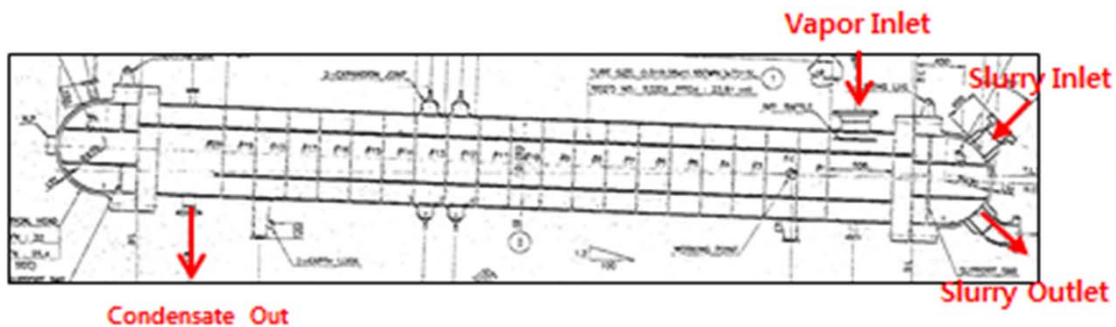
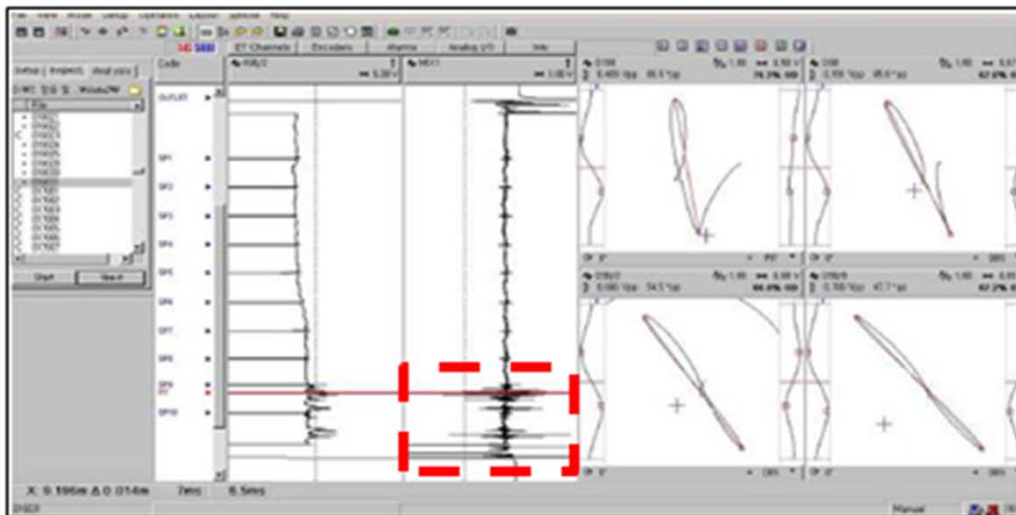
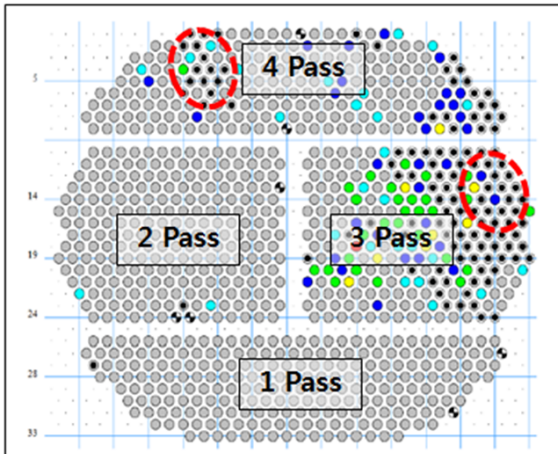


## TUBE FAILURE STATUS

Since Heat Exchanger operation in 2001 year, for 15 years Tube failure occurred at 3, 4 pass area particularly as much as 8~10 tube leakage yearly.

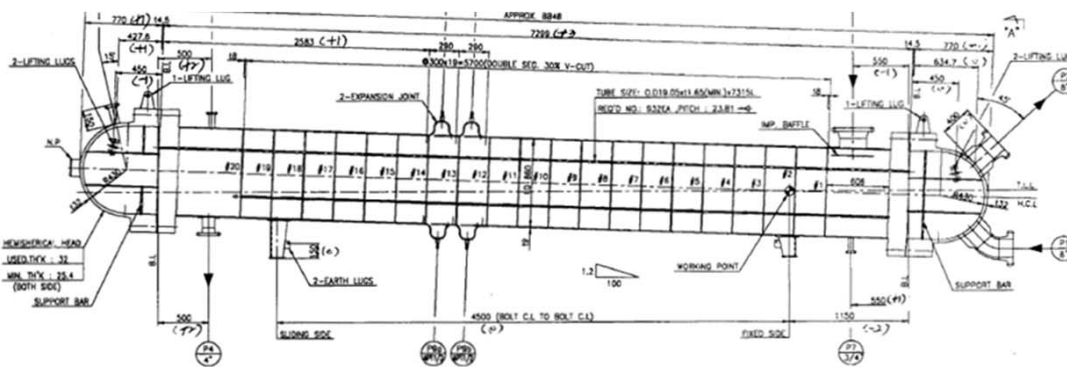
Currently total Tube Plugged q'ty is 127 of 932 tubes.



Design Condition

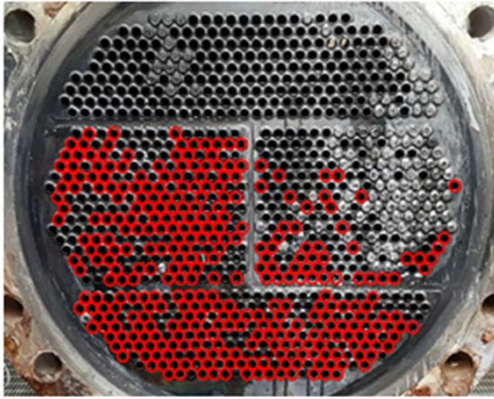
Description	Unit	Design	Actual
Tube O'ty	EA	932	901
ID	mm	860	860
Tube Thickness	mm	1.65	1.65
Tube Pitch	mm	23.8	23.8
Tube Length	m	7,315	7,315
Tube In/Out Velocity	m/s	1.7	1.9
Tube In / Out	°C	125 → 183°C	123 → 176°C
Shell In / Out	°C	187 → 187°C	196 → 171°C
Surface area	m <sup>2</sup>	408	380.9
Heat Duty	MMkcal	13.8	13.4

1) Shell Side Flash Vapor : 0.3% of Terephthalic Acid contained Water, Condensate water  
pH 3.8

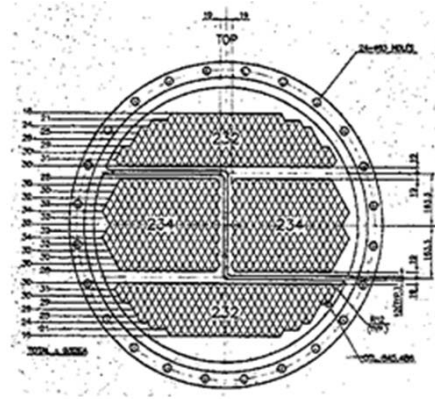


	Shell Side	Tube Side		Shell Side	Tube Side
Fluid	Process Steam	Reactor Feed	Design Press' (K/G)	14.5	120
재질	SUS304L	SUS316L	Operating Press' (K/G)	9.0	100
No. of Pass	1	4	Design Temp' (°C)	199	200
No. of Tube	-	932	Operating Temp' (°C) (In/Out)	178	128 / 162
Surface Area (m <sup>2</sup> )	408		Heat Duty (MMkcal)	13.79	

### 3) Tube Plugging Status for 3 months Operation



<1 Pass>  
 Tube : 232ea  
 Metal Plugged Tube : 1ea  
 T.A Plugging : 148 ea  
 <2 Pass>  
 Tube : 234ea  
 Metal Plugged Tube : 1 ea  
 T.A Plugging : 132 ea



<3 Pass>  
 Tube : 234ea  
 Metal Plugged Tube : 91ea  
 T.A Plugging : 46 ea  
 <4 Pass>  
 Tube : 232ea  
 Metal Plugged Tube : 36 ea  
 T.A Plugging : 0 ea

※ Tube Plugged Increased for Operation

2005.10	2007.09	2009.01
2012.05	2014.05	2016.05

- 118 ● Plugged
- 7 ● Obstructed
- 1 ● 80 < Defect <= 100
- 8 ● 60 < Defect <= 80
- 29 ● 40 < Defect <= 60
- 33 ● 20 < Defect <= 40
- 27 ● 0 < Defect <= 20
- 709 ● Defect = 0
- 0 ○ Default