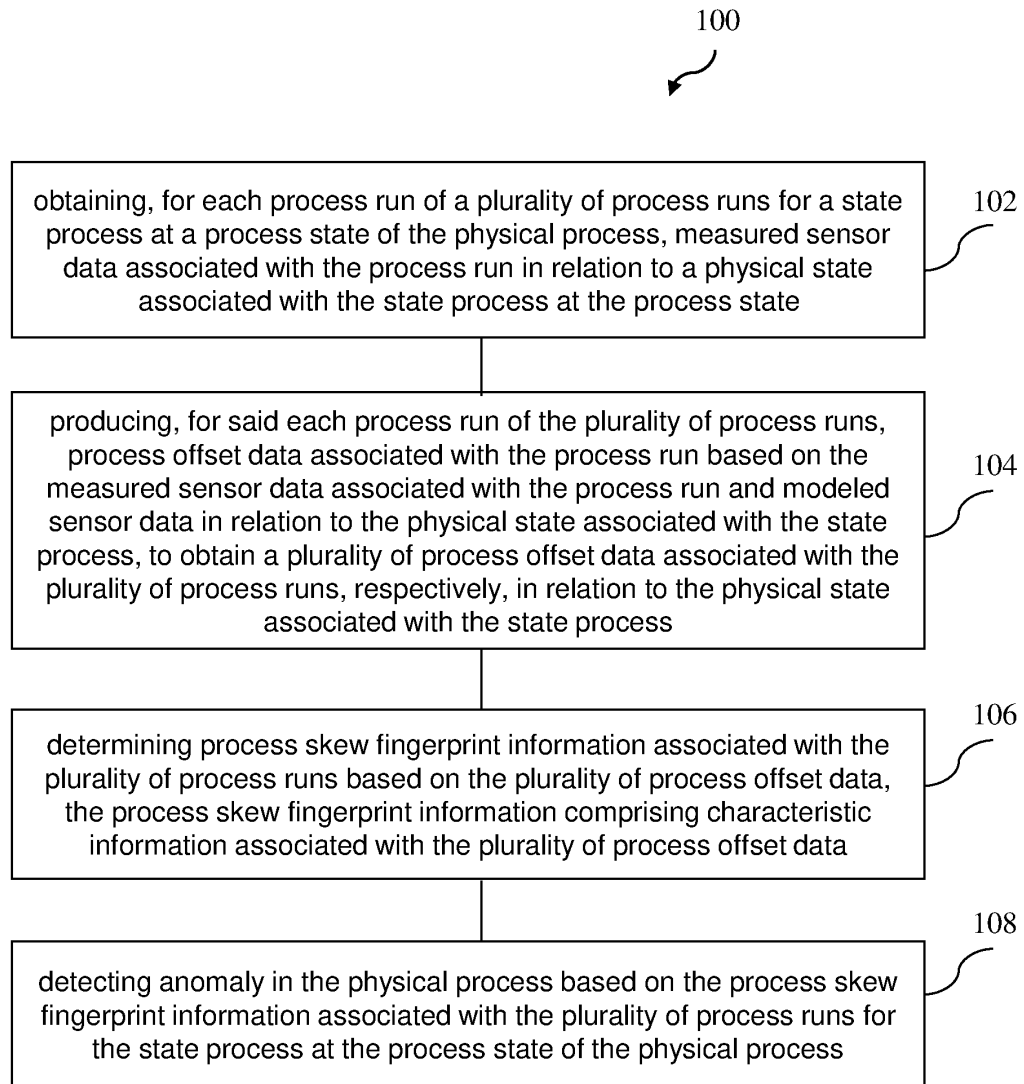


**FIG. 1**

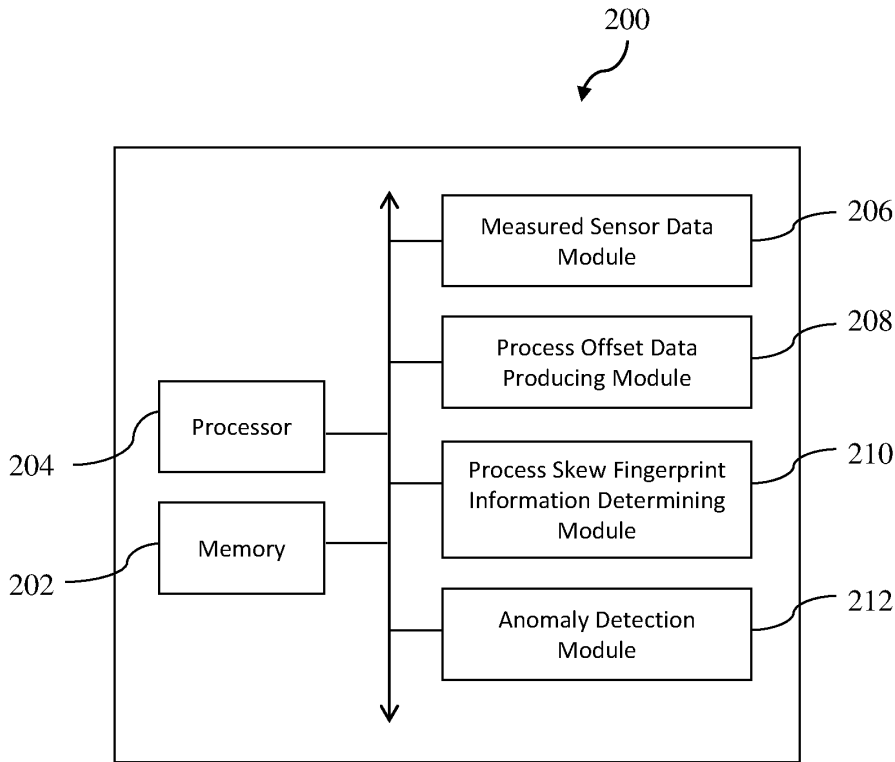


FIG. 2

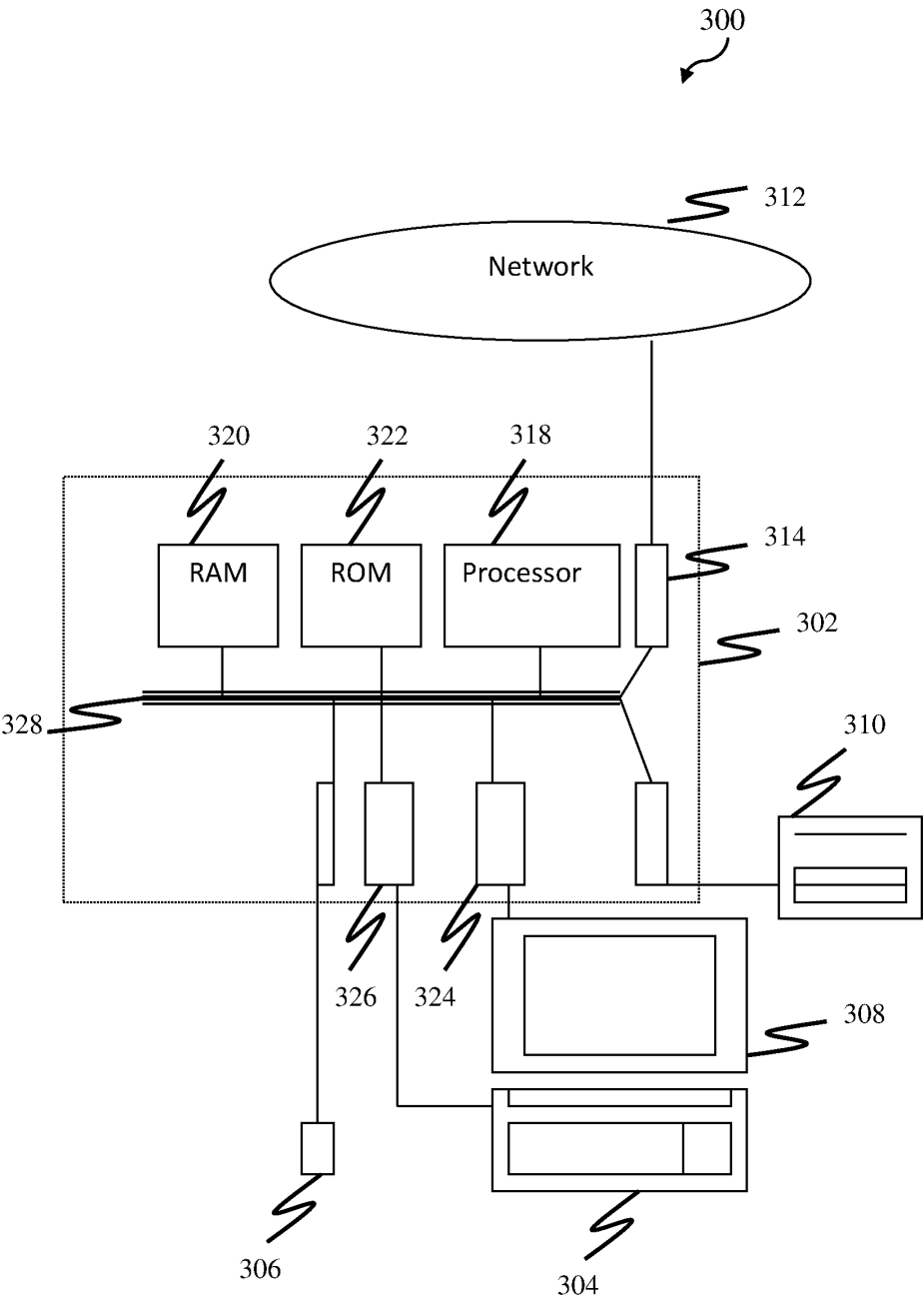


FIG. 3

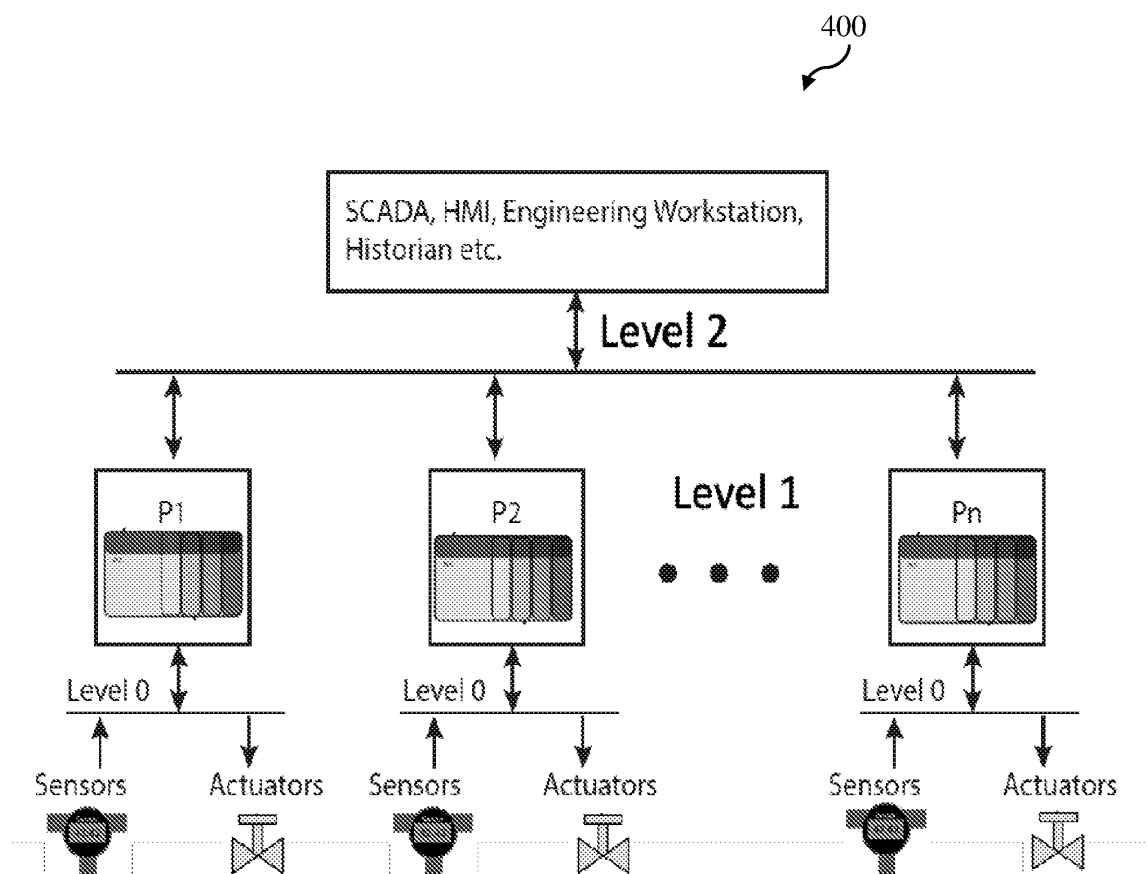


FIG. 4

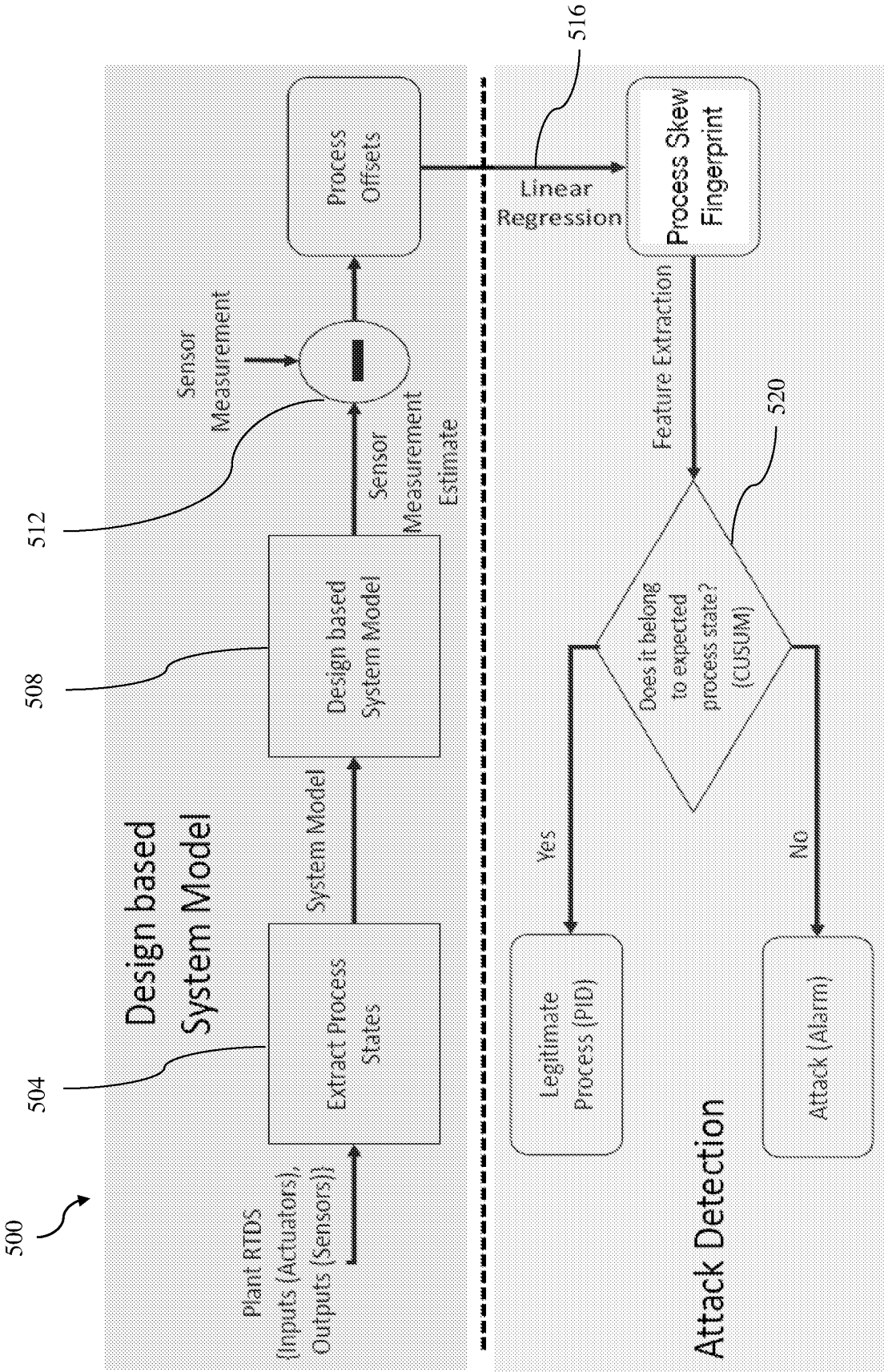


FIG. 5

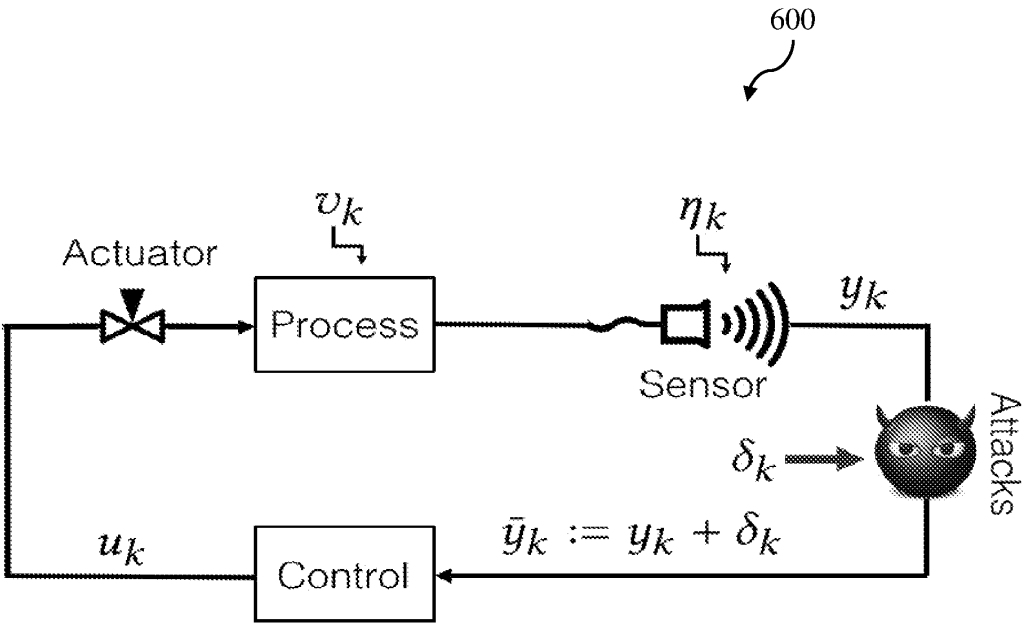


FIG. 6

Table 1 – Part 1

Attack Sequence Number	Start Time	End Time	Attack Point	Start State	Attack	Expected impact or Attacker Intent
1	28/12/2015 10:29:14	10:44:53	MV-101	MV-101 is closed	Open MV-101	Tank overflow
2	28/12/2015 10:51:08	10:58:30	P-102	P-101 is on where as P-102 is off	Turn on P-102	Pipe bursts
3	28/12/2015 11:22:00	11:28:22	LIT-101	Water level between L and H	Increase by 1 mm every second	Tank Underflow; Damage P-101
7	28/12/2015 12:08:25	12:15:33	LIT-301	Water level between L and H	Water level increased above HH	Stop of inflow; Tank underflow; Damage P-301
8	28/12/2015 13:10:10	13:26:13	DPTT-301	Value of DPTT is <40kpa	Set value of DPTT as >40kpa	Backwash process is started again and again; Normal operation stops; Decrease in water level of tank 401. Increase in water level of tank 301
10	28/12/2015 14:16:20	14:19:00	FTT-401	Value of FTT-401 above 1	Set value of FTT-401 as <0.7	UV shutdown; P-501 turns off; UV did not shutdown; P-501 did not turn off
11	28/12/2015 14:19:00	14:28:20	FTT-401	Value of FTT-401 above 1	Set value of FTT-401 as 0	UV shutdown; P-501 turns off
13	29/12/2015 11:11:25	11:15:17	MV-304	MV-304 is open	Close MV-304	Halt of stage 3 because change in the backwash process
14	29/12/2015 11:35:40	11:42:50	Mv-303	MV-303 is closed	Do not let MV-303 open	Halt of stage 3 because change in the backwash process
16	29/12/2015 11:57:25	12:02:00	LIT-301	Water level between L and H	Decrease water level by 1mm each second	Tank Overflow
17	29/12/2015 14:38:12	14:50:08	MV-303	MV-303 is Closed	Do not let MV-303 open	Halt of stage 3 because change in the backwash process
21	29/12/2015 18:30:00	18:42:00	MV-101, LIT-101	MV-101 is open; LIT-101 between L and H	Keep MV-101 on continuously; Value of LIT-101 set as 700 mm	Tank overflow

FIG. 7A

Table 1 – Part 2

22	29/12/2015 22:55:18	23:03:00	UV-401, AIT-502, P-501	UV-01 is on; AIT-502 is <150; P-501 is open	Stop UV-401; Value of AIT502 set as 150; Force P-501 to remain on	Possible damage to RO
25	30/12/2015 10:01:50	10:12:01	LIT-401, P-401	Value of LIT-401 <1000; P-402 is on	Set value of LIT-401 as 1000; P402 is kept on	Tank underflow
26	30/12/2015 17:04:56	17:29:00	P-101, LIT-301	P-101 is off; P-102 is on; LIT-301 is between L and H	P-101 is turned on continuously; Set value of LIT-301 as 801 mm	Tank 101 underflow; Tank 301 overflow
27	31/12/2015 01:17:08	01:45:18	P-302, LIT-401	P302 is on; LIT401 is between L and H	Keep P-302 on continuously; Value of LIT401 set as 600 mm till 1:26:01	Tank overflow
30	31/12/2015 15:47:40	16:07:10	LIT-101, P-101, MV-201	P-101 is off; MV-101 is off; MV-201 is off; LIT-101 is between L and H; LIT-301 is between L and H	Turn P-101 on continuously; Turn MV-101 on continuously; Set value of LIT-101 as 700 mm; P-102 started itself because LIT301 level became low	Tank 101 underflow; Tank 301 overflow
31	31/12/2015 22:05:34	22:11:40	LIT-401	Water level between L and H	Set LIT-401 to less than L	Tank overflow
32	1/01/2016 10:36:00	10:46:00	LIT-301	Water level between L and H	Set LIT-301 to above HH	Tank underflow; Damage P-302
33	1/01/2016 14:21:12	14:28:35	LIT-101	Water level between L and H	Set LIT-101 to above H	Tank underflow; Damage P-101
35	1/01/2016 17:18:56	17:26:56	P-101, P-102	P-101 is on; P-102 is off	Turn P-101 off; Keep P-102 off	Stops outflow
36	1/01/2016 22:16:01	22:25:00	LIT-101	Water level between L and H	Set LIT-101 to less than LL	Tank overflow
39	2/01/2015 11:43:48	11:50:28	FIT-401, AIT-502	In Normal Range	Set value of FIT-401 as 0.5; Set value of AIT-502 as 140 mV	UV will shut down and water will go to RO UV did not shut-down
40	2/01/2015 11:51:42	11:56:38	FIT-401	In Normal Range	Set value of FIT-401 as 0	UV will shut down and water will go to RO P-402 did not close, both should be interlinked
41	2/01/2015 13:13:02	13:40:56	LIT-301 12	Water level between L and H	decrease value by 0.5 mm per second	Tank overflow Rate of decrease in water level reduced after 1:33:25 PM

FIG. 7B

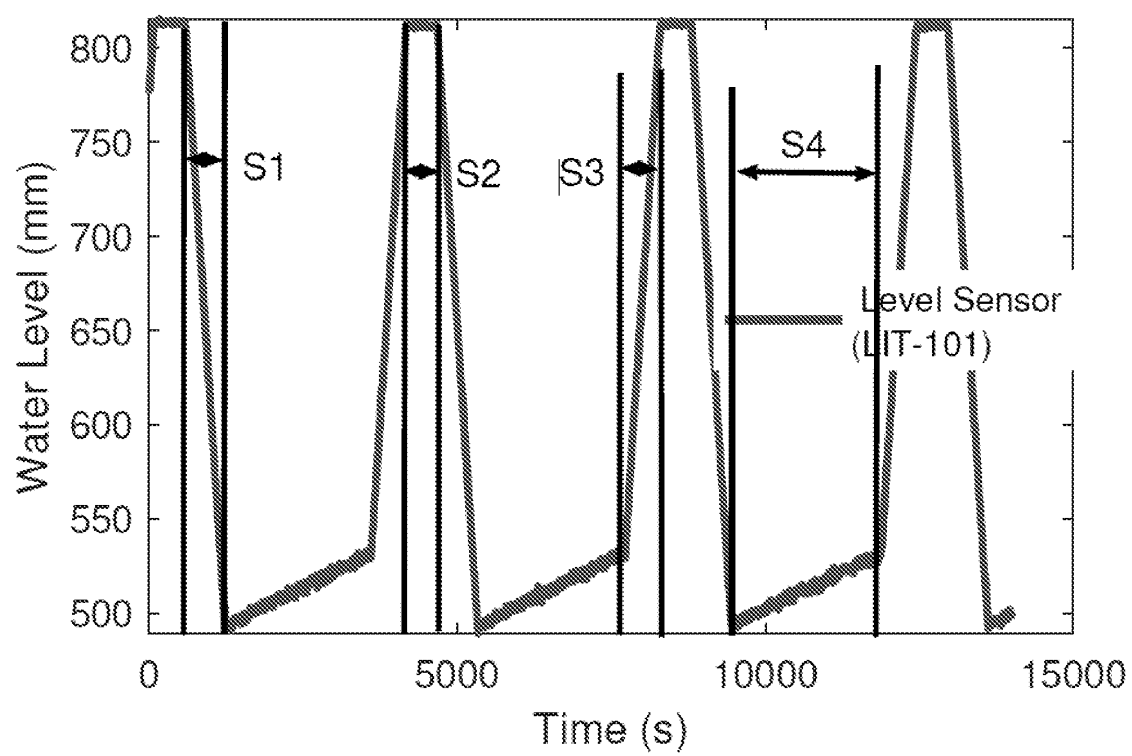
**FIG. 8**

Table 2

State (Inlet Flow Outlet Flow ¹)	Design Parameters	Process Details
S1 (0 1)	Outlet flow = $2.47m^3/hr$	In this scenario, the water is being flown out of the tank 1 i.e., emptying process.
S2 (0 0)		In this scenario, the water level stays constant, i.e., static process.
S3 (1 0)	Inlet flow = $2.54m^3/hr$	In this scenario, the water is being flown into the tank 1. i.e., filling process.
S4 (1 1)	Inlet flow = $2.54m^3/hr$ and Outlet flow = $2.47m^3/hr$	In this scenario, the water is being flown out and in of the tank 1 at the same time, i.e., both filling and emptying process.

1. If flow present it is 1 else 0.

FIG. 9

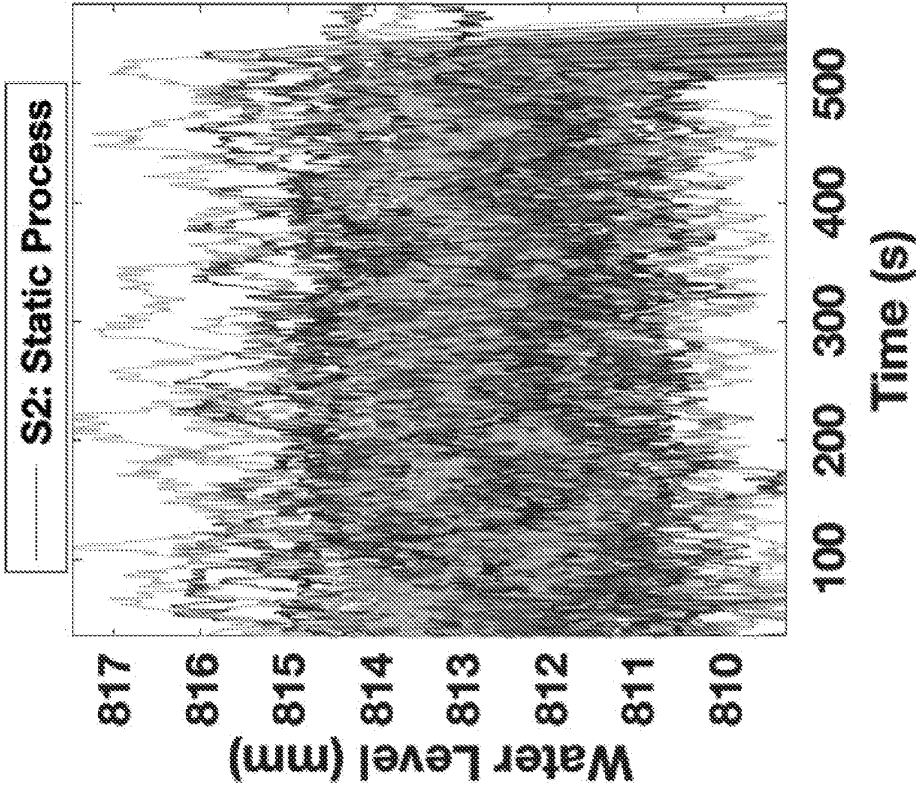


FIG. 10A

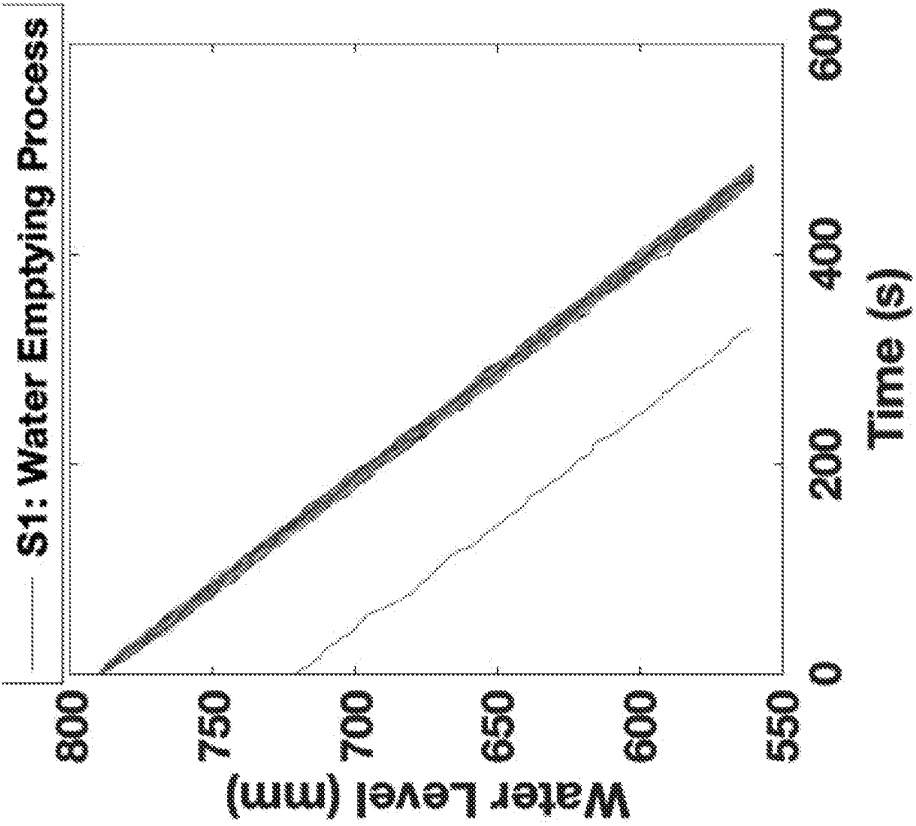


FIG. 10B

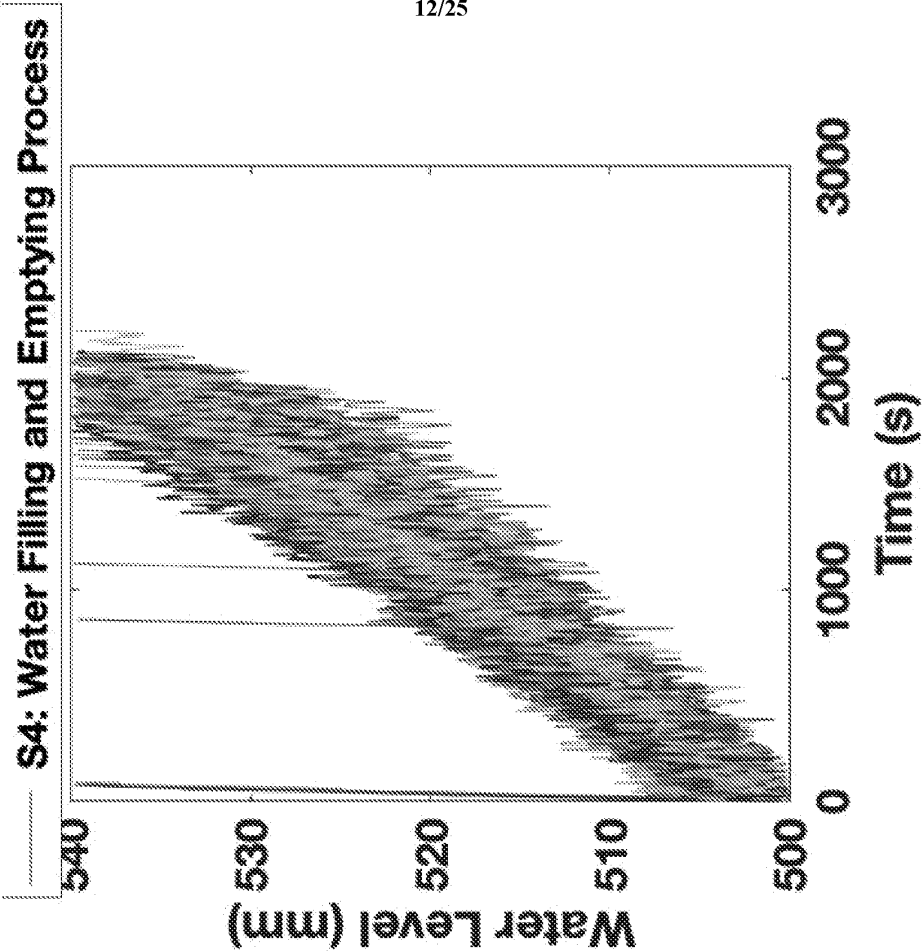


FIG. 10D

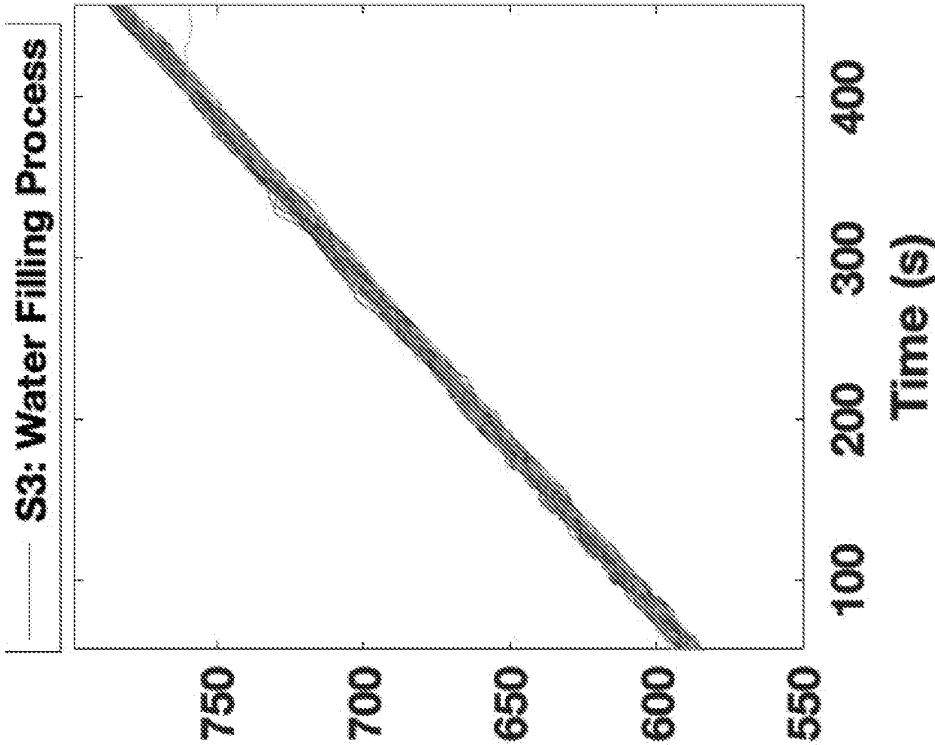


FIG. 10C

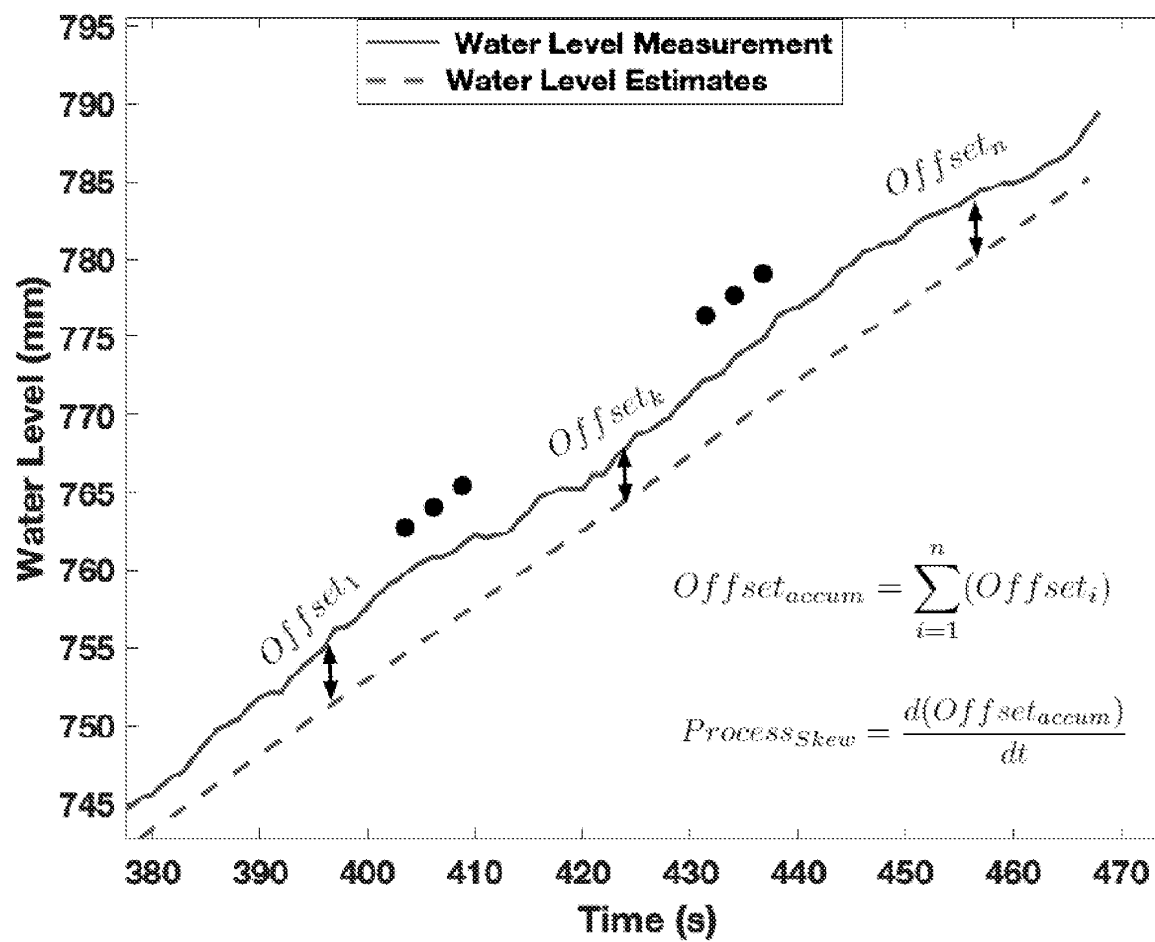


FIG. 11

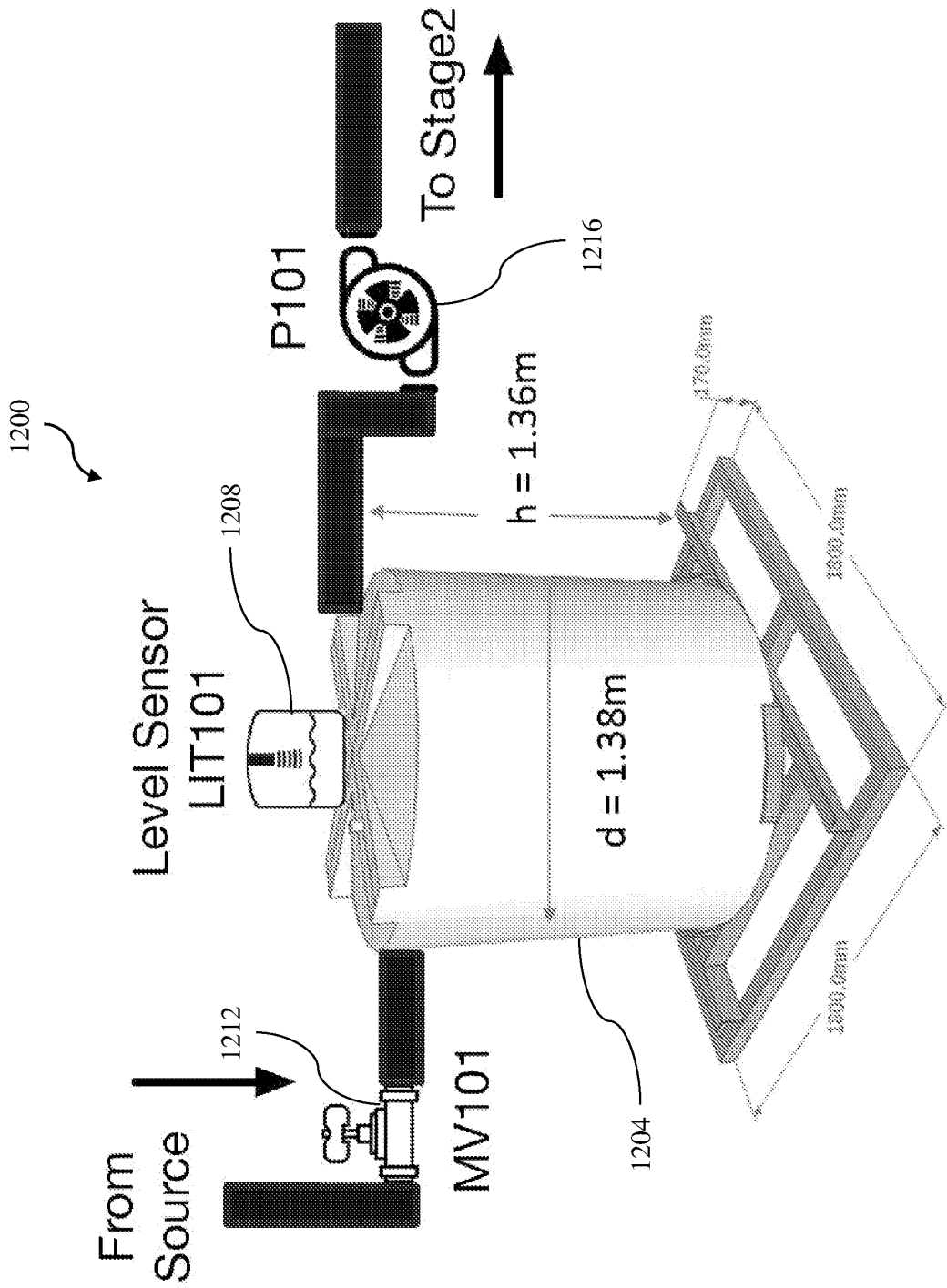


FIG. 12

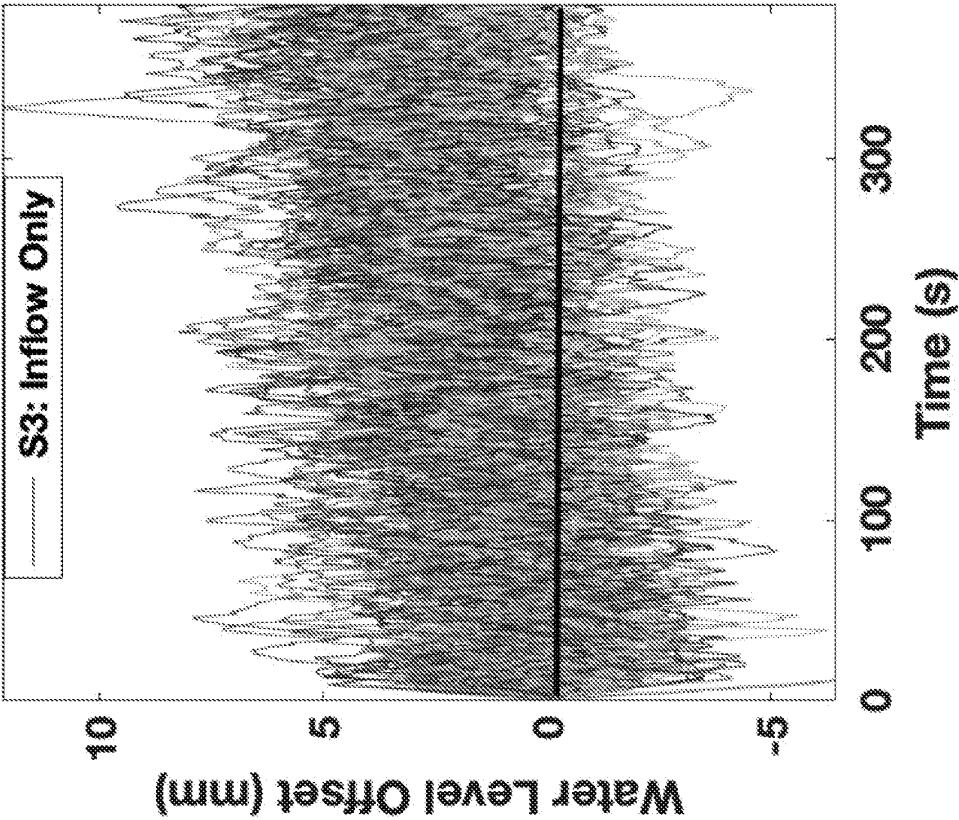


FIG. 13A

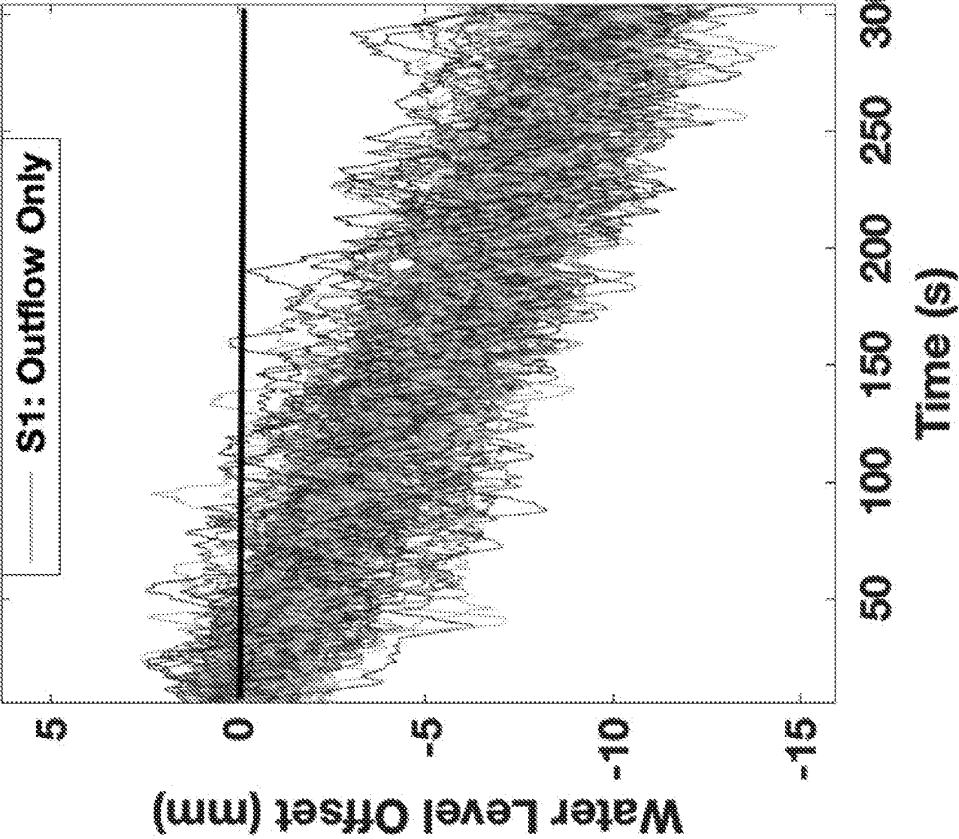


FIG. 13B

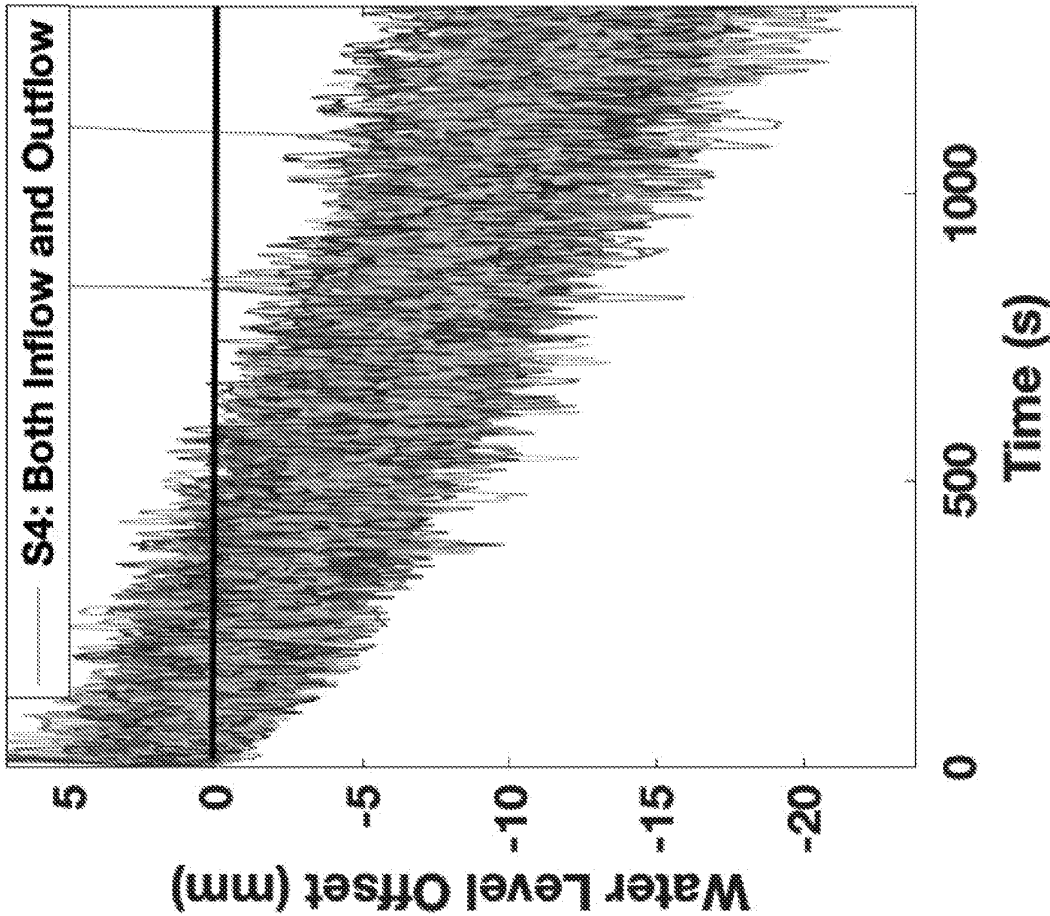
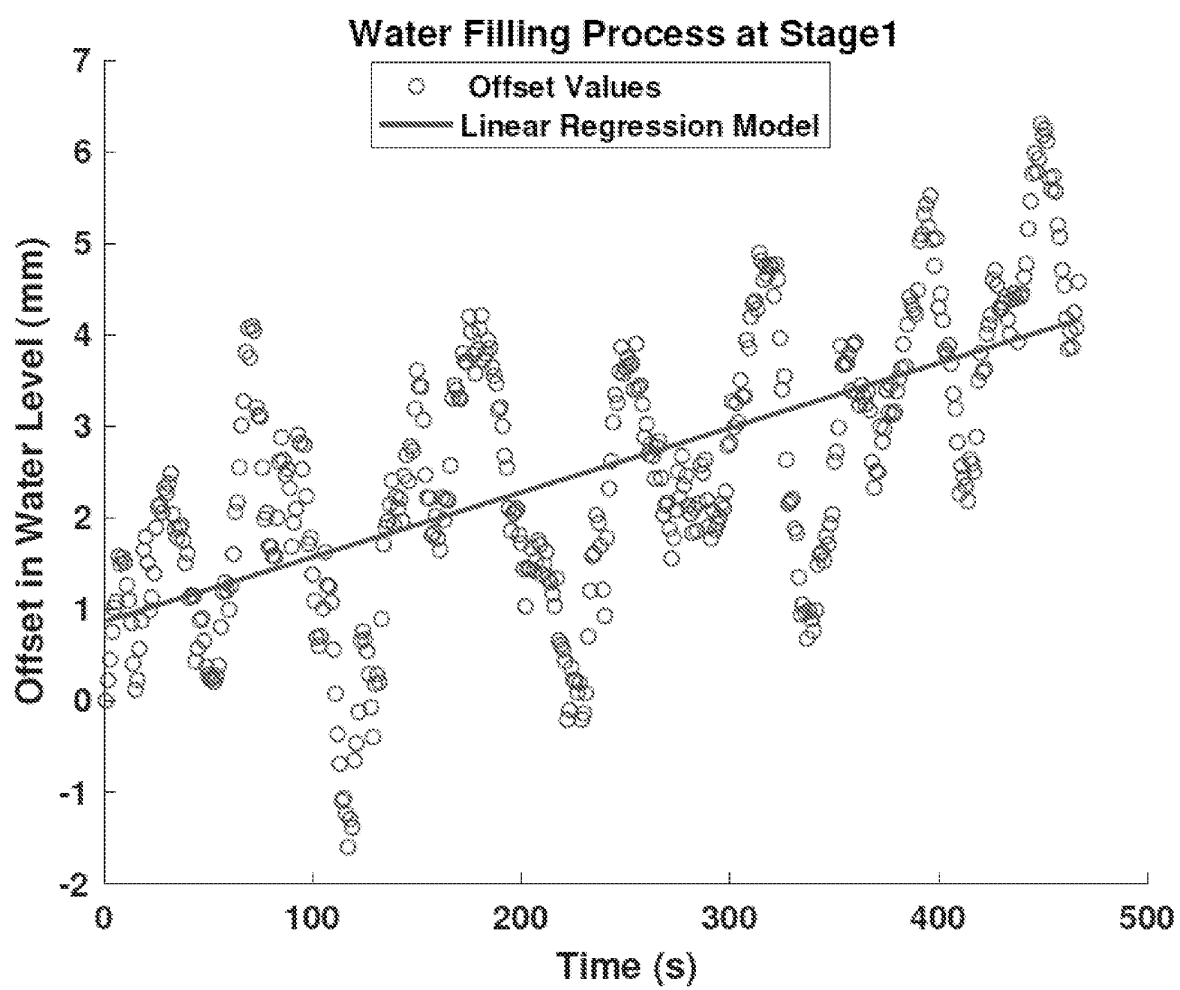


FIG. 13C

**FIG. 14**

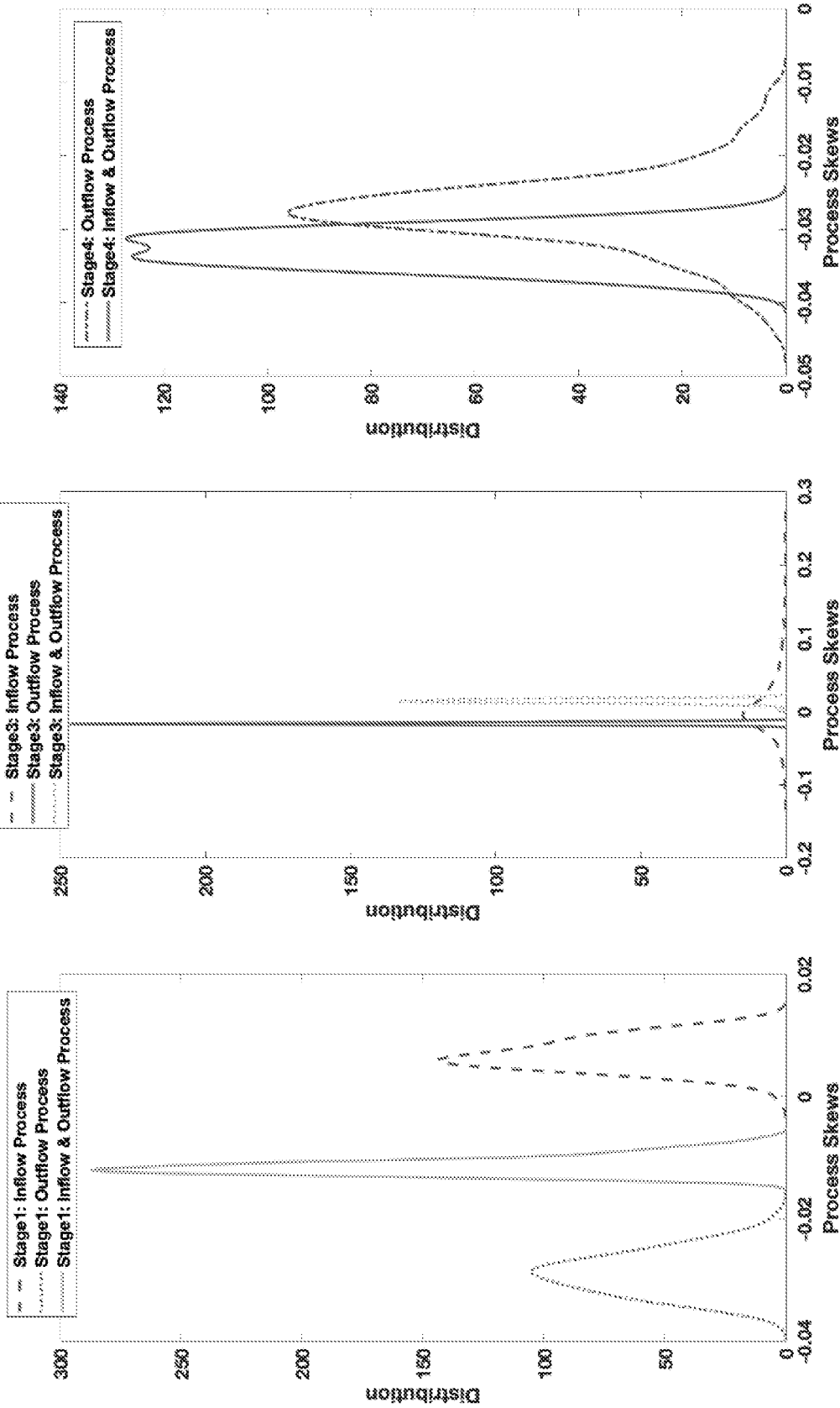


FIG. 15C

FIG. 15B

FIG. 15A

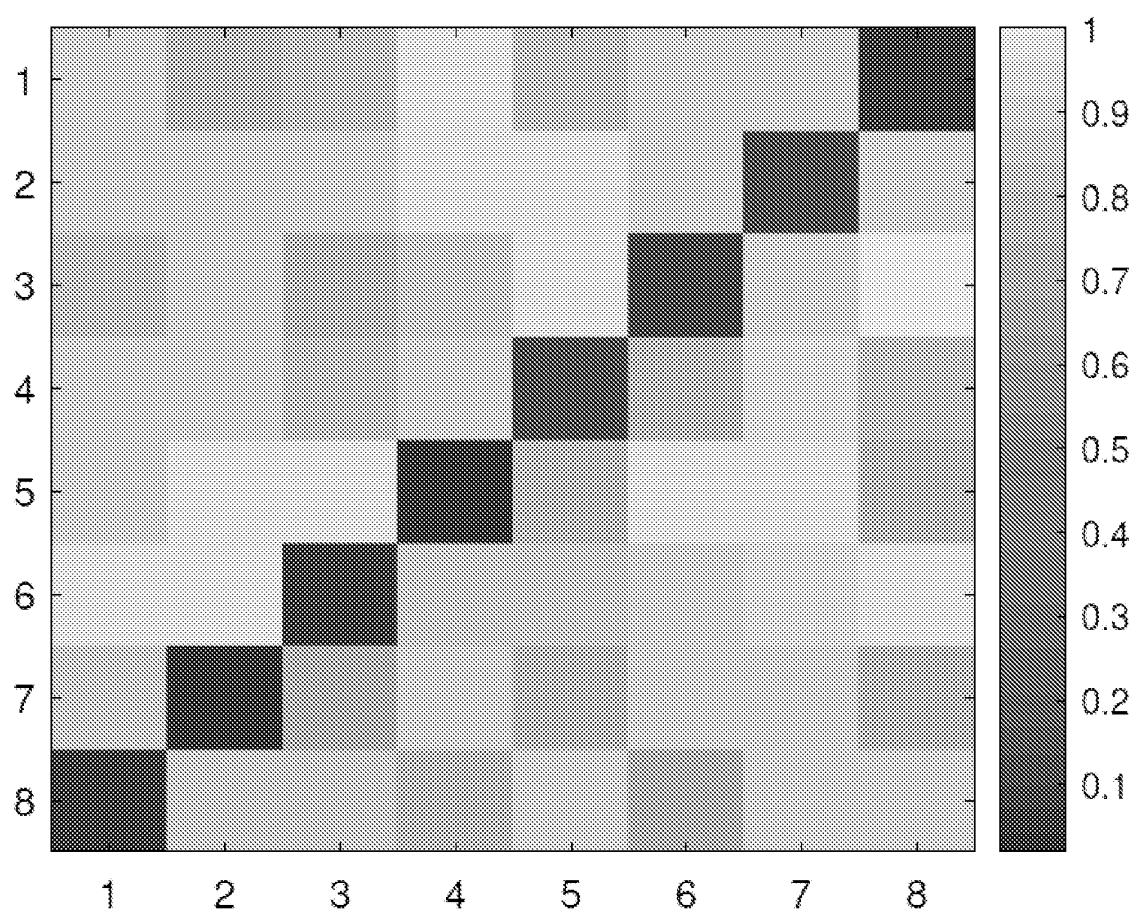


FIG. 16

Table 3

Metric	Stage 1			Stage 3			Stage 4 ²	
	IF, Only	O.F. Only	IF, and O.F. ³	IF, Only	O.F. Only	IF, and O.F.	O.F. Only	IF, and O.F.
Avg. [RMSE]	8.6e-15	2.9e-14	1.09e-13	3.33e-15	1.56e-14	6.37e-14	2.31e-14	2.05e-13
Avg. [(1 - RMSE)*100%]	100%	100%	100%	100%	100%	100%	100%	100%

2. Stage4 process outlet is always active, therefore, no IF, only case.
3. IF, stands for inflow and O.F. for outflow.

FIG. 17

Table 4

Parameters	Stage 1			Stage 3			Stage 4	
	LF. Only	OF. Only	LF. and OF.	LF. Only	OF. Only	LF. and OF.	OF. Only	LF. and OF.
κ	0.0013	0.0017	7.27e-04	0.0217	7.90e-04	0.0014	0.0027	0.0012
τ	0.0102	0.0219	0.0073	0.1083	0.0126	0.0199	0.0277	0.0148
μ	0.0070	-0.0288	-0.0113	0.0082	-0.0161	0.0146	-0.0277	-0.0327
σ	0.0026	0.0034	0.0015	0.0433	0.0016	0.0028	0.0054	0.0025
TNR	96.04%	97.46%	97.10%	96.99%	96.97%	96.38%	97.39%	95.31%
FPR	3.96%	2.54%	2.90%	3.01%	3.03%	3.62%	2.61%	4.69%

FIG. 18

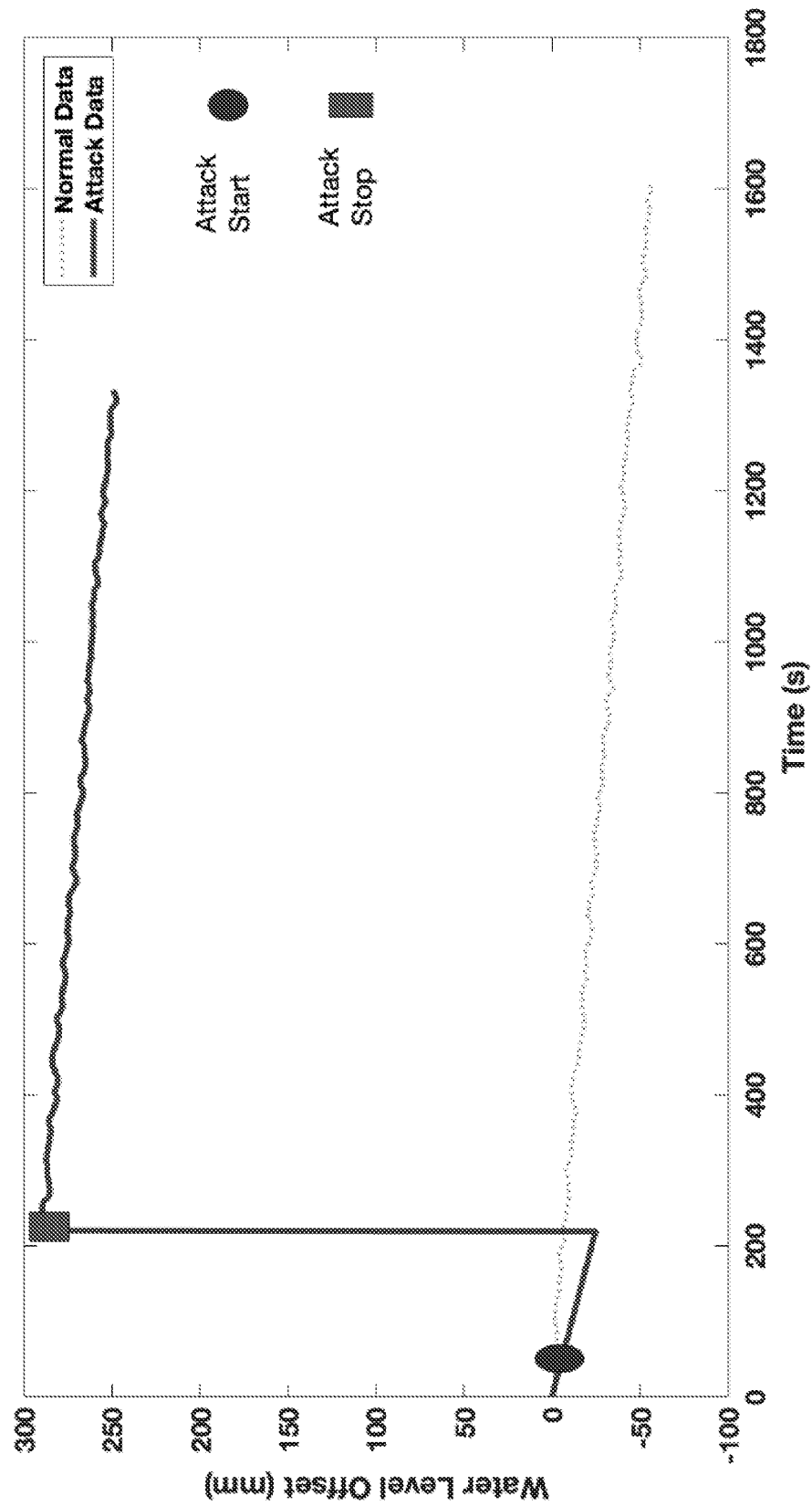


FIG. 19

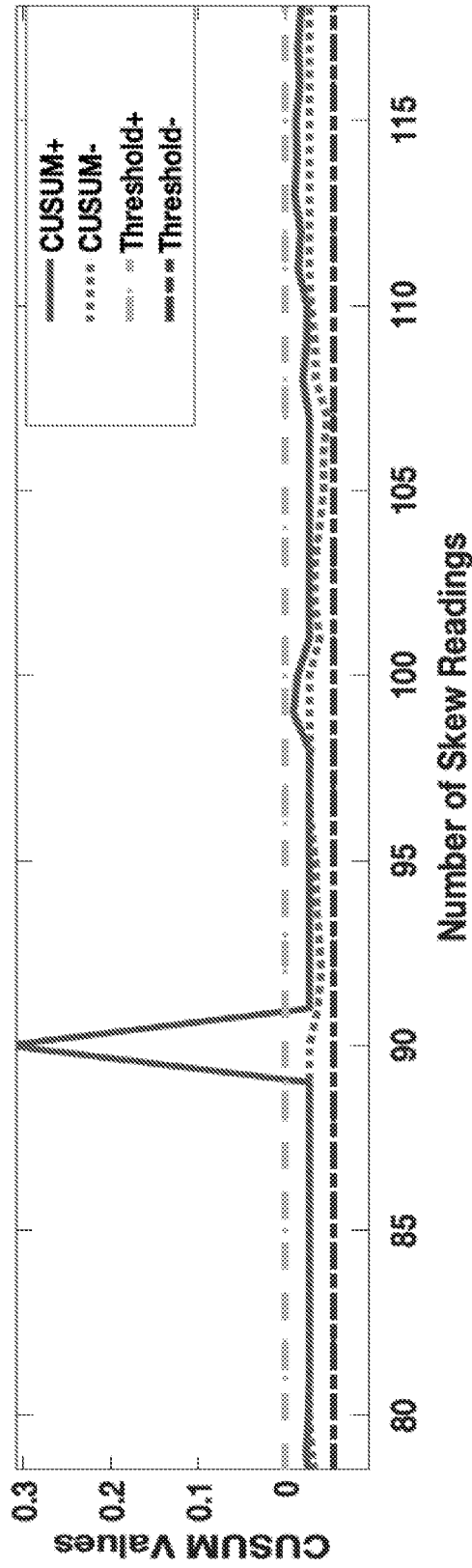


FIG. 20A

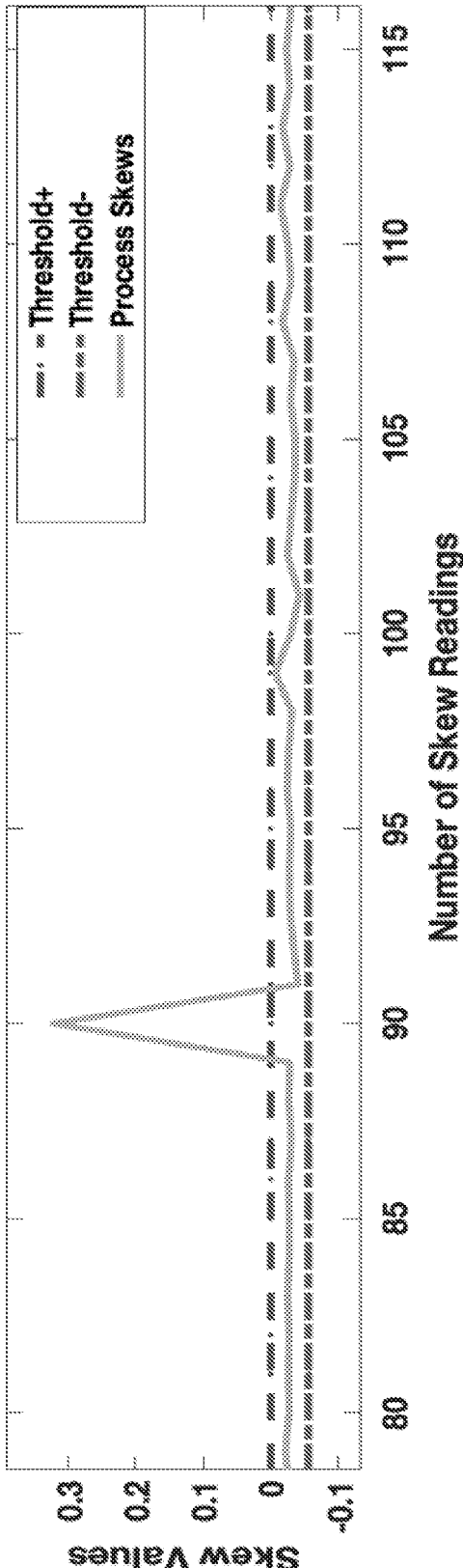


FIG. 20B

Table 5

Metrics	Stage 1			Stage 3			Stage 4	
	IF, Only	OF, Only	IF, and OF,	IF, Only	OF, Only	IF, and OF,	OF, Only	IF, and OF,
TPR	100%(3/3)	100%(4/4)	100%(1/1)	100%(1/1)	100%(3/3)	100%(7/7)	100(2/2)%	100(5/5)%
FPR	3.2%(4/125)	1.65%(2/121)	8.06%(10/124)	5.08%(9/177)	4.58%(7/153)	6.04%(13/215)	0.92%(2/217)	10.70%(23/215)

FIG. 21

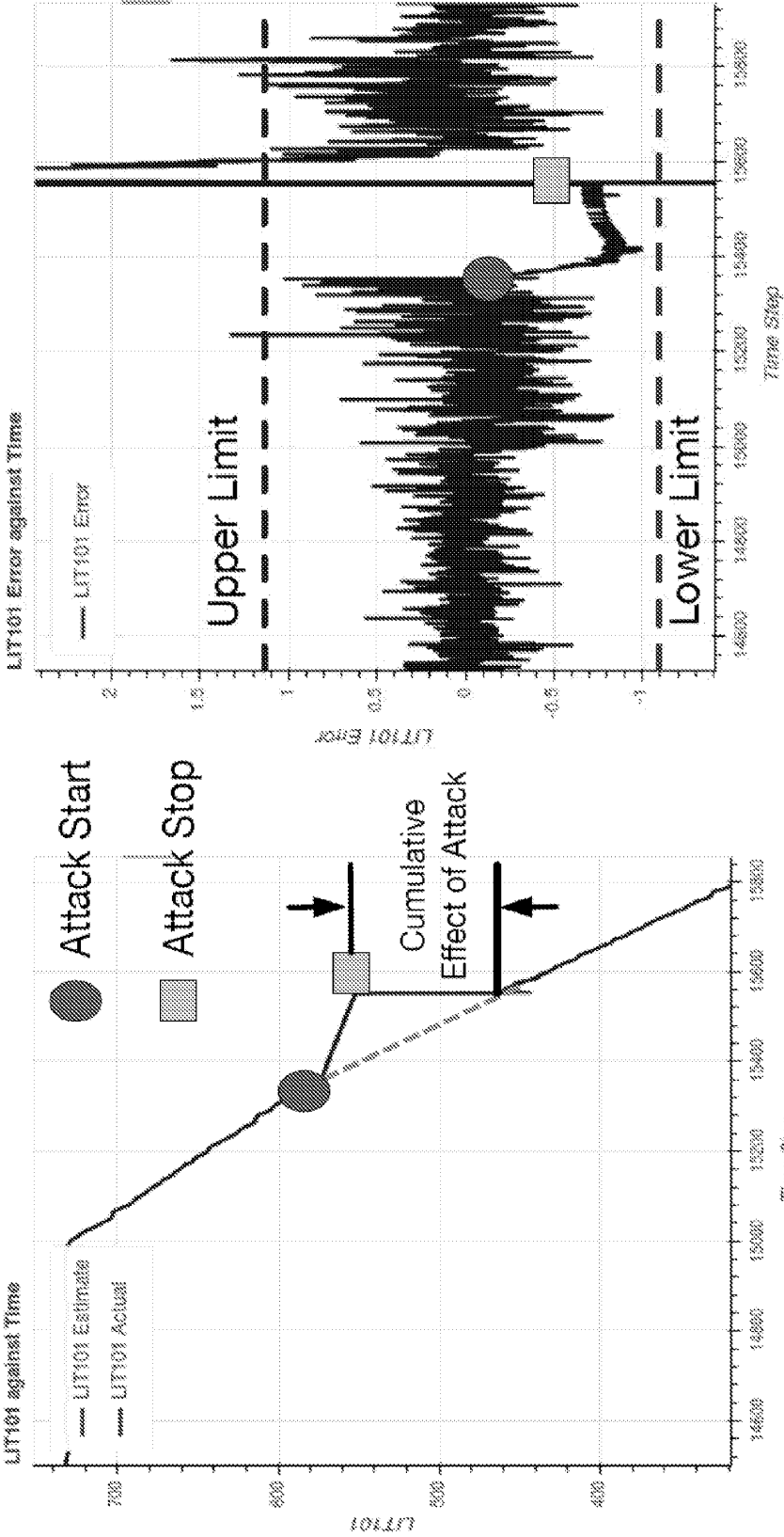


FIG. 22B

FIG. 22A