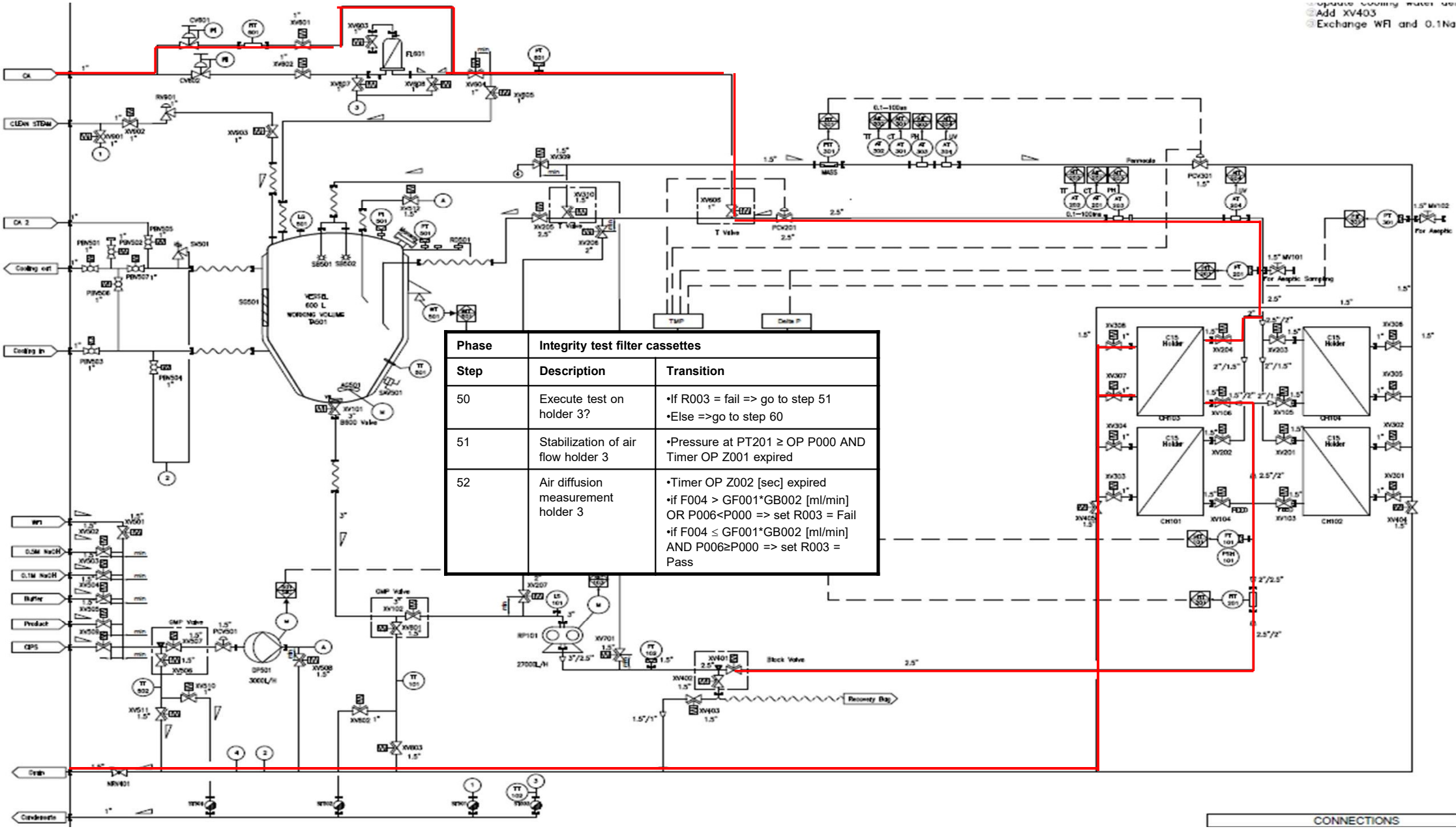
Phase	Integrity test filter cassettes	
Step	**Description**	**Transition**
20 If B001=2	Stabilize system	Timer Z004 expired If flow at FIT601 < F001 => go to step 30 If flow at FIT601 ≥ F001 => go to step 25
25 If B001=2	External test failed	If B003 = 0 → Step not executed Operator selection:. •1 = Repeat leak test. =>go to step 10 •2= End phase => go to step 100 and set variable B102 = 1. (Variable can be used as a criterium in a jump phase in the recipe).



Phase	Integrity test filter cassettes	
Step	**Description**	**Transition**
30	Execute test on holder 1?	If R001 = fail => go to step 31 Else go to step 40
31	Stabilization of air flow holder 1	•Pressure at PT201 ≥ OP P000 AND Timer OP Z001 expired
32	Air diffusion measurement holder 1	•Timer OP Z002 [sec] expired •if F002 > GF001*GB002 [ml/min] OR P004 <P000 => set R001 = Fail •if F002 ≤ GF001*GB002 [ml/min] AND P004≥P000 => set R001 = Pass

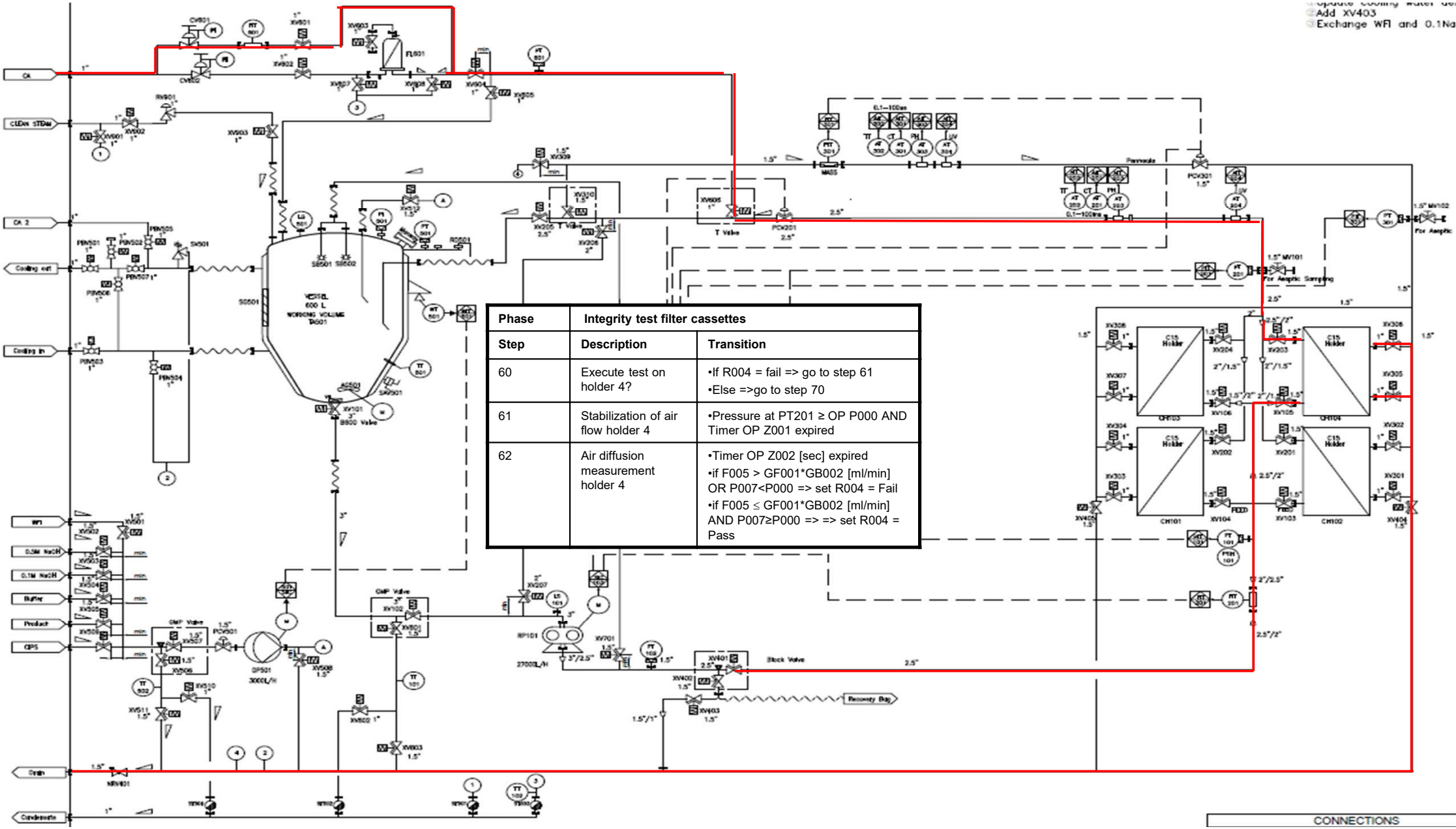


Phase	Integrity test filter cassettes	
Step	**Description**	**Transition**
40	Execute test on holder 2?	•If R002 = fail => go to step 41. •If R002 = Pass and B001 = 1 => go to step 90 •If R002 = Pass and B001 =2 => go to step 50
41	Stabilization of air flow holder 2	•Pressure at PT201 ≥ OP P000 AND Timer OP Z001 expired
42	Air diffusion measurement holder 2	•Timer OP Z002 [sec] expired •if F003 > GF001*GB002 [ml/min] OR P005<P000 => set R002 = Fail •if F003 ≤ GF001*GB002 [ml/min] AND P005≥P000 => set R002 = Pass •=> go to step 50 (if B001 = 2) •=> go to step 70 (if B001 = 1)

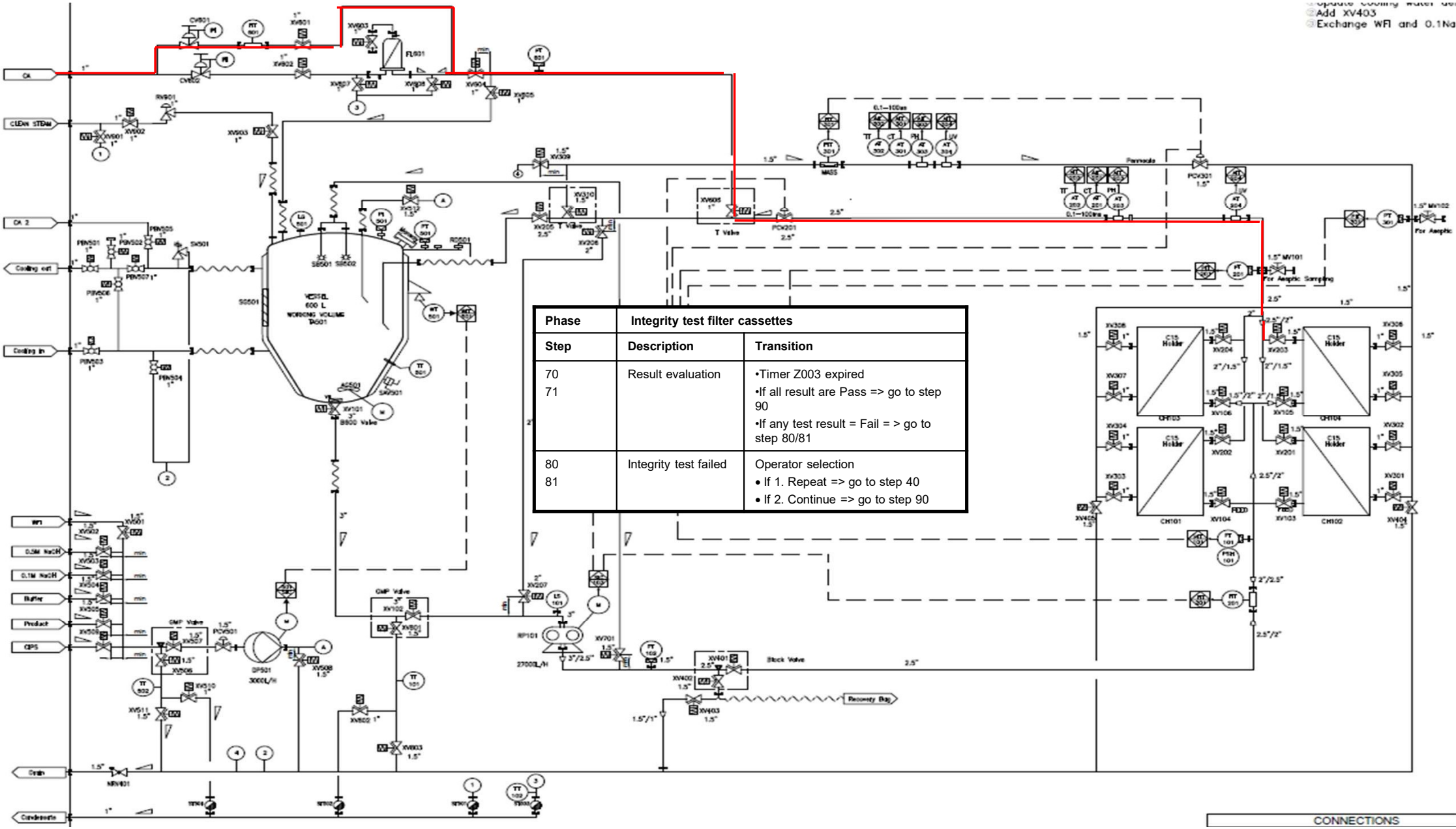


Phase	Integrity test filter cassettes	
Step	**Description**	**Transition**
50	Execute test on holder 3?	•If R003 = fail => go to step 51 •Else =>go to step 60
51	Stabilization of air flow holder 3	•Pressure at PT201 ≥ OP P000 AND Timer OP Z001 expired
52	Air diffusion measurement holder 3	•Timer OP Z002 [sec] expired •if F004 > GF001*GB002 [ml/min] OR P006<P000 => set R003 = Fail •if F004 ≤ GF001*GB002 [ml/min] AND P006≥P000 => set R003 = Pass

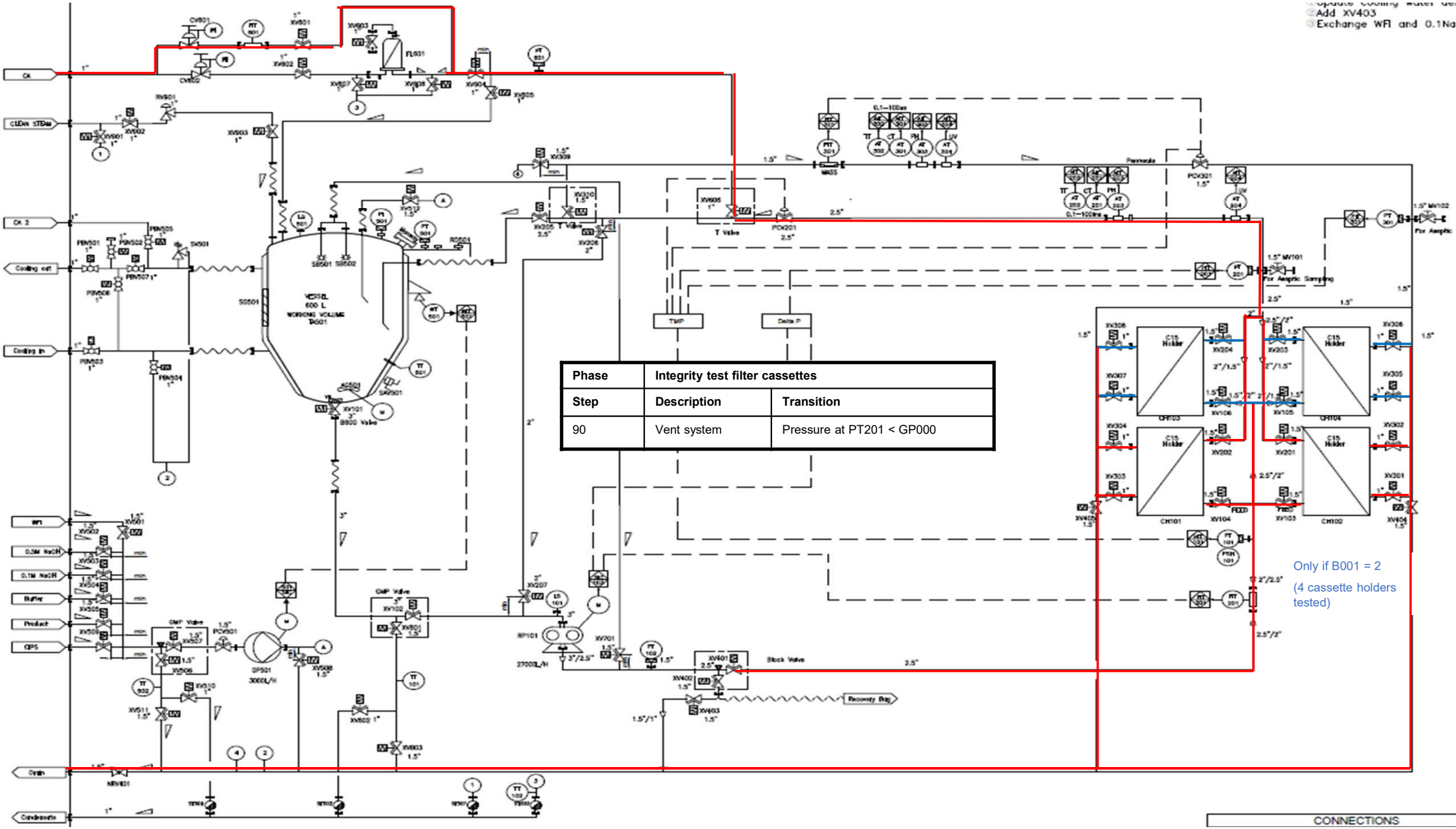
CONNECTIONS



Phase	Integrity test filter cassettes	
Step	**Description**	**Transition**
60	Execute test on holder 4?	•If R004 = fail => go to step 61 •Else =>go to step 70
61	Stabilization of air flow holder 4	•Pressure at PT201 ≥ OP P000 AND Timer OP Z001 expired
62	Air diffusion measurement holder 4	•Timer OP Z002 [sec] expired •if F005 > GF001*GB002 [ml/min] OR P007<P000 => set R004 = Fail •if F005 ≤ GF001*GB002 [ml/min] AND P007≥P000 => => set R004 = Pass



Phase	Integrity test filter cassettes	
Step	**Description**	**Transition**
70 71	Result evaluation	•Timer Z003 expired •If all result are Pass => go to step 90 •If any test result = Fail = > go to step 80/81
80 81	Integrity test failed	Operator selection • If 1. Repeat => go to step 40 • If 2. Continue => go to step 90



Phase	Integrity test filter cassettes	
Step	**Description**	**Transition**
90	Vent system	Pressure at PT201 < GP000

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Phase 16: Concentration with tank level control

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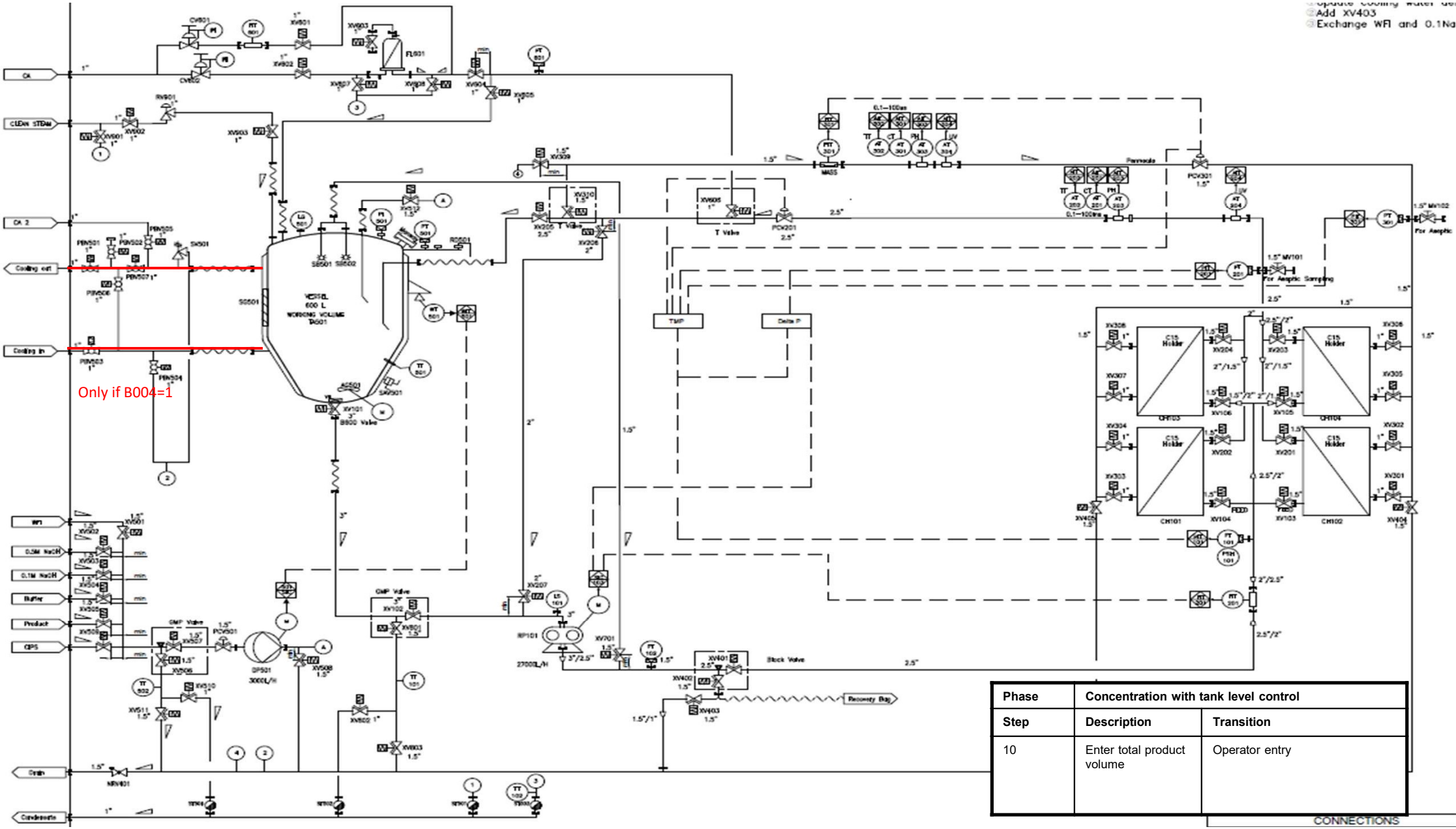
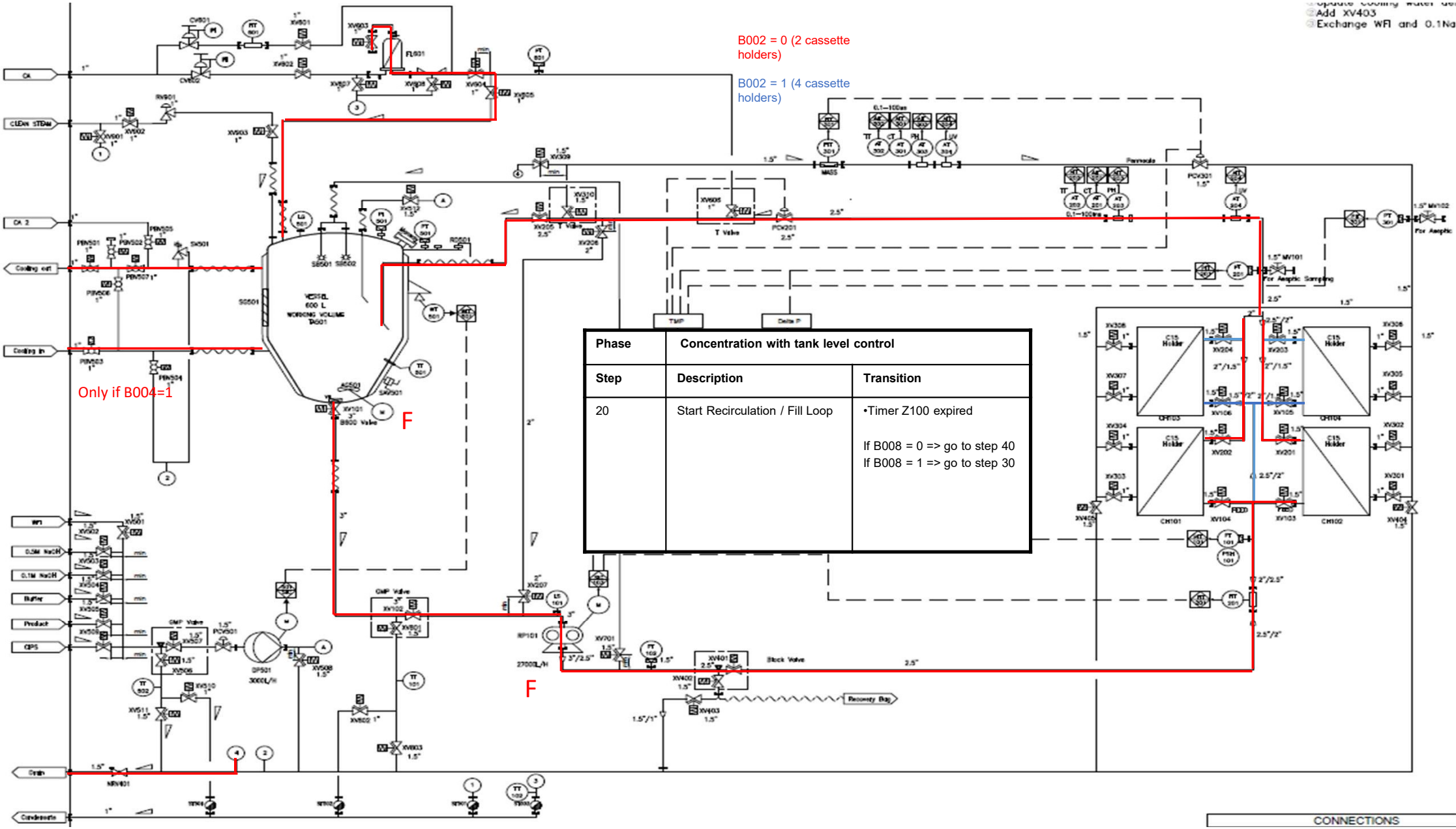
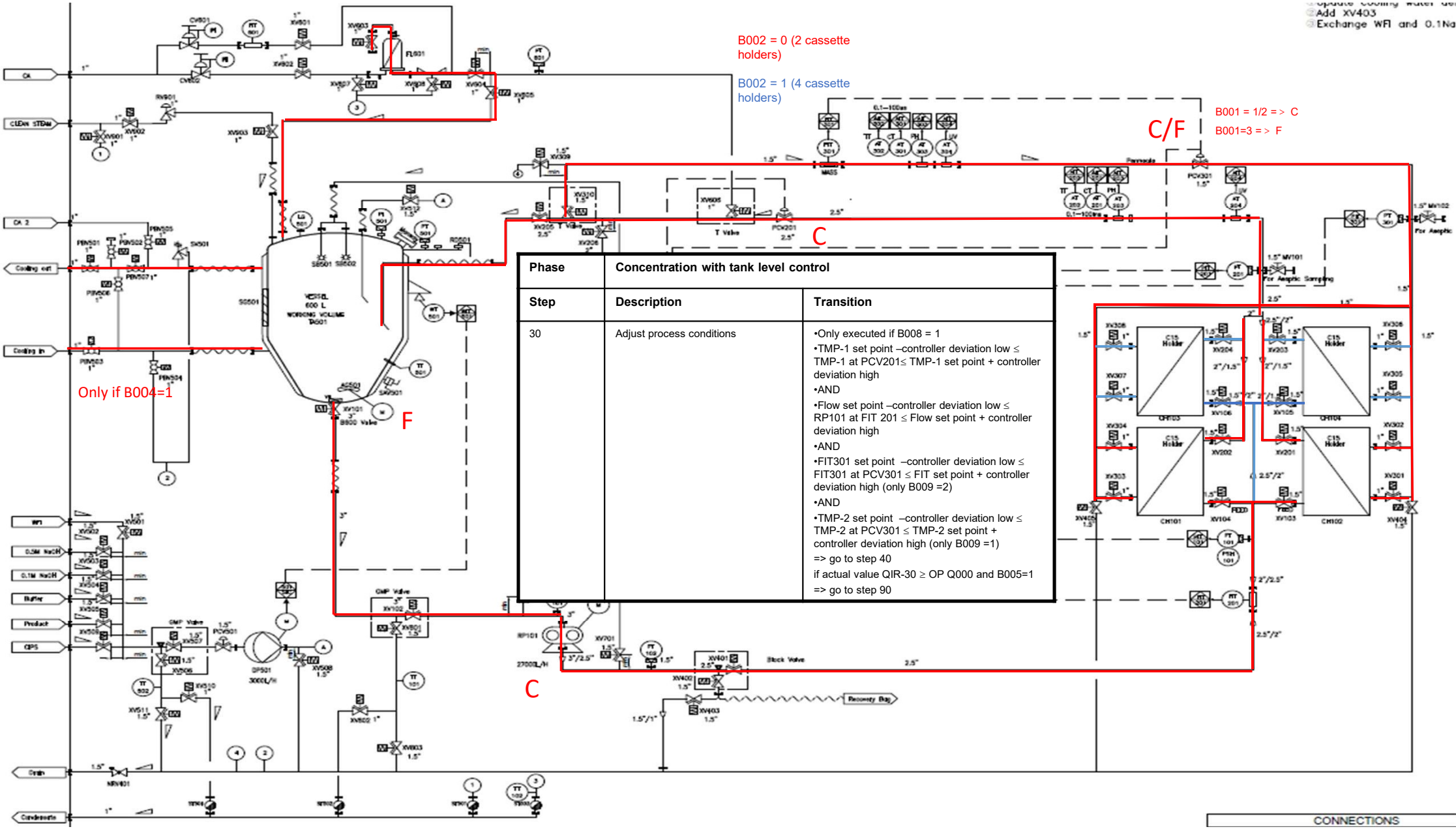


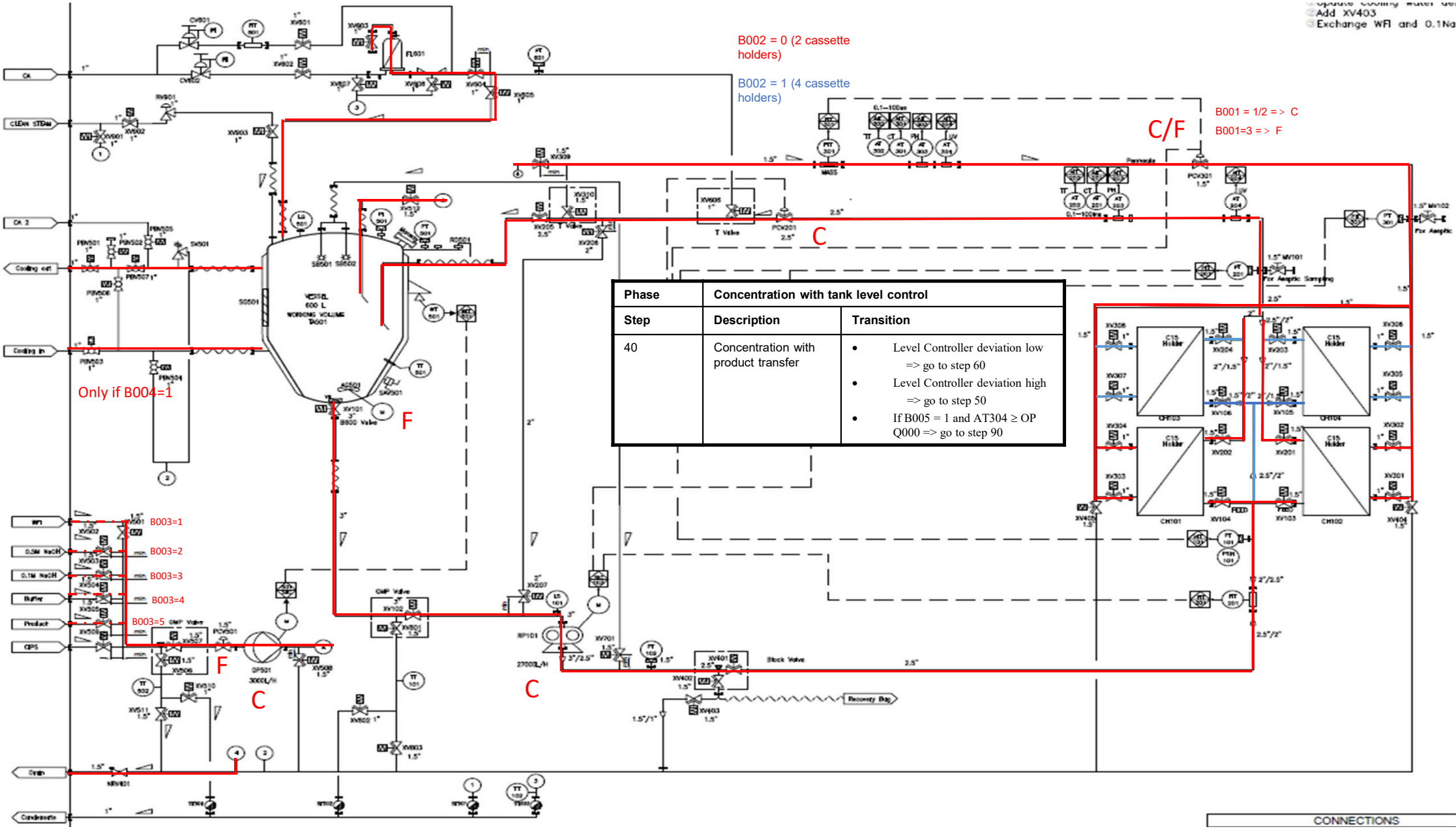
Phase	Concentration with tank level control	
Step	**Description**	**Transition**
10	Enter total product volume	Operator entry



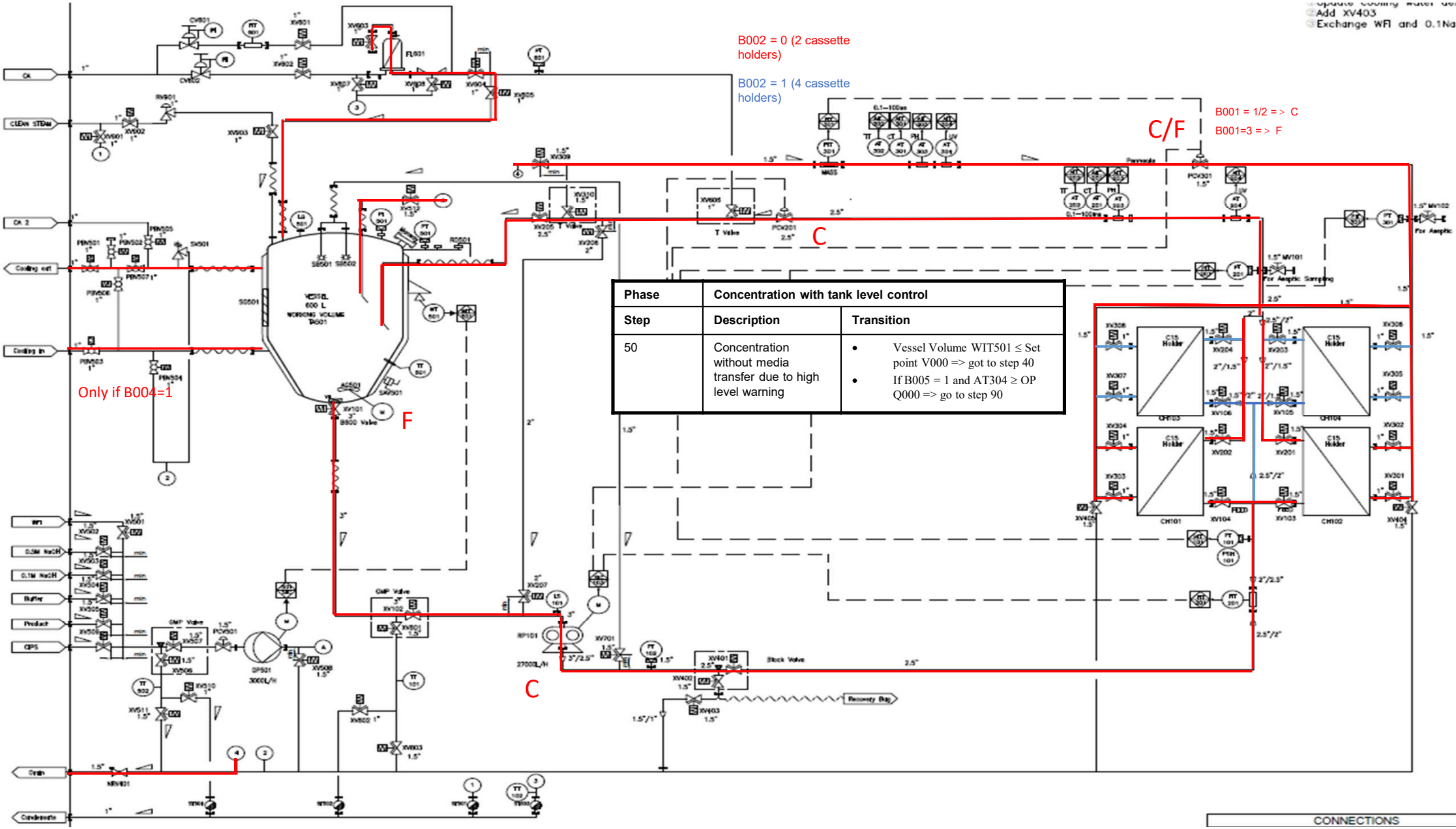
Phase	Concentration with tank level control	
Step	**Description**	**Transition**
20	Start Recirculation / Fill Loop	•Timer Z100 expired If B008 = 0 => go to step 40 If B008 = 1 => go to step 30



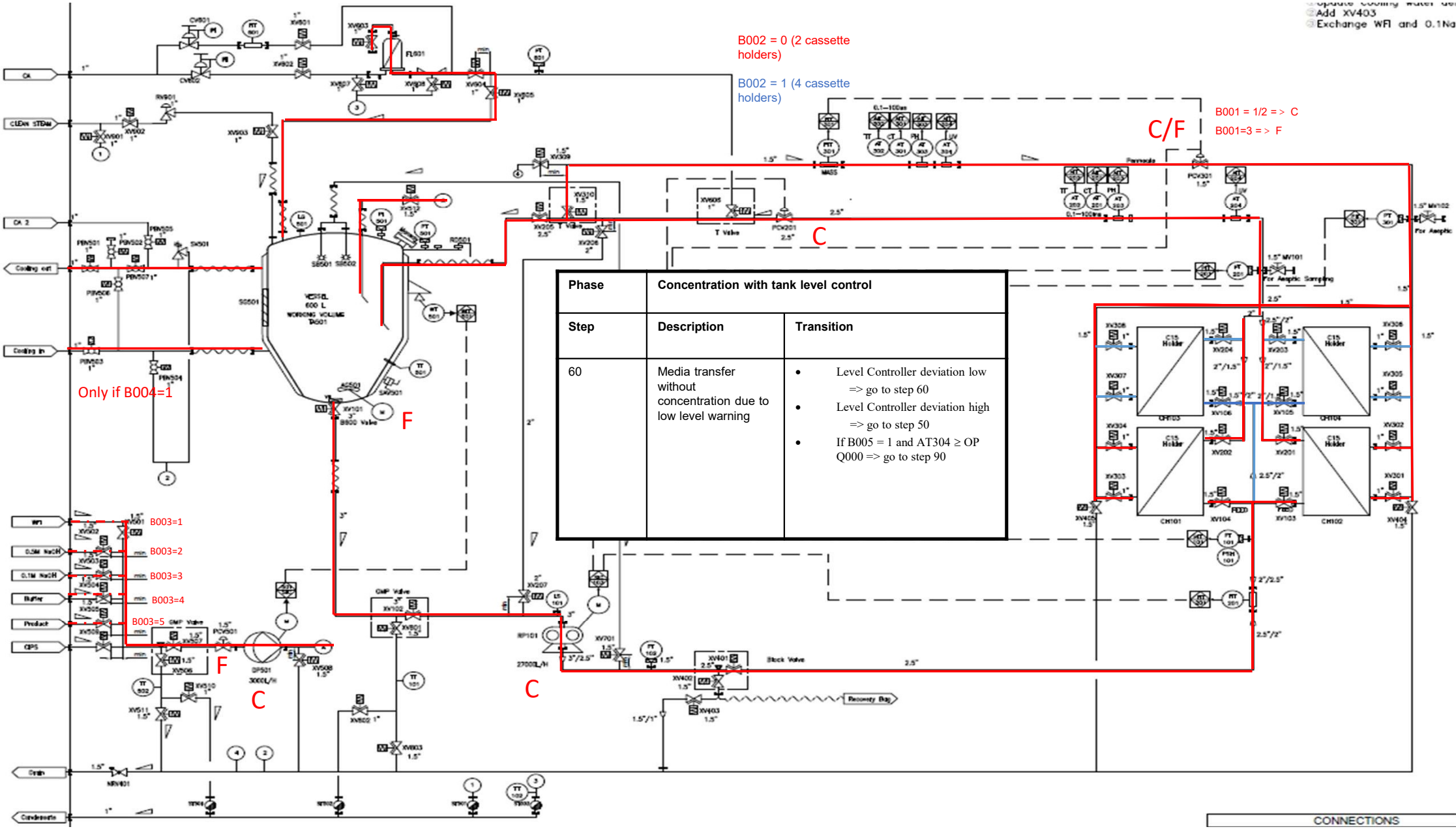
Phase	Concentration with tank level control	
Step	**Description**	**Transition**
30	Adjust process conditions	•Only executed if B008 = 1 •TMP-1 set point –controller deviation low ≤ TMP-1 at PCV201≤ TMP-1 set point + controller deviation high •AND •Flow set point –controller deviation low ≤ RP101 at FIT 201 ≤ Flow set point + controller deviation high •AND •FIT301 set point –controller deviation low ≤ FIT301 at PCV301 ≤ FIT set point + controller deviation high (only B009 =2) •AND •TMP-2 set point –controller deviation low ≤ TMP-2 at PCV301 ≤ TMP-2 set point + controller deviation high (only B009 =1) => go to step 40 if actual value QIR-30 ≥ OP Q000 and B005=1 => go to step 90



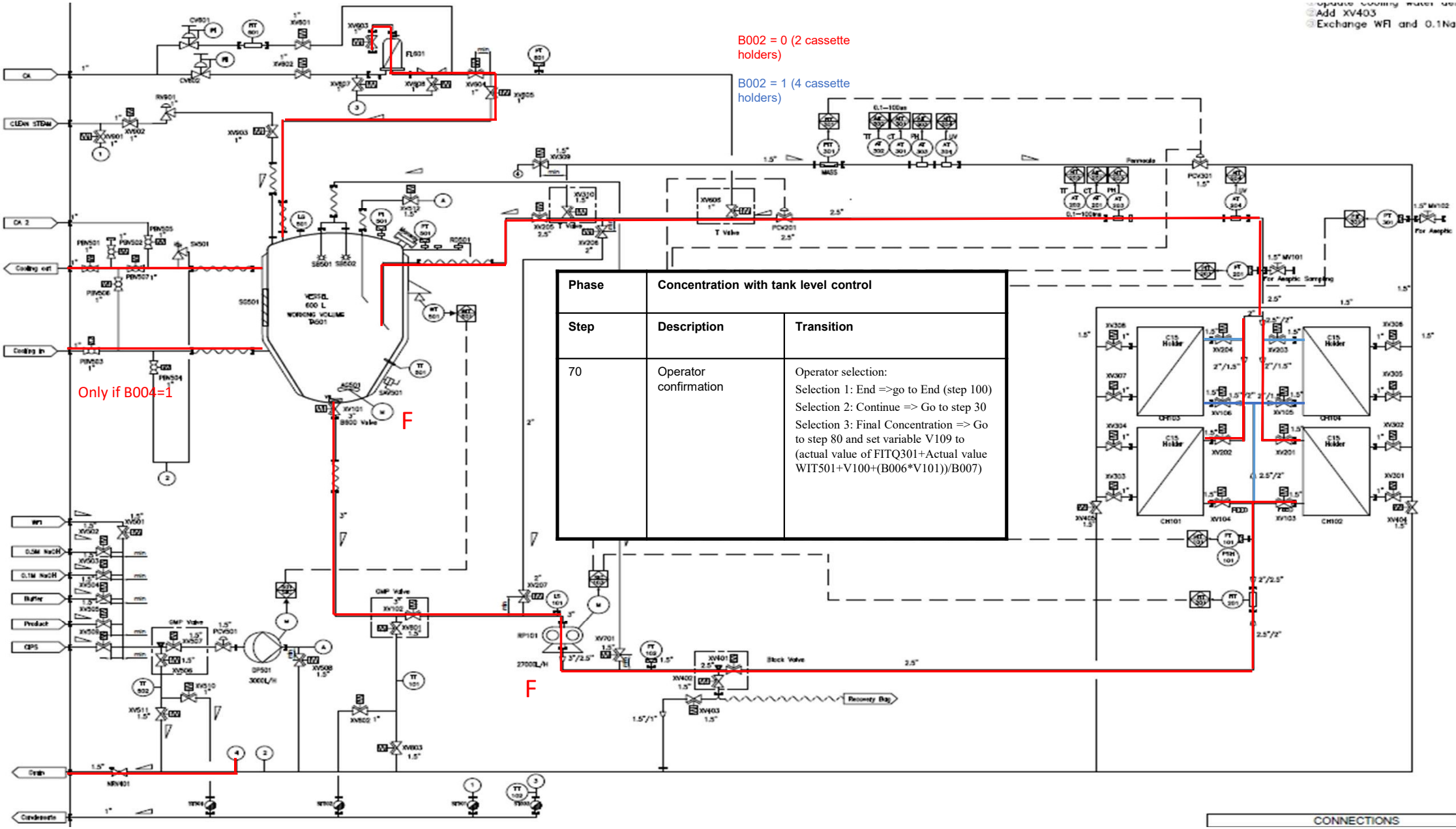
Phase	Concentration with tank level control	
Step	**Description**	**Transition**
40	Concentration with product transfer	• Level Controller deviation low => go to step 60 • Level Controller deviation high => go to step 50 • If B005 = 1 and AT304 ≥ OP Q000 => go to step 90



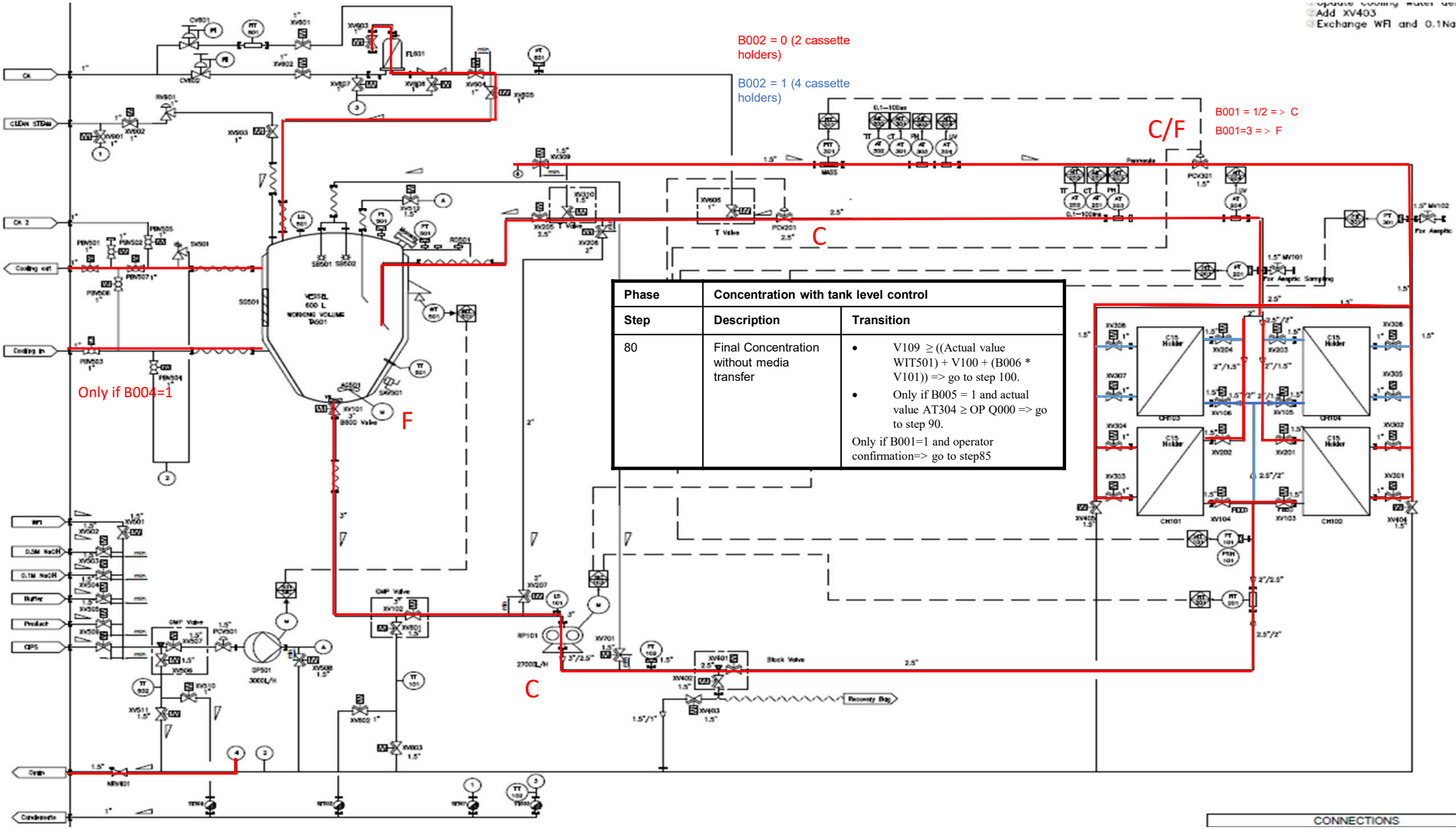
Phase	Concentration with tank level control	
Step	**Description**	**Transition**
50	Concentration without media transfer due to high level warning	• Vessel Volume WIT501 ≤ Set point V000 => got to step 40 • If B005 = 1 and AT304 ≥ OP Q000 => go to step 90



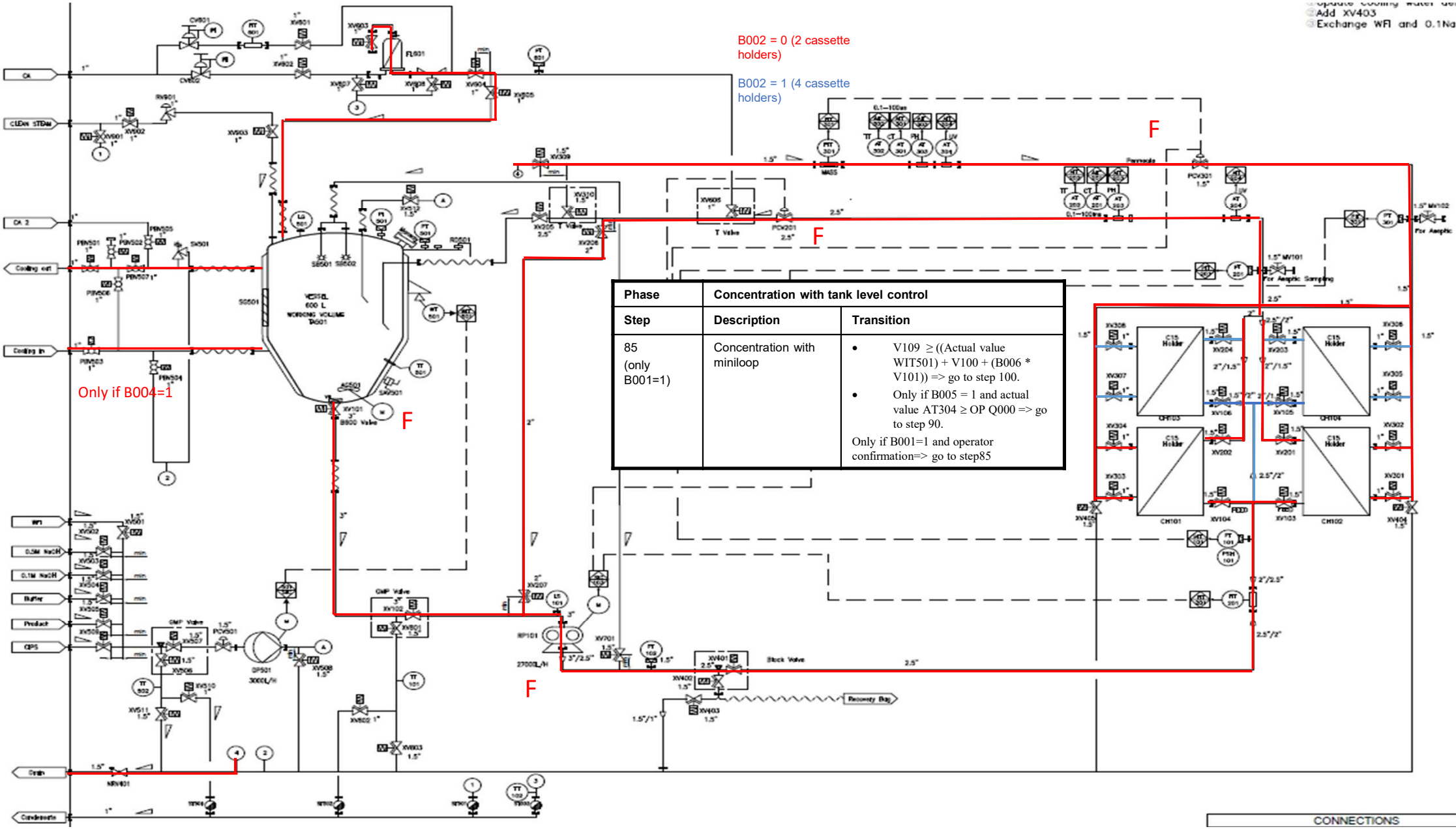
Phase	Concentration with tank level control	
Step	**Description**	**Transition**
60	Media transfer without concentration due to low level warning	• Level Controller deviation low => go to step 60 • Level Controller deviation high => go to step 50 • If B005 = 1 and AT304 ≥ OP Q000 => go to step 90



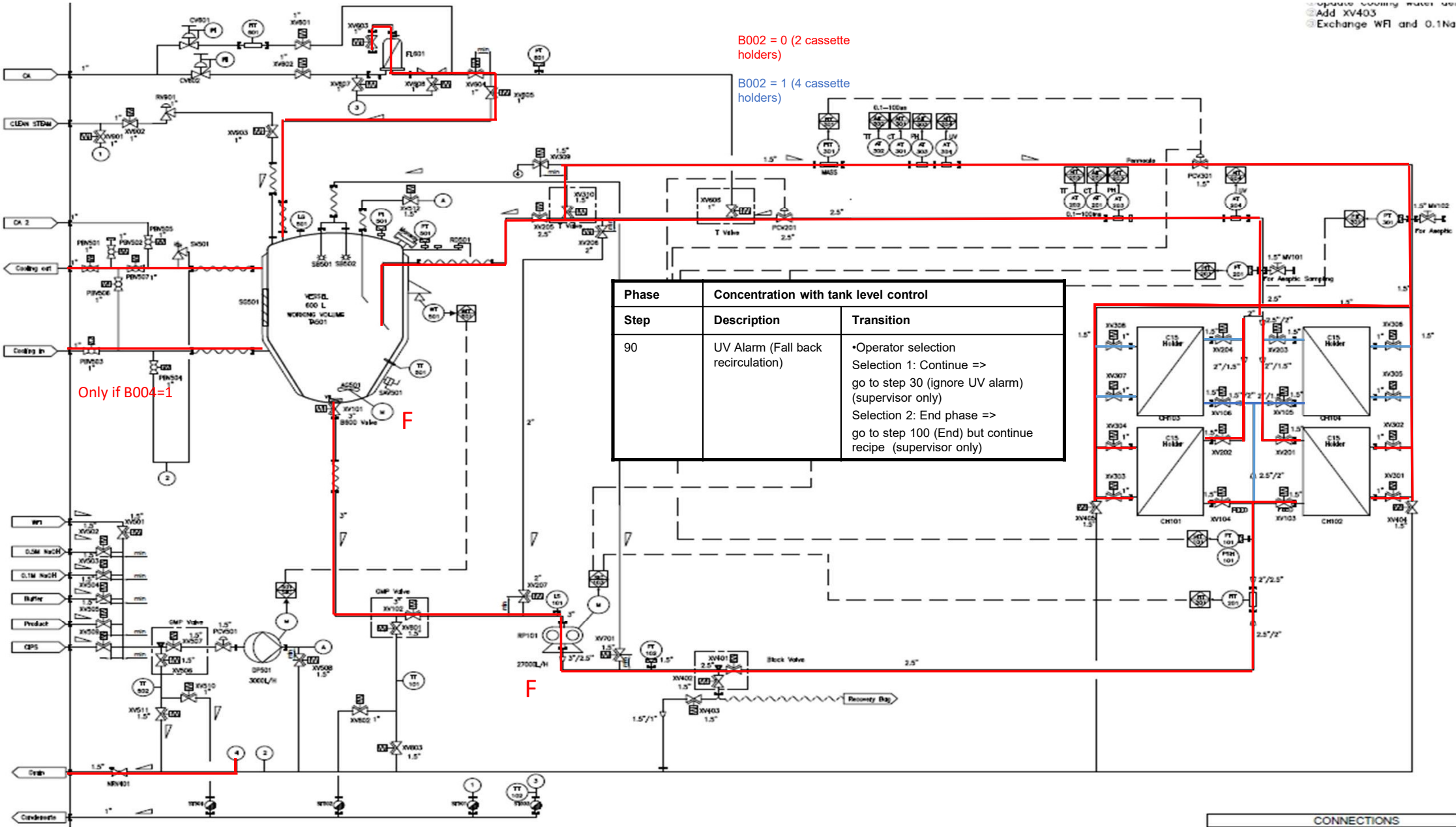
Phase	Concentration with tank level control	
Step	**Description**	**Transition**
70	Operator confirmation	Operator selection: Selection 1: End =>go to End (step 100) Selection 2: Continue => Go to step 30 Selection 3: Final Concentration => Go to step 80 and set variable V109 to (actual value of FITQ301+Actual value WIT501+V100+(B006*V101))/B007)



Phase	Concentration with tank level control	
Step	**Description**	**Transition**
80	Final Concentration without media transfer	• V109 ≥ ((Actual value WIT501) + V100 + (B006 * V101)) => go to step 100. • Only if B005 = 1 and actual value AT304 ≥ OP Q000 => go to step 90. Only if B001=1 and operator confirmation=> go to step85



Phase	Concentration with tank level control	
Step	**Description**	**Transition**
85 (only B001=1)	Concentration with miniloop	• V109 ≥ ((Actual value WIT501) + V100 + (B006 * V101)) => go to step 100. • Only if B005 = 1 and actual value AT304 ≥ OP Q000 => go to step 90. Only if B001=1 and operator confirmation=> go to step85



Phase	Concentration with tank level control	
Step	**Description**	**Transition**
90	UV Alarm (Fall back recirculation)	•Operator selection Selection 1: Continue => go to step 30 (ignore UV alarm) (supervisor only) Selection 2: End phase => go to step 100 (End) but continue recipe (supervisor only)

Phase 17: Tank SIP

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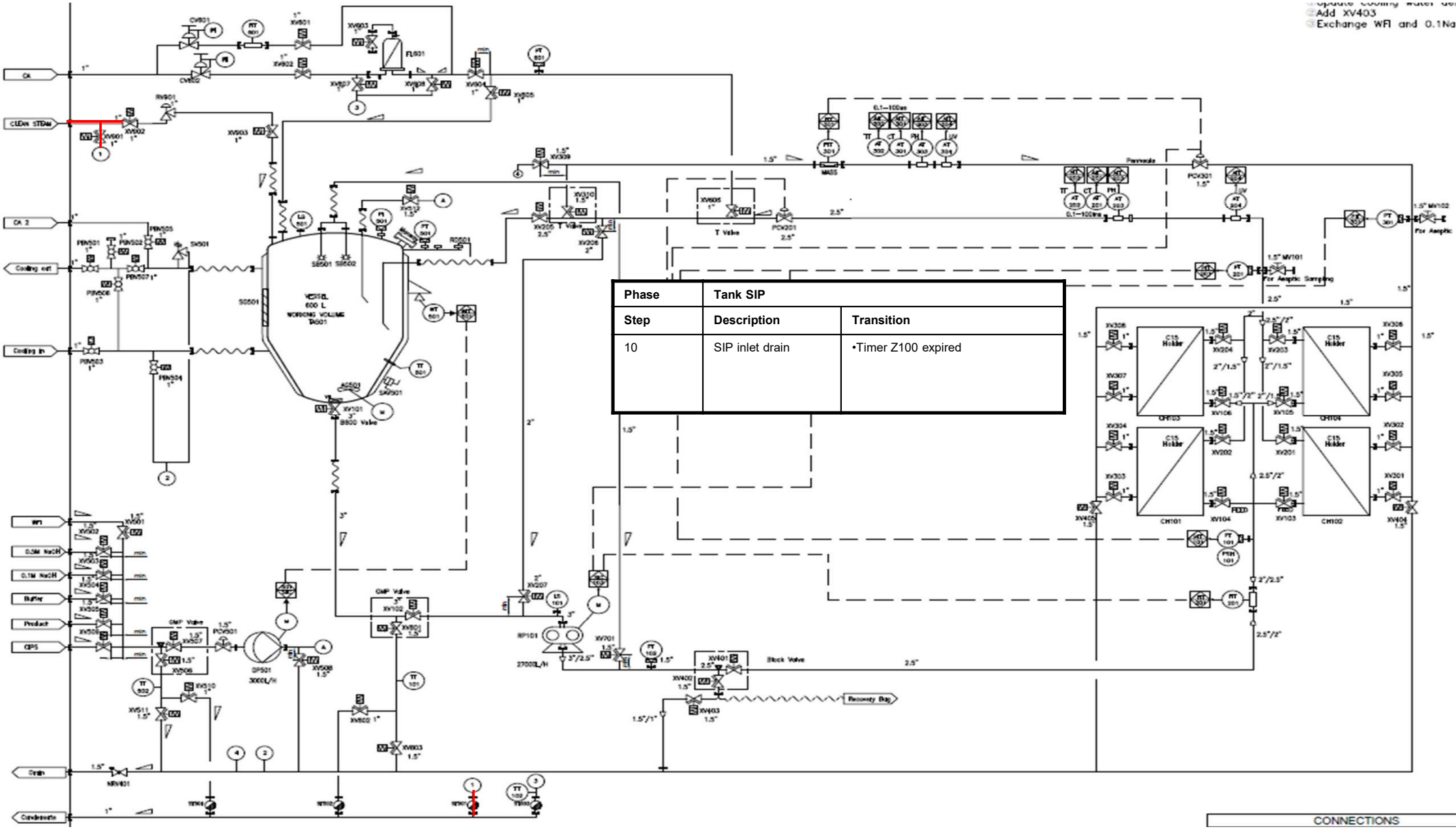
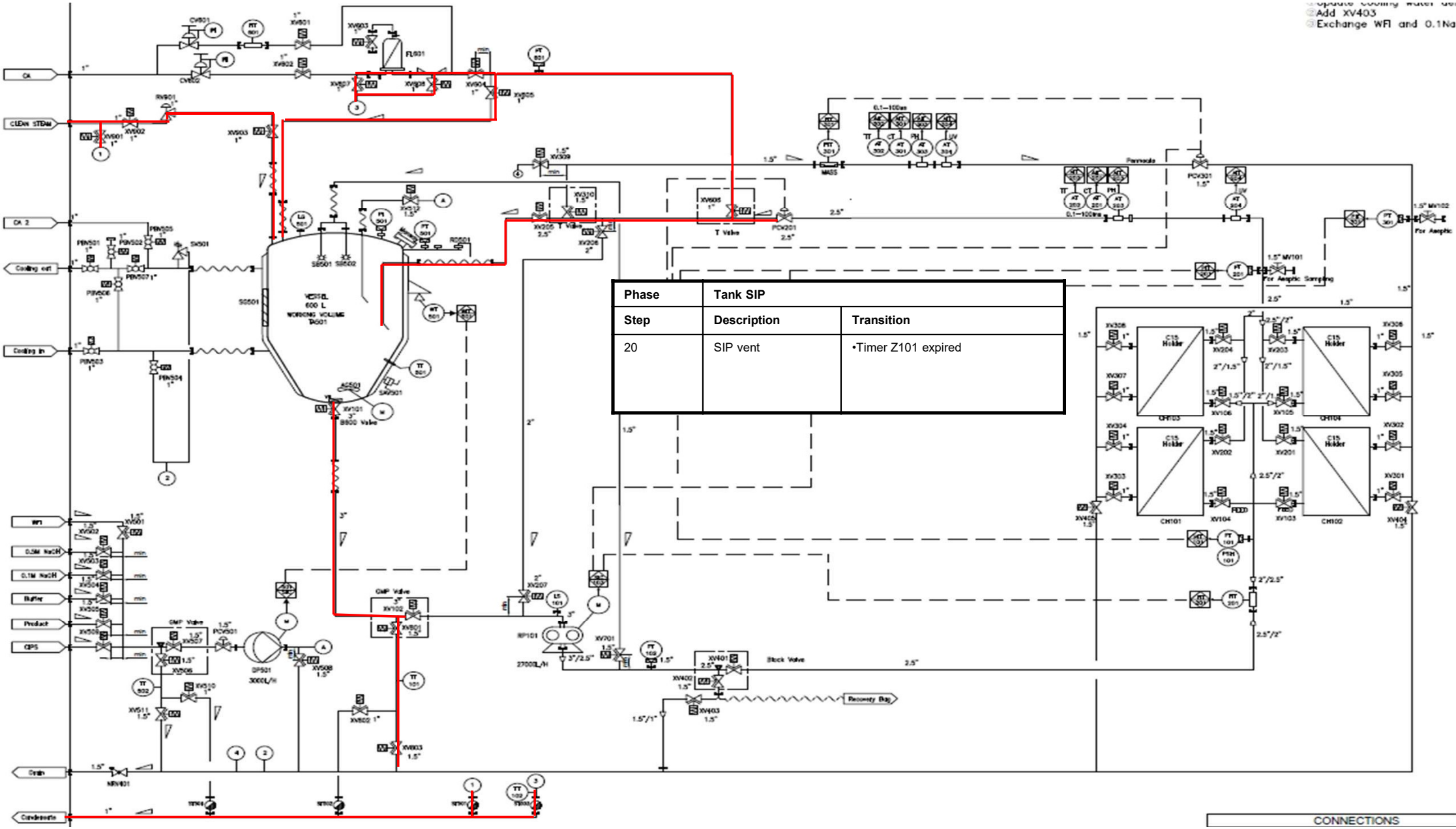
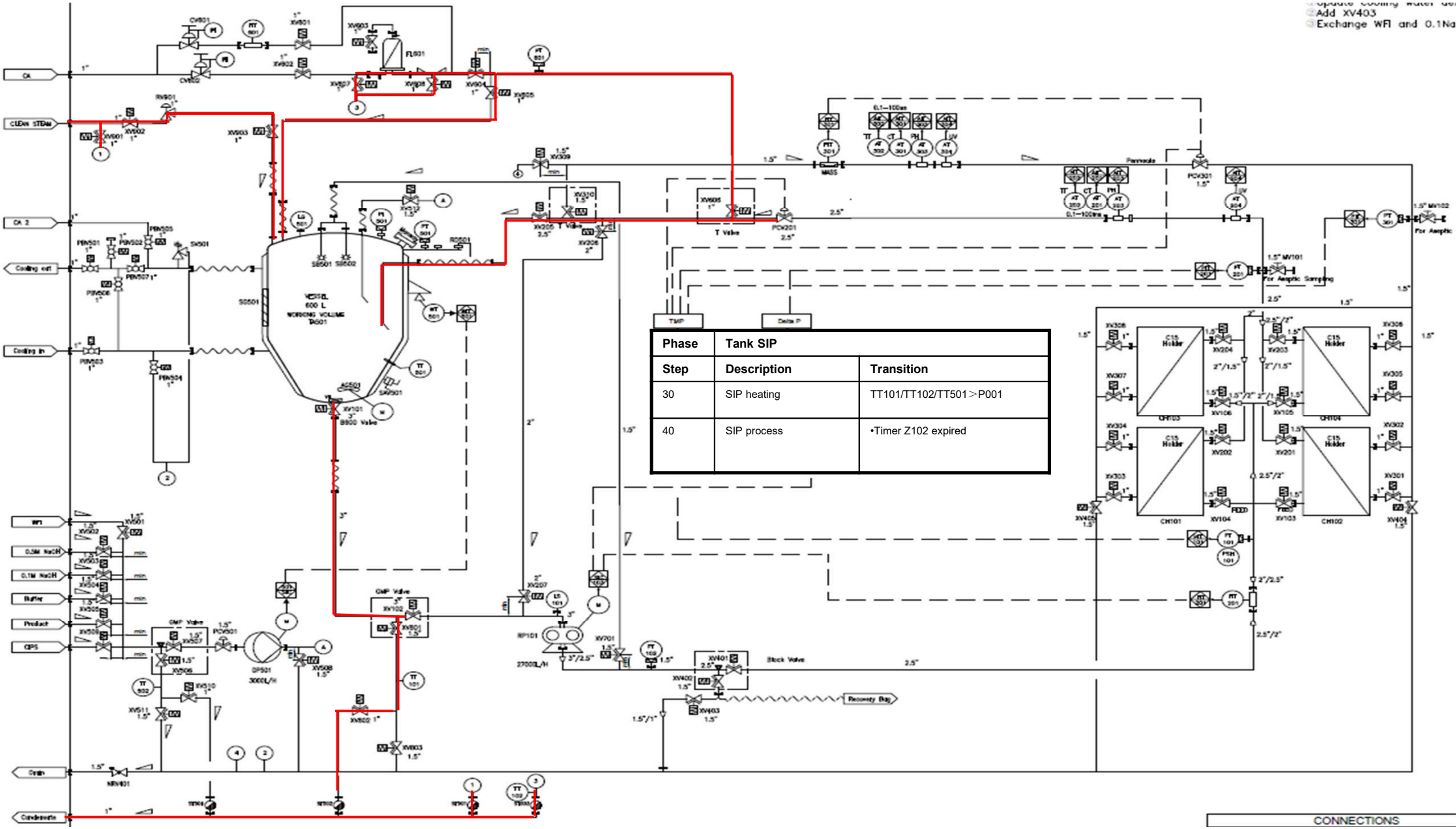


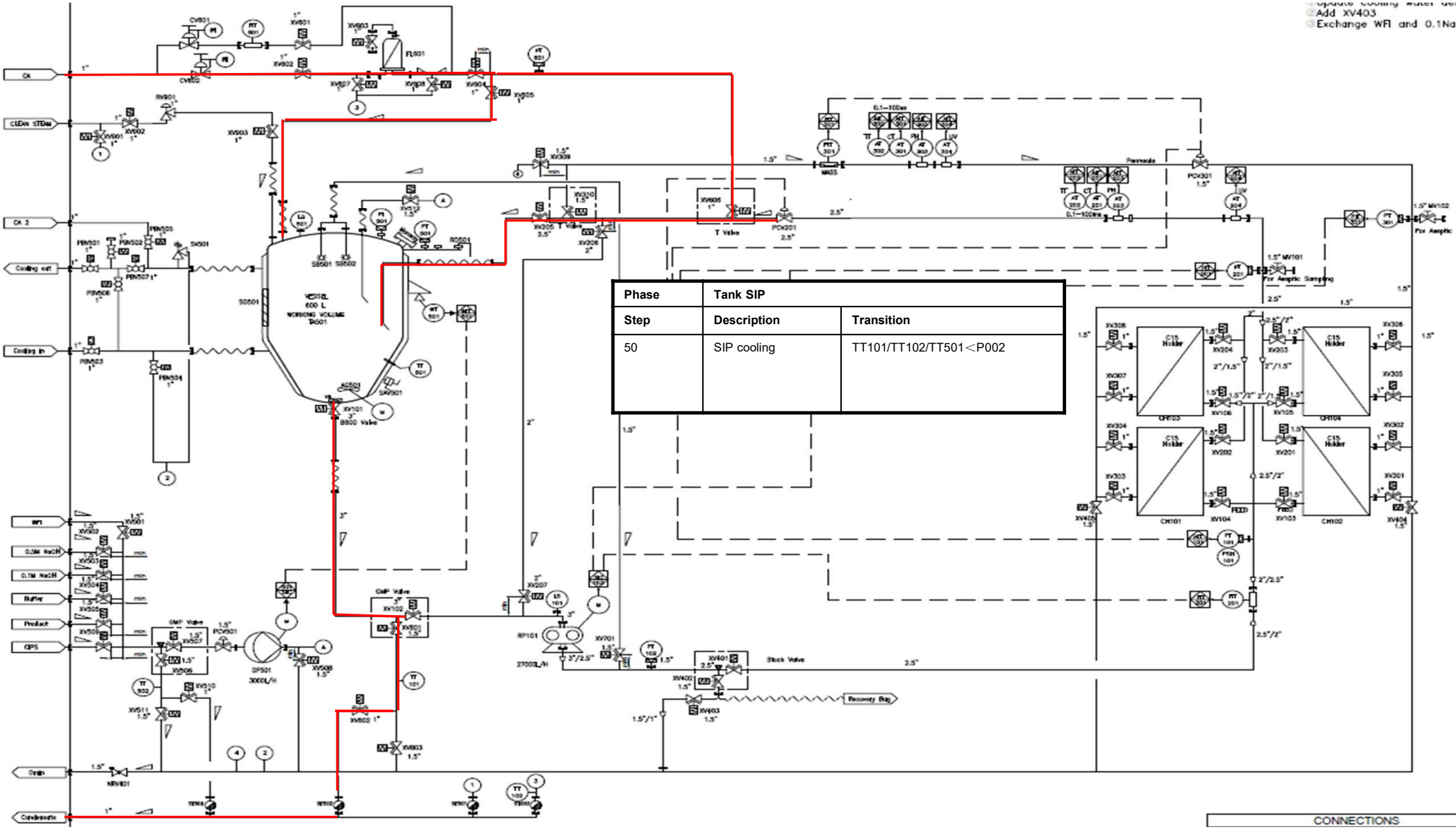
Phase	Tank SIP	
Step	**Description**	**Transition**
10	SIP inlet drain	•Timer Z100 expired



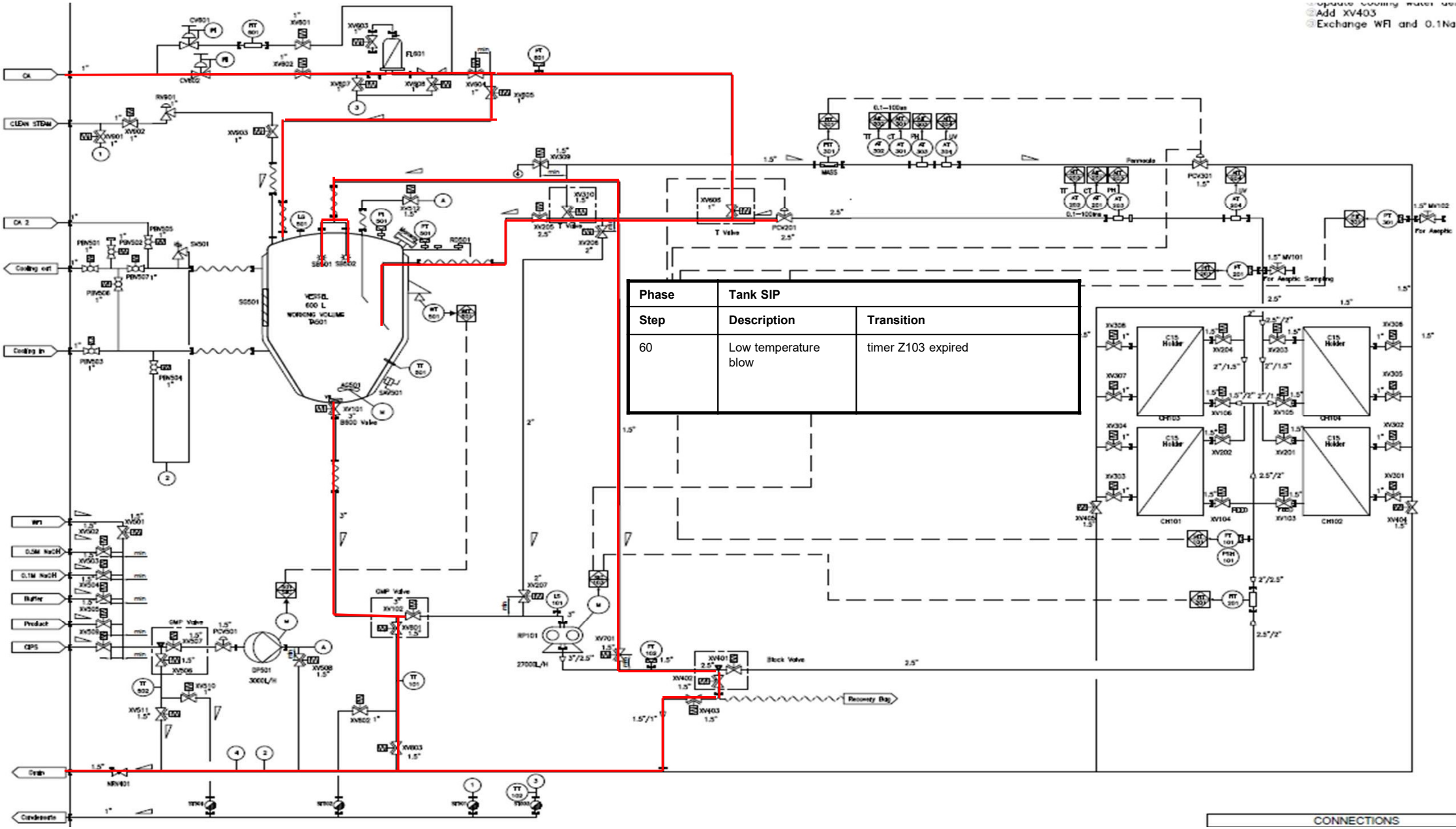
Phase	Tank SIP	
Step	**Description**	**Transition**
20	SIP vent	•Timer Z101 expired



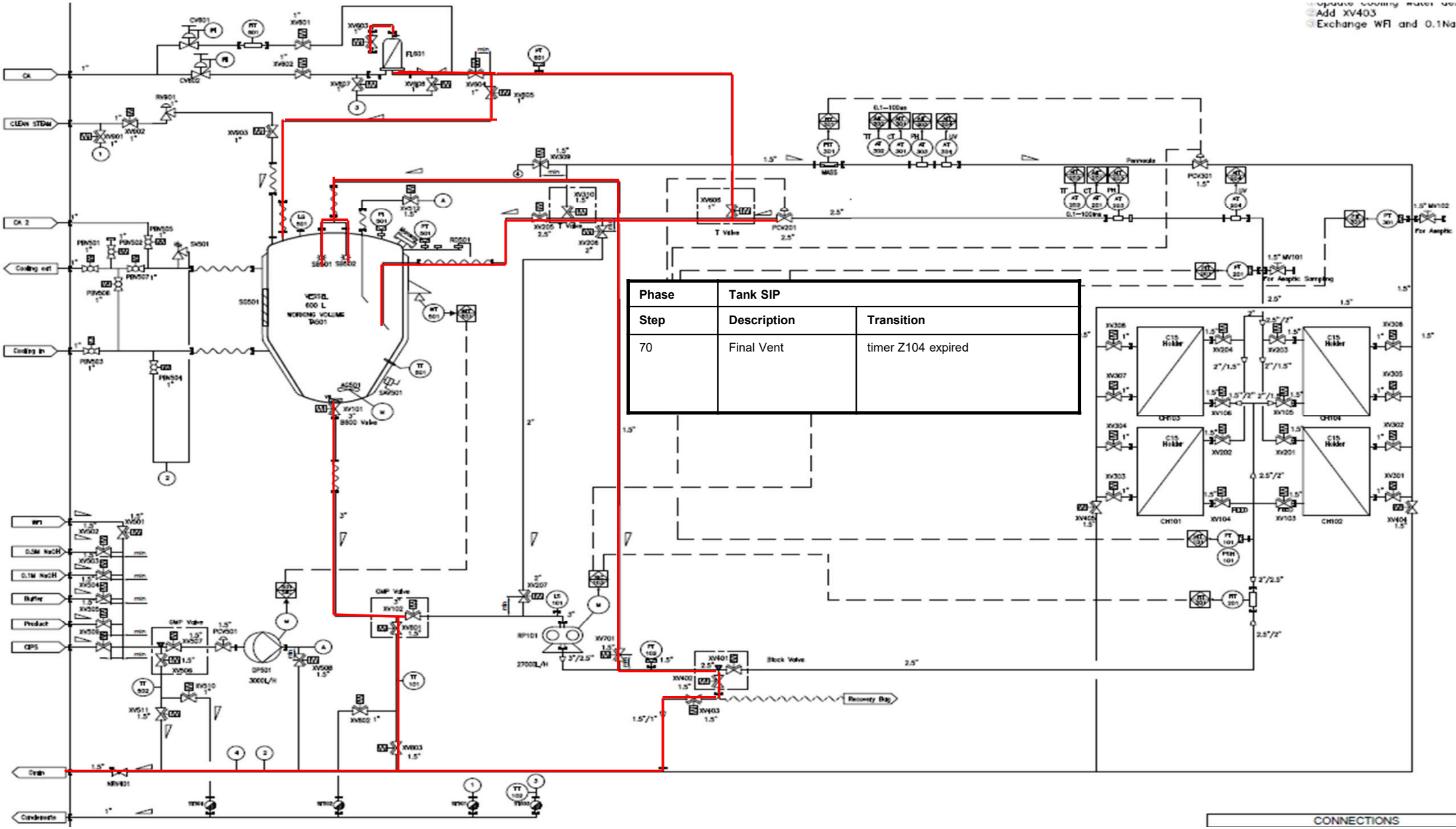
Phase	Tank SIP	
Step	**Description**	**Transition**
30	SIP heating	TT101/TT102/TT501＞P001
40	SIP process	•Timer Z102 expired



Phase	Tank SIP	
Step	**Description**	**Transition**
50	SIP cooling	TT101/TT102/TT501＜P002



Phase	Tank SIP	
Step	**Description**	**Transition**
60	Low temperature blow	timer Z103 expired



Phase	Tank SIP	
Step	**Description**	**Transition**
70	Final Vent	timer Z104 expired