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CONTENTS

I. General Description 5
II. Important Monitoring Items 6
1. Controllers' Description 6
2. Instruments' Description 6
1) 102TK01 Inventory Indicators 6
(1) 102LI001: 102TK01 Level Indicator 6
(2) 102LI001A: 102TK01 Volume Indicator 6
(3) 102FI080A: 102TK01 Volume Change Rate Indicator 6
(4) 102TK01 Timer 7
2) 202TK01 Inventory Indicators 7
(1) 202LI001: 202TK01 Level Indicator 7
(2) 202LI001A: 202TK01 Volume Indicator 7
(3) 202FI080A: 202TK01 Volume Change Rate Indicator 7
(4) 202TK01 Timer 7
3) 102LI001B: 102TK01 and 202TK01 Total Volume 7
4) 103TK11A Inventory Indicators 7
(1) 103LI003: 103TK11A Level Indicator 7
(2) 103LI003A: 103TK11A Volume Indicator 7
(3) 103FI093A: 103TK11A Volume Change Rate Indicator 8
(4) 103TK11A Timer 8
5) 103TK11B Inventory Indicators 8
(1) 103LI001: 103TK11B Level Indicator 8
(2) 103LI001A: 103TK11B Volume Indicator 8
(3) 103FI093B: 103TK11B Volume Change Rate Indicator 8
(4) 103TK11B Timer 8
6) 103LI001B: 103TK11A and 103TK11B Total Volume 8
7) 104TK05 Inventory Indicators 8
(1) 104LI005: 104TK05 Level Indicator 8
(2) 104LI005A: 104TK05 Volume Indicator 9
(3) 104FI010: 104TK05 Volume Change Rate Indicator 9
(4) 104TK05 Timer 9
8) 105TK05 Inventory Indicators 9
(1) 105LIC003: 105TK05 Level Indicator 9
(2) 105LIC003A: 105TK05 Volume Indicator 9
(3) 105FI046: 105TK05 Volume Change Rate Indicator 9
(4) 105TK05 Timer 9
9) 106TK01 Inventory Indicators 9
(1) 106LI001: 106TK01 Level Indicator 9
(2) 106LI001A: 106TK01 Volume Indicator 10
(3) 106FI055: 106TK01 Volume Change Rate Indicator 10
(4) 106TK01 Timer 10
10) 106TK14 Inventory Indicators 10
(1) 106LIC020: 106TK14 Level Indicator 10
(2) 106LI020A: 106TK14 Volume Indicator 10
(3) 106FI058: 106TK14 Volume Change Rate Indicator 10
(4) 106TK14 Timer 10
11) 131TK01 Inventory Indicators 10
(1) 131LI001: 131TK01 Level Indicator 10
(2) 131LI001A: 131TK01 Volume Indicator 11
(3) 131FI091: 131TK01 Volume Change Rate Indicator 11
(4) 131TK01 Timer 11
12) 131PD01 Inventory Indicators 11
(1) 131LI002: 131PD01 Level Indicator 11
(2) 131LI002A: 131PD01 Volume Indicator 11

(3) 131FI092: 131PD01 Volume Change Rate Indicator 11
(4) 131PD01 Timer 11
13) 416TK01 Inventory Indicators 11
(1) 416LI001: 416TK01 Level Indicator 11
(2) 416LI001A: 416TK01 Volume Indicator 12
(3) 416FI010: 416TK01 Volume Rate Change Indicator 12
(4) 416TK01 Timer 12
14) 416TK02 Inventory Indicators 12
(1) 416LI002: 416TK02 Level Indicator 12
(2) 416LI002A: 416TK02 Volume Indicator 12
(3) 416FI020: 416TK02 Volume Change Rate Indicator 12
(4) 416TK02 Timer 12
15) 416TK03 Inventory Indicators 12
(1) 416LI003: 416TK03 Level Indicator 12
(2) 416LI003A: 416TK03 Volume Indicator 12
(3) 416FI030: 416TK03 Volume Change Rate Indicator 13
(4) 416TK03 Timer 13
16) 422TK01 Inventory Indicators 13
(1) 422LI004: 422TK01 Level Indicator 13
(2) 422LI004A: 422TK01 Volume Indicator 13
(3) 422FI010: 422TK01 Volume Change Rate Indicator 13
(4) 422TK01 Timer 13
17) 111TK02 Inventory Indicators 13
(1) 111LI001: 111TK02 Level Indicator 13
(2) 111LI001A: 111TK02 Volume Indicator 13
(3) 111FI001: 111TK02 Volume Change Rate Indicator 14
(4) 111TK02 Timer 14
18) T-203 Inventory Indicators 14
(1) 112LI001: T-203 Level Indicator 14
(2) 112LI001A: T-203 Volume Indicator 14
(3) 112FI001A: T-203 Volume Change Rate Indicator 14
(4) T-203 Timer 14
19) 112TK01 Inventory Indicators 14
(1) 112LIC011: 112TK01 Level Indicator 14
(2) 112LIC011A: 112TK01 Volume Indicator 14
(3) 112FITBD: 112TK01 Volume Change Rate Indicator 14
(4) 112TK01 Timer 15
20) 114TK02 Inventory Indicators 15
(1) 114LI002: 114TK02 Level Indicator 15
(2) 114LI002A: 114TK02 Volume Indicator 15
(3) 114FI011: 114TK02 Volume Change Rate Indicator 15
(4) 114TK02 Timer 15
21) 115TK02 Inventory Indicators 15
(1) 115LI002: 115TK02 Level Indicator 15
(2) 115LI002A: 115TK02 Volume Indicator 15
(3) 115FI007: 115TK02 Volume Change Rate Indicator 15
(4) 115TK02 Timer 16
22) 106TK20 Inventory Indicators 16
(1) 106LI421: 106TK20 Level Indicator 16
(2) 106LI421A: 106TK20 Volume Indicator 16
(3) 106FI499: 106TK20 Volume Change Rate Indicator 16
(4) 106TK20 Timer 16
23) 513PD01AB Inventory Indicators 16
(1) 513LIC003: 513PD01AB Level Indicator 16
(2) 513LI003A: 513PD01AB Volume Indicator 16

(3) 513FI010: 513PD01AB Volume Change Rate Indicator 16
(4) 513PD01AB Timer 17
24) 513TK01 Inventory Indicators 17
(1) 513LIC001: 513TK01 Level Indicator 17
(2) 513LI001A: 513TK01 Volume Indicator 17
(3) 513FI020: 513TK01 Volume Change Indicator 17
(4) 513TK01 Timer 17
25) 701TK01 Inventory Indicators 17
(1) 701LI110: 701TK01 Level Indicator 17
(2) 701LI110A: 701TK01 Volume Indicator 17
(3) 701FI110A: 701TK01 Volume Change Rate Indicator 17
(4) 701TK01 Timer 18
3. Motors 18
4. Actuated Valves 18
5. Switches 18
III. Interlocks/Controls 18
IV. Control Sequences 18
V. Alarms 18
VI. DCS Emergency Shutdown 18
VII. Trend Graphs Grouping 18
Annex 1: WATER BALANCE (SURGE TANK INVENTORY) DCS Graphics 19

I. General Description

This graphics contains the inventory of the process slurry, pregnant and diluted solution, and process chemicals such as Sulfuric Acid, Methanol, Limestone, Slaked Lime, Flocculant and Caustic Soda. Inventory of all water supplies such as Supernatant and Clarified, Filtered and Demineralized Water are also views in this graphic.

This graphics shows the 100% volume capacity of the each tank which are reflected on the tank graphics. Additionally, the actual volume of solution/slurry and the rate of volume change for each of the storage tanks are indicated in this DCS screen. These indicators are calculated with the following general equations:

$$V\ [m^3] = L\ [\%] \times K\ [m^3/\%] \qquad \text{Equation (1)}$$

$$\text{Rate V change } [m^3/h] = \frac{\{L(T).PV - L(0)\}\ [\%]}{T\ [min]} \times 60\ (min/h) \times K\ [m^3/\%] \qquad \text{Equation (2)}$$

where:
- V = actual volume of solution/slurry inside the storage tank, [m^3]
- L = level of tank as measured by level transmitter, [%]
- K = volume factor of the tank , [m^3/%]
- Rate V change = rate change of volume per unit time or tank flowrate, [m^3/h]
- L(T).PV = actual level measurement at any time T, [%]
- L(0) = level measurement at time 0, [%]
- T = timer set point (operator input required), [min]

The timer set point for rate V change calculation has 60 level data points which has an interval of 1 minute as shown by database below. The timer set point, as manually entered by the DCS operator provides the basis of the level comparison data points. The level comparison will be every 1 minute therefore the flowrate indication is refreshed every 1 minute.

Table 1-1: Database for Rate V Change Calculation

Time, min	Volume, m^3	Calculation Basis, Level %
T0	V0	L0 (Current Level PV, %)
T1	V1	L1
T2	V2	L2
:	:	:
T60	V60	L60

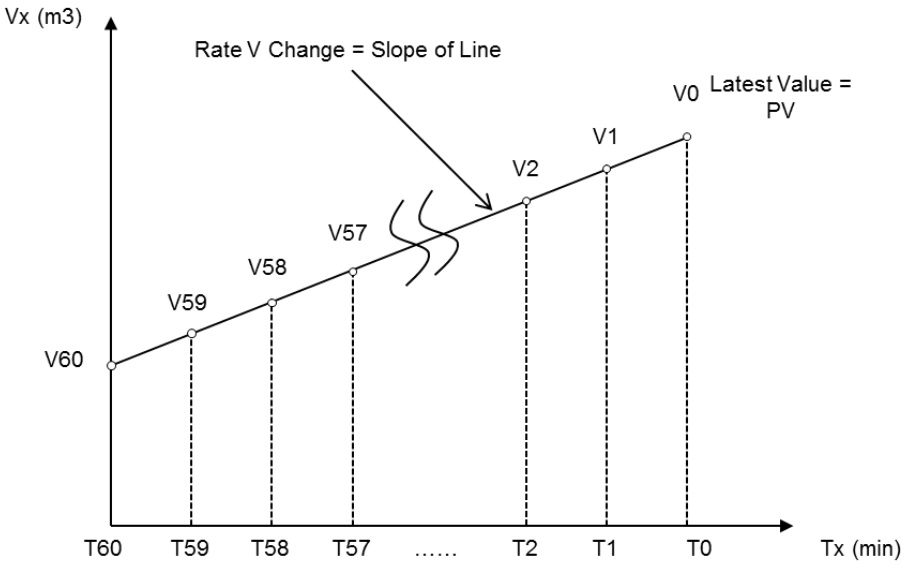


Figure 1-1: Representation of Database for Calculation of Rate V Change

The refresh rate of data is every minute thus whenever the TIMER setpoint for calculation is changed, it will also take one minute for the DCS to give the exact value of rate V change.

II. Important Monitoring Items

1. Controllers' Description

None

2. Instruments' Description

1) 102TK01 Inventory Indicators

(1) 102LI001: 102TK01 Level Indicator

This level indicator monitors the level of ore slurry stored in 102TK01.
(Operating Range: LL = 37.70%, H = 97.38 %, HH = 98.43%)

(2) 102LI001A: 102TK01 Volume Indicator

This volume indicator monitors the actual volume ore slurry stored in 102TK01. The volume factor K1 (C1 in DCS Calculation) is 37.36 m^3/%.
(Operating Range: 0 – 3736 m^3)

(3) 102FI080A: 102TK01 Volume Change Rate Indicator

This indicator monitors the rate of volume change of ore slurry stored in 102TK01.

(4) 102TK01 Timer

The 102TK01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

2) 202TK01 Inventory Indicators

(1) 202LI001: 202TK01 Level Indicator

This level indicator monitors the level of ore slurry stored in 202TK01.
(Operating Range: LL = 37.70%, H = 97.38 %, HH = 98.43%)

(2) 202LI001A: 202TK01 Volume Indicator

This volume indicator monitors the actual volume ore slurry stored in 202TK01. The volume factor K1 (C1 in DCS Calculation) is 37.36 m^3/%.
(Operating Range: 0 – 3736 m^3)

(3) 202FI080A: 202TK01 Volume Change Rate Indicator

This indicator monitors the rate of volume change of ore slurry stored in 202TK01.

(4) 202TK01 Timer

The 202TK01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

3) 102LI001B: 102TK01 and 202TK01 Total Volume

This indicator is a totalizer of the individual volume of 102TK01 and 202TK01.
V [m^3]= 102LI001A + 202LI001A [m^3]

4) 103TK11A Inventory Indicators

(1) 103LI003: 103TK11A Level Indicator

This level indicator monitors the level of pregnant solution stored in 103TK11A.
(Operating Range: LL = 8.78%, L = 10.48%, H = 95.47%, HH = 96.60%)

(2) 103LI003A: 103TK11A Volume Indicator

This volume indicator monitors the actual volume pregnant solution stored in 103TK11A. The volume factor K7 (C7 in DCS Calculation) is 74.744 m^3/%.
(Operating Range: 0 – 7537 m^3)

(3) 103FI093A: 103TK11A Volume Change Rate Indicator

This monitors the rate of volume change of pregnant solution stored in 103TK11A.

(4) 103TK11A Timer

The 103TK11A Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

5) 103TK11B Inventory Indicators

(1) 103LI001: 103TK11B Level Indicator

This level indicator monitors the level of pregnant solution stored in 103TK11B.
(Operating Range: LL = 8.78%, L = 10.48%, H = 95.47%, HH = 96.60%)

(2) 103LI001A: 103TK11B Volume Indicator

This volume indicator monitors the actual volume pregnant solution stored in 103TK11B. The volume factor K10 (C10 in DCS Calculation) is 74.744 m^3/%.
(Operating Range: 0 – 7537 m^3)

(3) 103FI093B: 103TK11B Volume Change Rate Indicator

This indicator monitors the rate of volume change of pregnant solution stored in 103TK11B.

(4) 103TK11B Timer

The 103TK11B Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

6) 103LI001B: 103TK11A and 103TK11B Total Volume

This indicator is a totalizer of the individual volume of 103TK01 and 202TK01.
V [m^3] = 103LI003A + 103LI001A [m^3]

7) 104TK05 Inventory Indicators

(1) 104LI005: 104TK05 Level Indicator

This level indicator monitors the level of pregnant solution stored in 104TK05.
(Operating Range: LL = 15.53%, L = 19.25%, H = 83.85%, HH = 86.34%)

(2) 104LI005A: 104TK05 Volume Indicator

This volume indicator monitors the actual volume pregnant solution stored in 104TK05. The volume factor K13 (C13 in DCS Calculation) is 64.461 m^3/%.
(Operating Range: 0 – 6566 m^3)

(3) 104FI010: 104TK05 Volume Change Rate Indicator

This monitors the rate of volume change of pregnant solution stored in 104TK05.

(4) 104TK05 Timer

The 104TK05 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

8) 105TK05 Inventory Indicators

(1) 105LIC003: 105TK05 Level Indicator

This level indicator monitors the level of zinc free solution stored in 105TK05.
(Operating Range: LL = 12.19%, L = 15.24%, L1 = 16.0%, L0 = 66.50%, H0 = 70.31%, H1 = 91.43%, H = 92.19%, HH = 95.24%)

(2) 105LIC003A: 105TK05 Volume Indicator

This volume indicator monitors the actual volume zinc free solution stored in 105TK05. The volume factor K16 (C16 in DCS Calculation) is 18.899 m^3/%.
(Operating Range: 0 – 2044 m^3)

(3) 105FI046: 105TK05 Volume Change Rate Indicator

This indicator monitors the rate of volume change of zinc free solution stored in 105TK05.

(4) 105TK05 Timer

The 105TK05 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

9) 106TK01 Inventory Indicators

(1) 106LI001: 106TK01 Level Indicator

This level indicator monitors the level of MS feed stored in 106TK01.
(Operating Range: LL = 10.15%, L = 13.27%, H = 92.12%, 95.24%)

(2) 106LI001A: 106TK01 Volume Indicator

This volume indicator monitors the actual volume MS feed stored in 106TK01. The volume factor K19 (C19 in DCS Calculation) is 18.446 m^3/%.
(Operating Range: 0 – 1972 m^3)

(3) 106FI055: 106TK01 Volume Change Rate Indicator

This indicator monitors the rate of volume change of MS feed stored in 106TK01.

(4) 106TK01 Timer

The 106TK01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

10) 106TK14 Inventory Indicators

(1) 106LIC020: 106TK14 Level Indicator

This level indicator monitors the level of barren liquor stored in 106TK14.
(Operating Range: LL = 25.15%, L = 28.92%, L0 = 30.18%, H0 = 86.77%, H = 88.03%, HH = 91.80%)

(2) 106LI020A: 106TK14 Volume Indicator

This volume indicator monitors the actual volume barren liquor stored in 106TK14. The volume factor K22 (C22 in DCS Calculation) is 18.931 m^3/%.
(Operating Range: 0 – 2118 m^3)

(3) 106FI058: 106TK14 Volume Change Rate Indicator

This indicator monitors the rate of volume change of barren liquor stored in 106TK14.

(4) 106TK14 Timer

The 106TK14 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

11) 131TK01 Inventory Indicators

(1) 131LI001: 131TK01 Level Indicator

This level indicator monitors the level of diluted solution stored in 131TK01.
(Operating Range: LL = 7.44%, L = 9.67%, H = 93.75%, HH = 95.24%)

(2) 131LI001A: 131TK01 Volume Indicator

This volume indicator monitors the actual volume diluted solution stored in 131TK01. The volume factor K40 (C40 in DCS Calculation) is 72.020 m^3/%.
(Operating Range: 0 – 7609 m^3)

(3) 131FI091: 131TK01 Volume Change Rate Indicator

This indicator monitors the rate of volume change of diluted solution stored in 131TK01.

(4) 131TK01 Timer

The 131TK01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

12) 131PD01 Inventory Indicators

(1) 131LI002: 131PD01 Level Indicator

This level indicator monitors the level of diluted solution stored in 131PD01.
(Operating Range: LL = 25%, L = 30.0%)

(2) 131LI002A: 131PD01 Volume Indicator

This volume indicator monitors the actual volume diluted solution stored in 131PD01. The volume factor K43 (C43 in DCS) is 53.28 m^3/%.
(Operating Range: 0 – 5328 m^3)

(3) 131FI092: 131PD01 Volume Change Rate Indicator

This indicator monitors the rate of volume change of diluted solution stored in 131PD01.

(4) 131PD01 Timer

The 131PD01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

13) 416TK01 Inventory Indicators

(1) 416LI001: 416TK01 Level Indicator

This level indicator monitors the level of sulfuric acid stored in 416TK01.
(Operating Range: LL = 5%, L = 5%, H = 70%, HH = 80%)

(2) 416LI001A: 416TK01 Volume Indicator

This volume indicator monitors the actual volume sulfuric acid stored in 416TK01. The volume factor K46 (C46 in DCS Calculation) is 103.495 m^3/%.
(Operating Range: 0 – 11974 m^3)

(3) 416FI010: 416TK01 Volume Rate Change Indicator

This indicator monitors the rate of volume change of sulfuric acid stored in 416TK01.

(4) 416TK01 Timer

The 416TK01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

14) 416TK02 Inventory Indicators

(1) 416LI002: 416TK02 Level Indicator

This level indicator monitors the level of sulfuric acid stored in 416TK02.
(Operating Range: LL = 5%, L = 5%, H = 70%, HH = 80%)

(2) 416LI002A: 416TK02 Volume Indicator

This volume indicator monitors the actual volume sulfuric acid stored in 416TK02. The volume factor K49 (C49 in DCS Calculation) is 103.495 m^3/%.
(Operating Range: 0 – 11974 m^3)

(3) 416FI020: 416TK02 Volume Change Rate Indicator

This indicator monitors the rate of volume change of sulfuric acid stored in 416TK02.

(4) 416TK02 Timer

The 416TK02 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

15) 416TK03 Inventory Indicators

(1) 416LI003: 416TK03 Level Indicator

This level indicator monitors the level of sulfuric acid stored in 416TK03.
(Operating Range: LL = 5%, L = 5%, H = 70%, HH = 80%)

(2) 416LI003A: 416TK03 Volume Indicator

This volume indicator monitors the actual volume sulfuric acid stored in 416TK03. The volume factor K52 (C52 in DCS Calculation) is 103.495 m^3/%.

(Operating Range: 0 – 11974 m^3)

(3) 416FI030: 416TK03 Volume Change Rate Indicator

This indicator monitors the rate of volume change of sulfuric acid stored in 416TK03.

(4) 416TK03 Timer

The 416TK03 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

16) 422TK01 Inventory Indicators

(1) 422LI004: 422TK01 Level Indicator

This level indicator monitors the level of methanol stored in 422TK01.
(Operating Range: LL = 3.41%, L = 4.55%, H = 98%, HH = 99.72%)

(2) 422LI004A: 422TK01 Volume Indicator

This volume indicator monitors the actual volume methanol stored in 422TK01. The volume factor K55 (C55 in DCS in DCS Calculation) is 30.849 m^3/%.
(Operating Range: 0 – 3357 m^3)

(3) 422FI010: 422TK01 Volume Change Rate Indicator

This indicator monitors the rate of volume change of methanol stored in 422TK01.

(4) 422TK01 Timer

The 422TK01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

17) 111TK02 Inventory Indicators

(1) 111LI001: 111TK02 Level Indicator

This level indicator monitors the level of limestone slurry stored in 111TK02.
(Operating Range: LL = 19%, L = 20%, H = 88%, HH = 89%)

(2) 111LI001A: 111TK02 Volume Indicator

This volume indicator monitors the actual volume limestone slurry stored in 111TK02. The volume factor K28 (C28 in DCS Calculation) is 33.350 m^3/%.
(Operating Range: 0 – 3688 m^3)

(3) 111FI001: 111TK02 Volume Change Rate Indicator

This indicator monitors the rate of volume change of limestone slurry stored in 111TK02.

(4) 111TK02 Timer

The 111TK02 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

18) T-203 Inventory Indicators

(1) 112LI001: T-203 Level Indicator

This level indicator monitors the level of slaked lime stored in T-203.
(Operating Range: L = 22%, H = 97.6%)

(2) 112LI001A: T-203 Volume Indicator

This volume indicator monitors the actual volume slaked lime stored in T-203. The volume factor K31 (C31 in DCS Calculation) is 3.755 m^3/%.
(Operating Range: 0 – 350 m^3)

(3) 112FI001A: T-203 Volume Change Rate Indicator

This indicator monitors the rate of volume change of slaked lime stored in T-203.

(4) T-203 Timer

The T-203 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

19) 112TK01 Inventory Indicators

(1) 112LIC011: 112TK01 Level Indicator

This level indicator monitors the level of slaked lime stored in 112TK01.
(Operating Range: L = 30%, H = 80%)

(2) 112LIC011A: 112TK01 Volume Indicator

This volume indicator monitors the actual volume slaked lime stored in 112TK01. The volume factor Kxx (Cxx in DCS Calculation) is 10.00 m^3/%.
(Operating Range: 0 – 1000 m^3)

(3) 112FITBD: 112TK01 Volume Change Rate Indicator

This indicator monitors the rate of volume change of slaked lime stored in 112TK01.

(4) 112TK01 Timer

The 112TK01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

20) 114TK02 Inventory Indicators

(1) 114LI002: 114TK02 Level Indicator

This level indicator monitors the level of flocculant stored in 114TK02.
(Operating Range: LL = 5.58%, L = 7.30%, L0 = 8.15%, H0 = 81.97%, H = 82.83%, HH = 84.55%)

(2) 114LI002A: 114TK02 Volume Indicator

This volume indicator monitors the actual volume flocculant stored in 114TK02. The volume factor K34 (C34 in DCS Calculation) is 8.503 m^3/%.
(Operating Range: 0 – 861 m^3)

(3) 114FI011: 114TK02 Volume Change Rate Indicator

This indicator monitors the rate of volume change of flocculant stored in 114TK02.

(4) 114TK02 Timer

The 114TK02 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

21) 115TK02 Inventory Indicators

(1) 115LI002: 115TK02 Level Indicator

This level indicator monitors the level of caustic soda solution stored in 115TK02.
(Operating Range: LL = 7.94%, L = 14.29%, H0 = 84.13%, H = 87.30%)

(2) 115LI002A: 115TK02 Volume Indicator

This volume indicator monitors the actual volume caustic soda solution stored in 115TK02. The volume factor K37 (C37 in DCS Calculation) is 0.281 m^3/%.
(Operating Range: 0 – 29 m^3)

(3) 115FI007: 115TK02 Volume Change Rate Indicator

This indicator monitors the rate of volume change of caustic soda solution stored in 115TK02.

(4) 115TK02 Timer

The 115TK02 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

22) 106TK20 Inventory Indicators

(1) 106LI421: 106TK20 Level Indicator

This level indicator monitors the level of supernatant stored in 106TK20.
(Operating Range: LL = 6.06%, L = 9.19%, L1 = 17.55%, L0 = 38.43%, H0 = 69.77%, H1 = 90.66%, H = 91.70%, HH = 94.83%)

(2) 106LI421A: 106TK20 Volume Indicator

This volume indicator monitors the actual volume supernatant stored in 106TK20. The volume factor K25 (C25 in DCS) is 3.427 m^3/%.
(Operating Range: 0 – 375 m^3)

(3) 106FI499: 106TK20 Volume Change Rate Indicator

This indicator monitors the rate of volume change of supernatant stored in 106TK20.

(4) 106TK20 Timer

The 106TK20 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

23) 513PD01AB Inventory Indicators

(1) 513LIC003: 513PD01AB Level Indicator

This level indicator monitors the level of clarified water stored in 513PD01AB.
(Operating Range: LL = 13.51%, L = 16.67, H = 94.14%, HH = 97.30%)

(2) 513LI003A: 513PD01AB Volume Indicator

This volume indicator monitors the actual volume clarified water stored in 513PD01AB. The volume factor K58 (C58 in DCS Calculation) is 7.304 m^3/%.
(Operating Range: 0 – 895 m^3)

(3) 513FI010: 513PD01AB Volume Change Rate Indicator

This indicator monitors the rate of volume change of clarified water stored in 513PD01AB.

(4) 513PD01AB Timer

The 513PD01AB Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

24) 513TK01 Inventory Indicators

(1) 513LIC001: 513TK01 Level Indicator

This level indicator monitors the level of filtered water stored in 513TK01.
(Operating Range: LL = 8.08%, L = 10.19%, H = 97.89%, HH = 100%)

(2) 513LI001A: 513TK01 Volume Indicator

This volume indicator monitors the actual volume filtered water stored in 513TK01. The volume factor K61 (C61 in DCS Calculation) is 138.550 m^3/%.
(Operating Range: 0 – 11420 m^3)

(3) 513FI020: 513TK01 Volume Change Indicator

This indicator monitors the rate of volume change of filtered water stored in 513TK01.

(4) 513TK01 Timer

The 513TK01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

25) 701TK01 Inventory Indicators

(1) 701LI110: 701TK01 Level Indicator

This level indicator monitors the level of demineralized water stored in 701TK01.
(Operating Range: TBD %)

(2) 701LI110A: 701TK01 Volume Indicator

This volume indicator monitors the actual volume demineralized water stored in 701TK01. The volume factor K64 (C64 in DCS Calculation) is 1.100 m^3/%.
(Operating Range: 0 – 110 m^3)

(3) 701FI110A: 701TK01 Volume Change Rate Indicator

This indicator monitors the rate of volume change of demineralized water stored in 701TK01.

(4) 701TK01 Timer

The 701TK01 Timer set point is accessible by DCS operator and defines how frequent the rate of volume change data will be renewed.

3. Motors

None

4. Actuated Valves

None

5. Switches

None

III. Interlocks/Controls

None

IV. Control Sequences

None

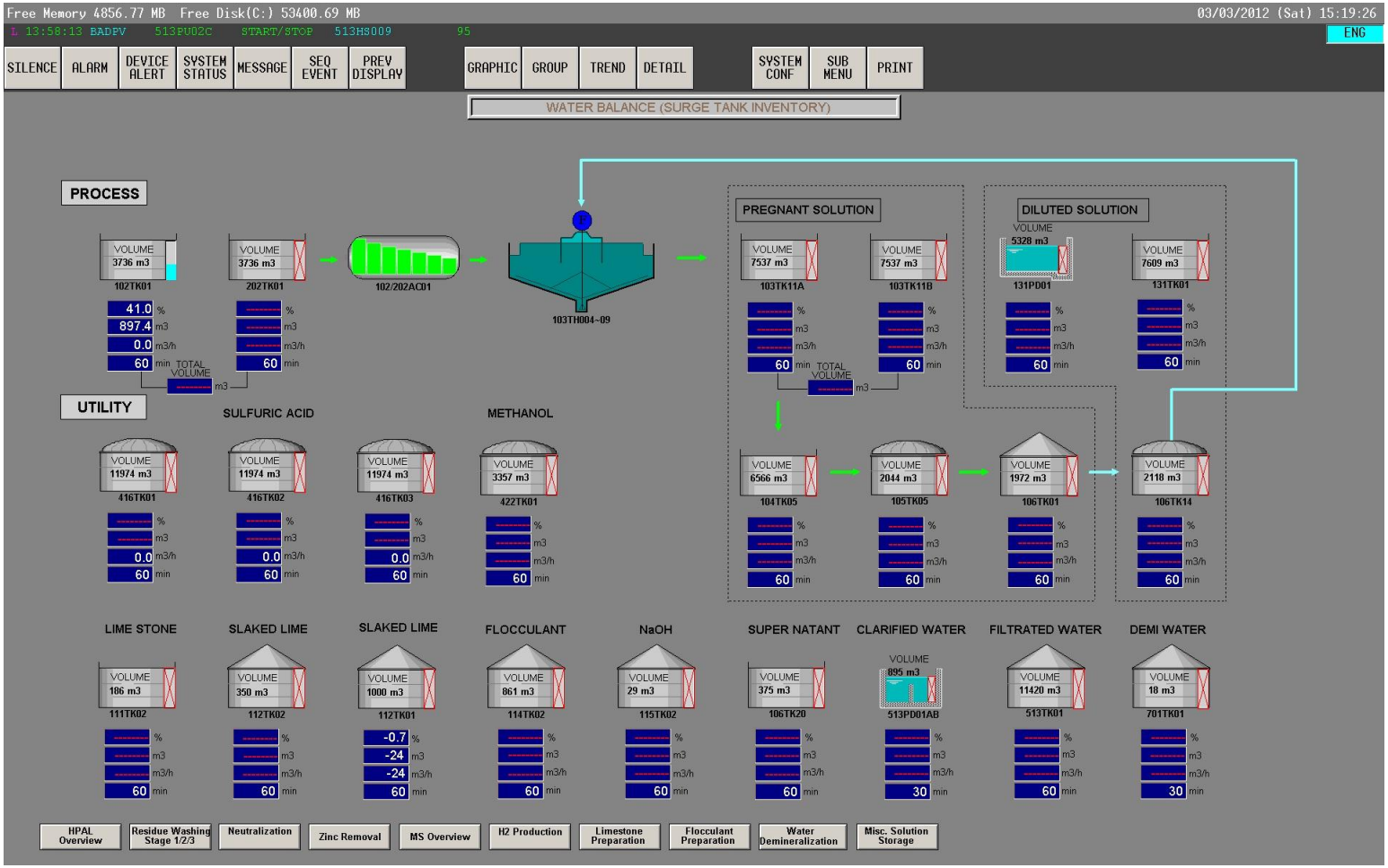
V. Alarms

None

VI. DCS Emergency Shutdown

None

VII. Trend Graphs Grouping

None

Annex 1: WATER BALANCE (SURGE TANK INVENTORY) DCS Graphics