

DESIGN MANUAL

SPD0056ERN

Process Design Manual

Depressuring

REV. : 1

DATE : 2010. 11. 20

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1.0 INTRODUCTION

Plant emergency depressuring is required for the following basic reasons.

- (a) To reduce the risk of equipment or piping rupture in a fire.
- (b) To minimize the fuel inventory which could supply a fire.
- (c) To minimize the uncontrolled release of flammable or toxic gas.

Equipment and above-ground piping are normally protected from overpressure in the fire case by relief valves. In high pressure service in a fire, the system could heat-up rapidly and rupture at pressures well below vessel design pressure or relief valve set pressure.

Depressuring a system allows controlled inventory disposal to a safe location in event of leakage or fire to prevent an escalation of the hazard due to the failure of any vessels.

The objective of the depressuring system is to keep the internal pressure of the exposed vessels and piping below the rupture pressure as the yield stress of the wall reduces due to overheating.

2.0 SCOPE

After performing depressuring calculation as per the proposed procedure, an engineer can get the following products.

- (a) The minimum temperature reached during depressuring. This minimum temperature is used to select proper material for equipment and piping.
- (b) Released gas rate from a defined system to flare. This result is used to check the capacity of flare stack and to size sub-header and main-header.

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The general calculation procedure of depressuring consists of 6 steps.

- Step 1 - Define criteria to be depressured.
Which system shall be depressured? For the selection of objectives, criteria shall be set-up.
- Step 2 – System Sectionalisation
Based on the criteria, system to be depressurized is selected. At the emergency, the system is isolated by emergency shutdown valves and control valves and the section is depressurised through the depressurisation valve(s).
- Step 3 – Define depressuring requirement
Depressuring time and target pressure shall be defined.
- Step 4 – Set-up assumption set for calculation.
- Step 5 – Collect the required data for calculation.
- Step 6 – Perform calculation

3.0 BASIC KNOWLEDGE

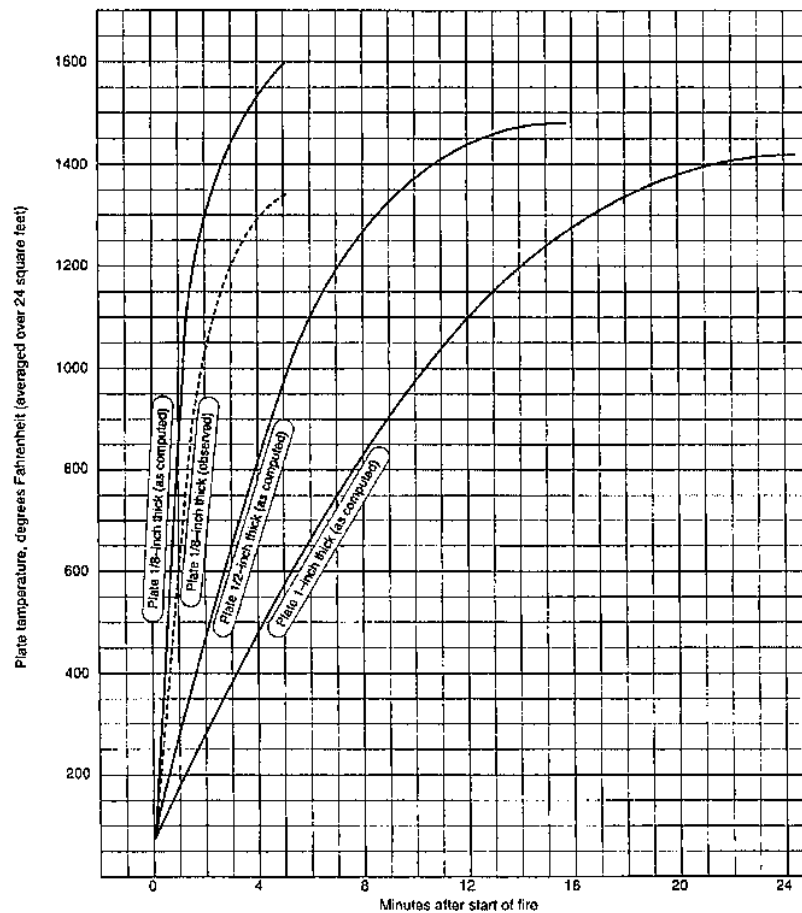
3.1 Depressuring valve vs. Safety valve

Generally, the vessel is protected by pressure safety valve (PSV) at fire case. But, the vessel in high-pressure service is heated-up fast at fire and temperature reaches higher than design temperature quickly. It causes the vessel rupture at lower pressure than design pressure of vessel or set pressure of PSV. If the fire causes higher temperature of vessel than design temperature of vessel, the stress rupture could happen without higher pressure than design pressure. (See the DWG 2 and 3). It means that PSV can't protect a vessel against this situation.

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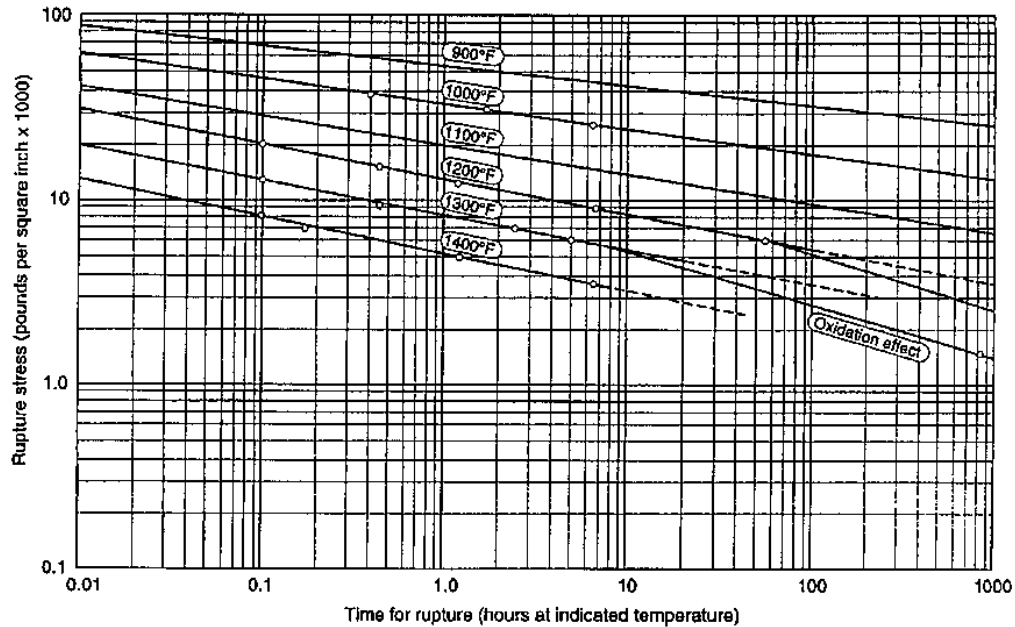
Therefore, a vessel or a system needs to be released using depressuring valve before the pressure reaches its design pressure or set pressure of PSV on an emergency situation.



DWG 3-1. Rising of metal temperature vs. Minutes after start of fire

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DWG 3-2. Rupture time vs. Metal temperature

3.2 ESD Level for Depressuring

Before depressuring a system, the system must be isolated by Emergency Shutdown system (ESD system). Normally, ESD system has three levels as follow;

ESD Level-1: This level is called red level or plant shutdown and is the highest level. If depressuring is required on confirmed detection of a fire or of a gas release, it is recommended that the operator will not depressure more than one zone that is defined in Level-2 at any time to ensure that the flare system is not overloaded. Time-delay between zone depressuring will be defined.

ESD Level-2: This level is called yellow level or zone (process) shutdown. This will shutdown and isolate process units in the designated zone. After ESD level-2 isolates a certain zone, the depressuring can be allowed. When an engineer defines zone, the follow consideration must be taken into. 1) Process concept 2) Design pressure of equipments 3) Location of equipments. Normally flare load is decided before depressruing calculation is performed.

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Therefore, if derpressuring rate is bigger than flare load, it is recommended that an engineer redefine zone to ensure that flare is not overloaded.

ESD Level-3: This level is called blue level or unit shutdown. This level will cause trip of single equipment or closing of single Emergency shutdown valve (ESDV). The depressuring is not considered in this level.

3.3 Configuration of vapor depressuring system

Typical vapor depressuring system composes below (See figure 3-3) but an engineer can modify it case by case. A guide to material selection can be specified in figure 3-4.

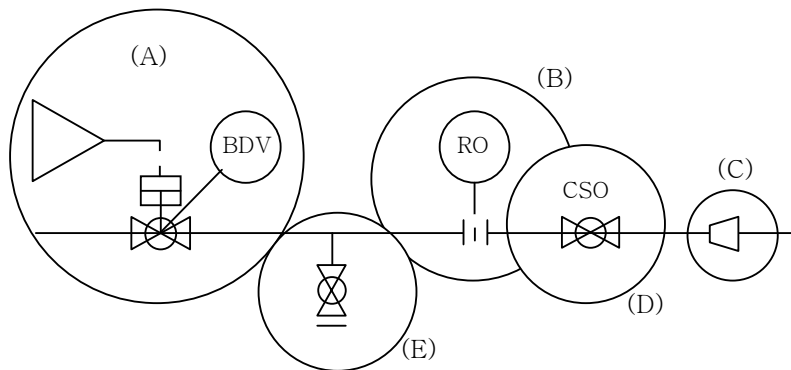


Figure 3-3. Vapor Depressuring System
((D) and (E) are optional items.)

- (A) Remote Initiation
- (B) For Letdown (needs sizing)
- (C) For Corresponding to Expansion (needs keeping Mach No. 0.6 – 0.7)
- (D) For Shutting the System when there is Leaking out
- (E) For Methanol Injection when there is Plugging by Hydrate

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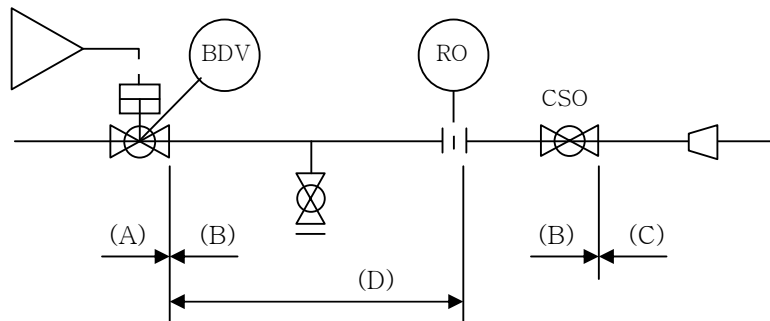


Figure 3-4. Material Selection for Vapor Depressuring System

- (A) Material for High Pressure and Ambient Temperature (e.g. 900# CS)
- (B) Material for High Pressure and Low Temperature (e.g. 900# SS)
- (C) Material for Low Pressure and Low Temperature (e.g. 150# SS)
- (D) Minimum Distance for Not being Affected with Low Temperature

The followings are to be considered in order to prevent plugging.

- In case of using low noise valve, it is confirmed whether it's plugged or not by vendor.
- It's not allowed to install a filter at inlet side or a silencer at outlet side.

3.4 Automatic venting vs. remote venting

Operation method of depressuring valve is divided into two types - automatic venting and remote venting, and it depends on who make a decision to depressurize a system when emergency happens.

Remote venting means that an operator decides whether depressuring is needed or not in emergency case that the plant has to be shut down by ESD system. On the contrary, if the logic decides final action with ESD signal, it is called automatic venting.

Normally it is strongly recommended that an operator make a decision of depressuring after confirming a fire or gas release.

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3.5 Minimum Temperature Analysis

Temperature drop calculation is executed based on non-fire case. Minimum temperature of non-fire case is lower than that of fire case because the required target pressure of non-fire case is lower and the initial temperature in fire case is much higher.

■ Minimum Design Metal Temperature

To determine the minimum design metal temperature, the minimum vessel wall temperature is taken using the result of process simulator

■ Target Pressure for Depressuring temperature

Target pressure should be discussed with client and finalized because each company applies the different philosophy. Some companies define 35% of design pressure as target pressure for depressuring temperature. Other companies consider that depressurisation may be continued to atmospheric pressure. This manual recommends to discuss and finalize target pressure at proposal stage. If nothing is specified, it is recommended in conservative way to apply atmospheric pressure.

■ Material Selection

Material for equipment and piping is selected based on the following criteria. When carbon steel or killed carbon steel is selected, the requirement of impact test should be judged by manufacturer in detail engineering since it depends on the thickness of material.

For equipment:

If the calculated MDMT is higher than $-29\text{ }^{\circ}\text{C}$, Killed Carbon Steel is selected.

If MDMT is between $-29\text{ }^{\circ}\text{C}$ and $-45\text{ }^{\circ}\text{C}$, Low Temperature Carbon Steel (LTCS), viz. killed carbon steel with impact test, is selected.

If MDMT is below $-45\text{ }^{\circ}\text{C}$, Stainless Steel is selected.

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For piping:

If the calculated MDMT is higher than -20°C , Carbon Steel is selected.

If MDMT is between -20°C and -45°C , Low Temperature Carbon Steel (LTCS), viz. killed carbon steel with impact test, is selected.

If MDMT is below -45°C , Stainless Steel is selected.

■ Temperature downstream of EDP orifice

In addition to the blowdown minimum temperature analysis within equipments, the temperature downstream of EDP orifice has been investigated assuming adiabatic expansion across the orifice. Using the results of the depressurising simulation, the minimum piping temperature downstream of BDV, containing main flare header, has been calculated and the piping classes was determined according to the simulation results.

4.0 DESIGN CRITERIA

4.1 Objective Selection

Based upon a fully survey of all available International Code and Practice (Ref. : API 520/521) , the following criteria are recommended :

Design pressure is more than 17.24 barg. (250 psig)

Size of the equipment and volume of the content are significant.

An emergency depressuring device shall be provided when the above criteria is met. Sometimes these selection criteria could be ambiguous, especially for size. Client or Basic Engineering Company normally recommends detail criteria.

The Figure 4.1 and 4.2 shows selection criteria used in GSP-5 project.

Chiyoda and BP companies choose the minimum system volume of 15 tons for depressruing.

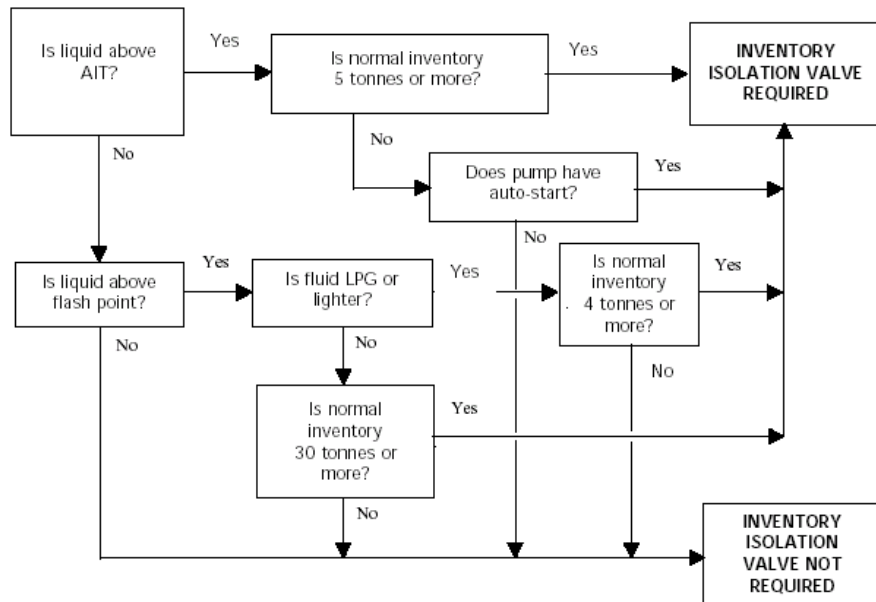


Figure 4-1. Decision Tree for Equipment in Pumped Liquid Systems

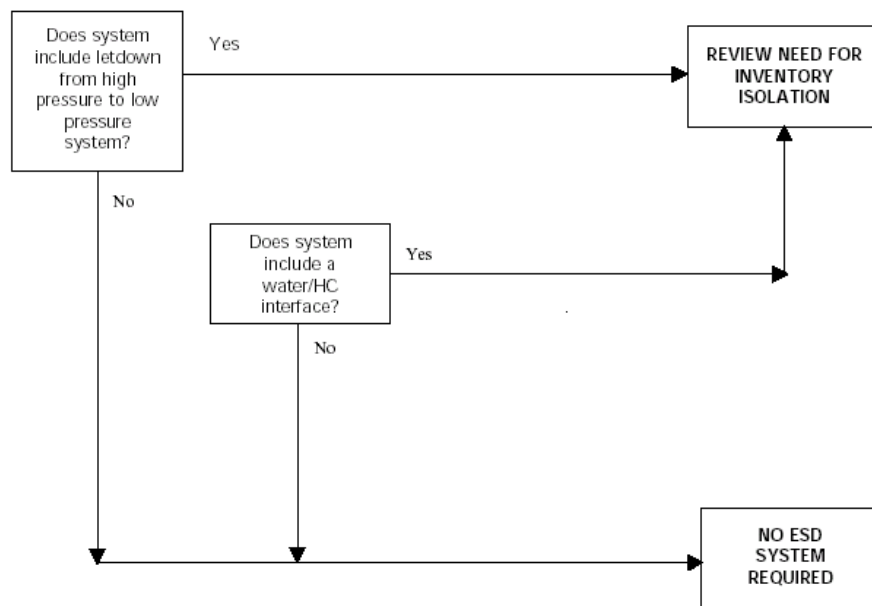


Figure 4-1. Decision Tree for Equipment in Other Systems

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In case that the basis of depressuring is not included in ITB, the basis should be confirmed because many depressuring valves and ESD valves could be added later.

4.2 Sectionalization

Based on the above criteria, system to be depressurised is selected and sectionalised as follows. The method of sectionalization is not unique and the various means could be considered according to process characteristics.

This is just general guideline.

1) Feed section & dehydration adsorption section

Just one valve is installed in sections under uniform design pressure. If several valves are installed in the same zone and opened at the same time, total flowrate in the flare system is equal to that in case one valve is installed. Therefore it is recommended to reduce the number of valves on condition that any trouble doesn't happened in process.

However, if there is a wide difference of temperature among the sections which are under the same design pressure, separate valve needs to be installed at each section because the temperature influences on material selection.

2) Dehydration regeneration section

In dehydration unit, regeneration section is considered apart from adsorption section. Because these sections have different design pressures, operating temperatures and fluid compositions, separate depressuring valves are required.

3) Compressor suction & discharge

Suction and discharge sides of the compressor are combined as one section even though two sides have different design pressure. It is reasonable that depressuring valve is installed at lower pressure side (vapor outlet line of suction drum).

4) Heat exchanger

For heat exchanger between equipments, depressuring valve is installed in the equipment of cold temperature. If the valve's installed at hot side, low

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temperature fluid can flow into hot side and drop the metal temperature during depressuring. In case that depressuring fluid drops below 0 C and another fluid passing heat exchanger is cooling water, the cooling water could be frozen.

5) Fractionation unit (Column)

Fractionation unit usually comprises several equipments that include column, gs - reboiler, overhead condenser, reflux drum, reflux pump, etc. At emergency, all of equipments should be depressurized. The valve location is decided depending on condenser type or process.

At the emergency, the sectionalized system is isolated by emergency shutdown valves and the section is depressurised through the depressurisation valve(s). Control valve with fail close position could be used for the system isolation because it is not efficient that ESD valves are installed in all pipelines, especially small and normally not used.

4.3 Depressuring Requirement

A vapor depressuring system should have adequate capacity to permit reduction of the vessel stress to a level at which stress rupture is not of immediate concern. For sizing, this generally involves reducing the equipment pressure from initial conditions to a level equivalent to 50 % of the vessel design pressure or 6.90 barg, whichever is lower, within 15 minutes.

Exceptionally for the compressor or expander system depressuring, the system should be depressurized within 15 minutes down to 1.0 barg. This requirement has been set as there may be some risk of leakage from the shaft seals under shutdown conditions.

Sometimes the different requirement depending on the wall thickness is applied as Songkhla gas project, Egypt Khalda project (ABB Lummus) and BP specification. Vessel with wall thickness greater than 1" is depressed to half design pressure in 15 minutes as a minimum. Vessel with wall thickness less than 1" is depressed to at least 6.9 barg in 15 minutes.

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4.4 Assumption Set in the Calculation

General assumptions are set in the calculation as follows.

1) Isentropic efficiency

An isentropic efficiency is used to account for the fact that the depressurisation process is not ideal. Studies have shown that 100 % gives a good accord with experimental data for gas filled systems and values of 40 ~ 70 % are generally used for liquid containing systems.

For Songkhla gas project, 50 % isentropic efficiency was applied for both gas filled system and liquid filled system. Because Higher values yield lower final temperature for the fluid, the basis should be included in ITB otherwise it should be confirmed by owner.

2) Vapor and liquid of pure component

A method of a single stage flash calculation is applied to investigate the auto-refrigeration effects. Single flash calculation is considered to be enough because of no composition change during depressuring.

3) Heat Input from Surrounding

In fire case, heat input from the fire has been calculated in accordance with API RP 521 considering the wetted surface, while in non-fire case, heat input from the surrounding air was not considered whichever the system is insulated or not, because the heat input from ambient air has no effect over the depressuring time scale.

4.5 Data Collection

The various materials should be prepared for the depressuring load or MDMT calculation. The purpose of each material is summarized below.

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Item	Purpose
P&ID	Sectionalization
Material Balance	Composition
Datasheet	System volume
Engineering DWG	System volume, Vessel weight
H-103	Pipe volume and weight

4.6 Calculation

Two cases, that is, fire condition and non-fire condition, are investigated to evaluate a required flare capacity (fire case) and a low temperature (non-fire case). Since in a fire case larger flow rate is required than that in non-fire case, size of EDP orifice is determined based on the fire case calculation. Then, utilizing the same orifice sizing, non-fire case is calculated to obtain the minimum temperature reached.

Calculation starts from the estimated starting condition expected when system is shutdown and isolated. Taking a pressure reduction rate properly, simulation is made repeatedly at every pressure level from starting pressure to target pressure. Heat and material balance of each system is simulated at given pressure using process simulator based on the assumption stated in Section 4.4

4.6.1 Fire case

First, fire case calculation is carried out in order to determine the required value of the depressuring valve and to check flare capacity. Assuming the value, dynamic simulation is performed to obtain the time duration meeting the depressuring requirement. If the system pressure is not lowered to the required level or lowered too fast in 15 minutes, assumed value is adjusted and calculations are repeated until the depressurization requirement is met. Finally the relieving rate during the depressuring are determined.

1) Initial pressure and temperature

It was assumed that the depressuring will start after the pressure in the system

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reaches its design pressure and the temperature is taken as being the temperature at design pressure when a fire breaks out, except the following system :

“For compressor system, it was assumed that suction and discharge pressures equalize (settle down) after shutting down, since anti-surge valve(s) of compressor will open very quickly (within a few second).”

2) Target pressure

Final pressure will be decided by depressuring requirement shown in section 4.3.

3) Heat Input from Surrounding

In fire case, heat input from the fire has been calculated in accordance with API RP 521 considering the wetted surface. For calculating the vapor generation by heat input in fire case, following assumptions were further made:

The wetted area is based on the normal operating liquid level, provided that the normal operating liquid level does not exceed 8m above grade. In instance where the normal operating liquid level exceeds 8m above grade, the wetted area is calculated assuming a liquid level 8m above grade. This height is from any level on which a substantial spill can accumulate and be sustained. The liquid hold-up on tower trays, the liquid inventory of any integral reboiler and liquid filled piping was included for determining the wetted surface up to 8 meters. But in the case of air coolers, no height limitation is applied.

4.6.2 Non-fire case

Once the depressuring value size is determined, depressuring simulation for non-fire case, i.e. without heat input from the fire, is performed to estimate the Minimum Design Metal Temperature.

1) Initial pressure and temperature

Equipment has been shut in, and initial pressure and temperature equal to settling pressure and temperature.

2) Target pressure

Depressurisation may be continued to atmospheric pressure through the

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depressuring valve sizing as determined for the fire case blowdown of the particular section of the plant.

3) Minimum Design Metal Temperature

To determine the minimum design metal temperature, the minimum vessel wall temperature is taken using the result of Hyprotech process simulation package HYSYS.Process.

4) Material Selection

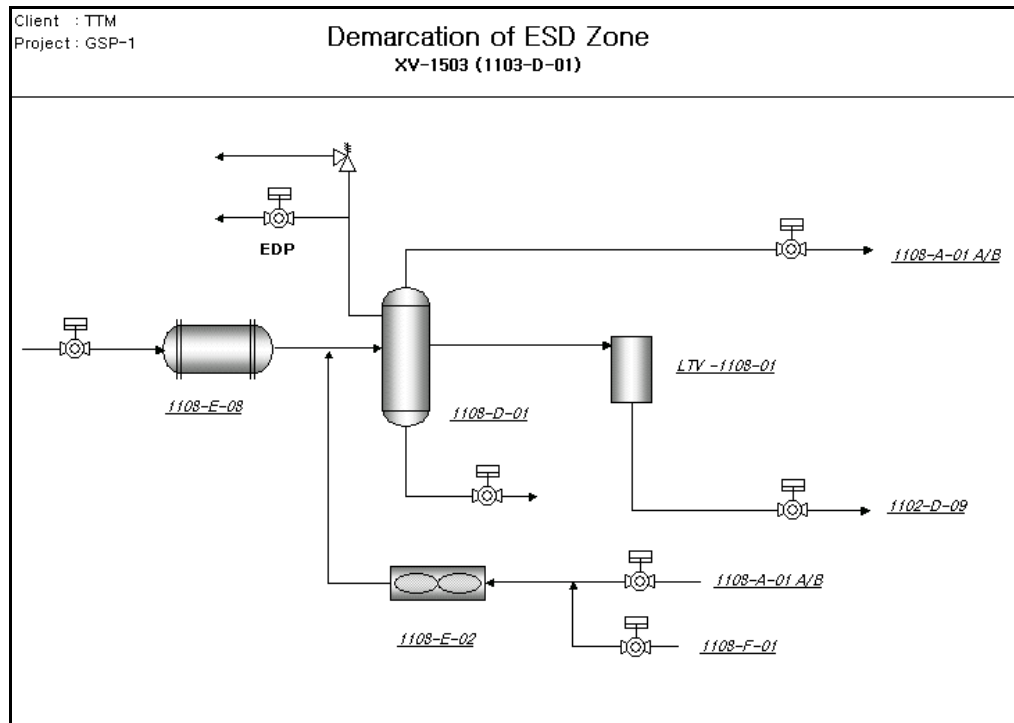
Material for equipment and piping is selected based on the criteria in section 3.5.

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5.0 CALCULATION EXAMPLE

The following procedure is one of depressuring calculations used in Songkhla gas project.

1) Sectionalization



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2) System volume and composition calculation

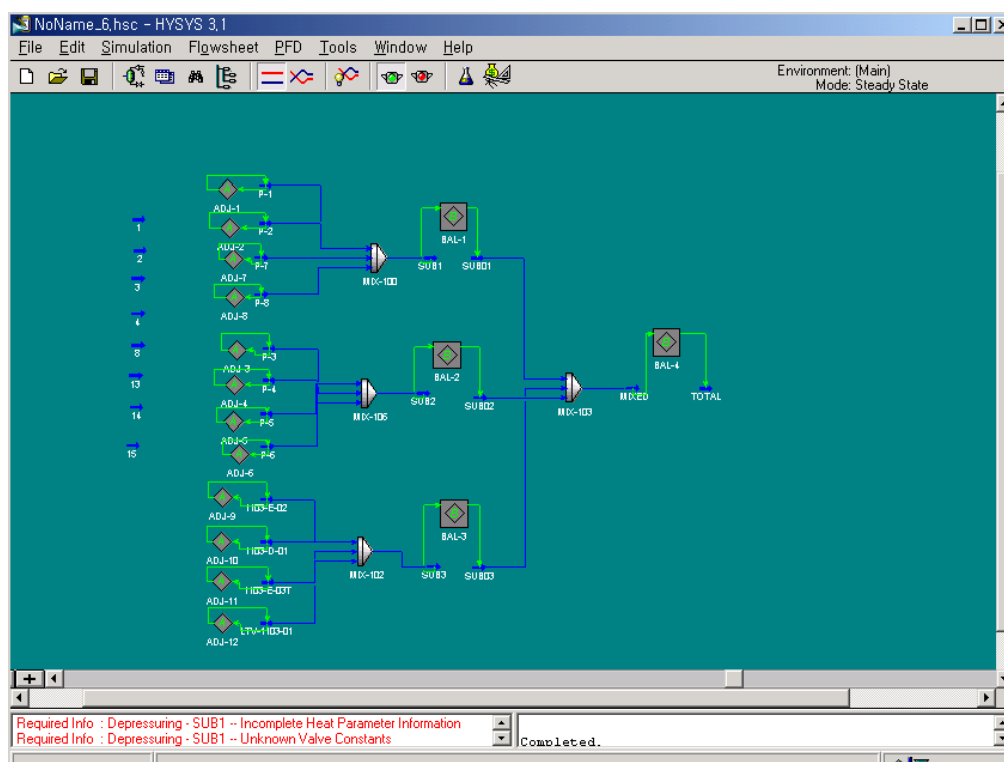
Combine equipment volume and piping volume in the depressuring zone and calculate the system conditions such as temperature, pressure, and composition by using HYSYS simulator.

Equipment	1103-D-01	1103-E-02	1103-E-03T	LTV-1103-01		
Stream No.	3	14	1	4		
Design Condition	Bar G / °C	89.5 / 100	89.5 / 65	89.5 / 100	89.5 / 100	
Size	mmID x mmTT	900 x 2650			254 x 1500	
Operation Condition	Bar G / °C	73.5 / 35	78.8 / 25	74 / 44.7	73.5 / 35	
Total volume (m ³)		1,877	4,408	13,550	0,080	
Vapor volume (m ³)		1,463	4,408	13,550	0,080	
Liquid volume (m ³)		0,414	0,000	0,000	0,000	
Wetted Surface Area (m ²)		23	0.0	0.0	0.0	
Heat Transfer Area (m ²)		92	694.2	28.5	1.3	
Weight(kg)		10000	17000	25546	144	
Liquid Level (m)						

Pipe	1-1	2-1	3-1	4-1	5-1	6-1	7-1	8-1	8-2	8-3	8-4		
Size (inch)	12	12	8	8	2	6	16	2	16	2	3		
Piping Class	E9001	E9001	E9001	E9001	E9001	E9001	E9001	E9001	E9001	E9001	E9001		
Len(m)	31	11.0	35.9	30.8	1.0	14.0	2.8	5.2	15.4	0.5	27.8		
Vap %	100	100	100	100	100	100	100	100	100	100	100		
NLL(Inch)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Total Volume (m3)	0.28	0.80	1.16	1.00	0.00	0.26	0.86	0.01	2.00	0.00	0.18		
VAP,VOL BY NLL (m3)	0.28	0.80	1.16	1.00	0.00	0.26	0.86	0.01	2.00	0.00	0.18		
LIQ,VOL BY NLL (m3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Wetted Area (m2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
H/Trans. Area (m2)	8.0	10.6	22.9	19.7	0.2	6.7	8.6	0.8	19.7	0.1	6.7		
Weight (kg)	874	1827	2820	1991	7	696	669	89	3181	4	426		

Pipe	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8
Stream No.	2	1	15	14	8	13	3	4
Total Volume (m3)	0.226	0.803	1.164	0.999	0.002	0.255	0.363	2.136
VAP,VOL BY NLL (m3)	0.226	0.803	1.164	0.999	0.002	0.255	0.363	2.136
LIQ,VOL BY NLL (m3)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wetted Area (m2)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H/Trans. Area (m2)	2.968	10.533	22.918	19.662	0.160	6.703	3.575	27.227
Weight (kg)	373,860	1327	2320	1991	7	596	569.2	3598.0

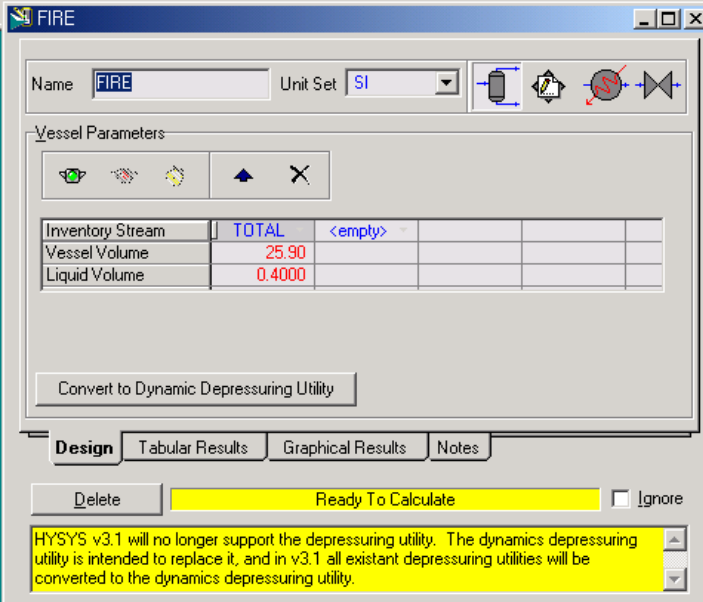
TOTAL		
Total Vol.	25.9	m3
Vap. Vol.	25.5	m3
Liq. Vol.	0.4	m3
Wet Area	2	m2
H/T Area	827	m2
Weight	63472	kg



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3) Fire case calculation

- Add total inventory volume and liquid volume.



Name: FIRE Unit Set: SI

Vessel Parameters

Inventory Stream	TOTAL	<empty>			
Vessel Volume	25.90				
Liquid Volume	0.4000				

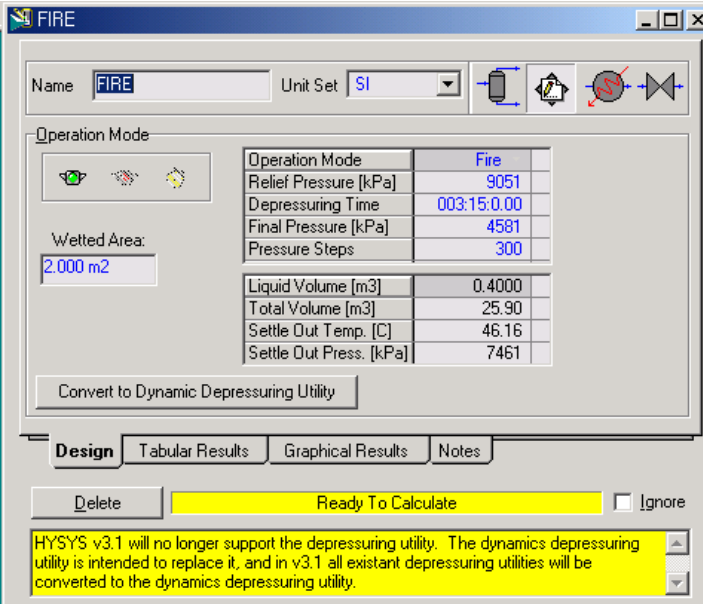
Convert to Dynamic Depressuring Utility

Design Tabular Results Graphical Results Notes

Delete Ready To Calculate Ignore

HYSYS v3.1 will no longer support the depressuring utility. The dynamics depressuring utility is intended to replace it, and in v3.1 all existant depressuring utilities will be converted to the dynamics depressuring utility.

- Input data; total surface area (wetted area), initial and final pressure, depressuring time (15 min), operation mode - fire



Name: FIRE Unit Set: SI

Operation Mode

Operation Mode	Fire
Relief Pressure [kPa]	9051
Depressuring Time	003:15:00
Final Pressure [kPa]	4581
Pressure Steps	300

Wetted Area: 2.000 m2

Liquid Volume [m3]	0.4000
Total Volume [m3]	25.90
Settle Out Temp. [C]	46.16
Settle Out Press. [kPa]	7461

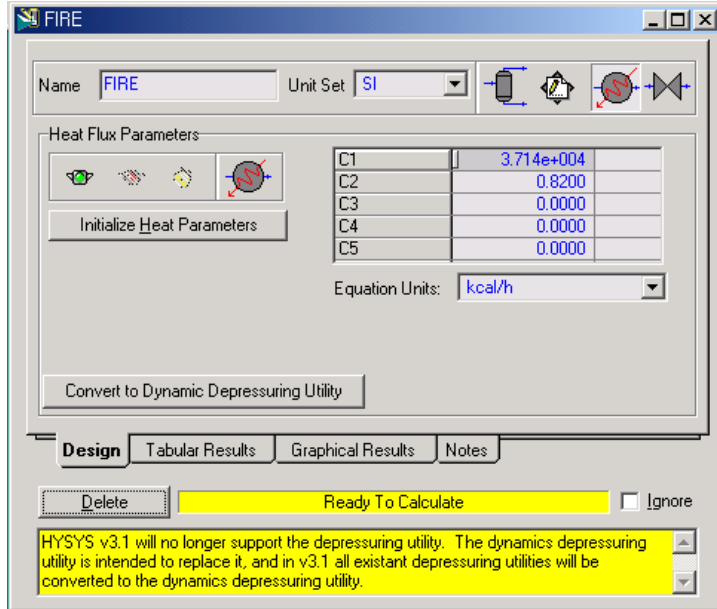
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- Set up heat flux parameter.



Name: FIRE Unit Set: SI

Heat Flux Parameters

C1	3.714e+004
C2	0.8200
C3	0.0000
C4	0.0000
C5	0.0000

Equation Units: kcal/h

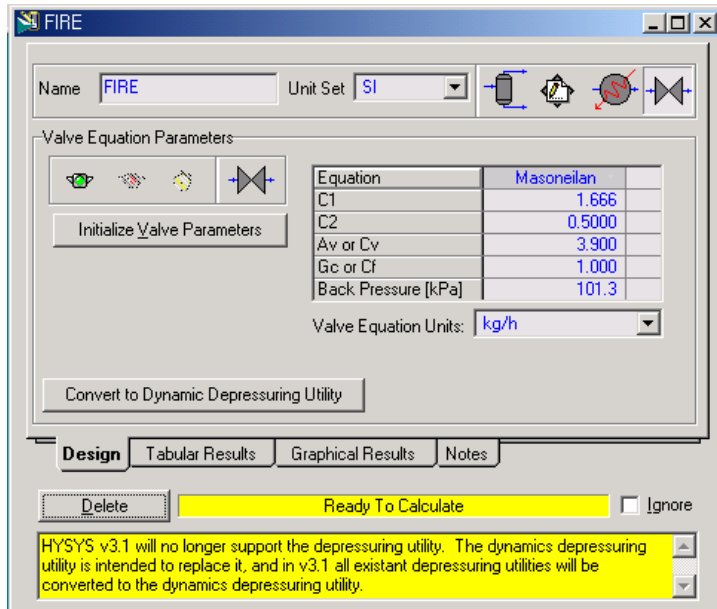
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- Calculate Cv (use Masoneilan equation and initialize valve parameter bottom to get initial values)



Name: FIRE Unit Set: SI

Valve Equation Parameters

Equation	Masoneilan
C1	1.666
C2	0.5000
Av or Cv	3.900
Gc or Cf	1.000
Back Pressure [kPa]	101.3

Valve Equation Units: kg/h

Convert to Dynamic Depressuring Utility

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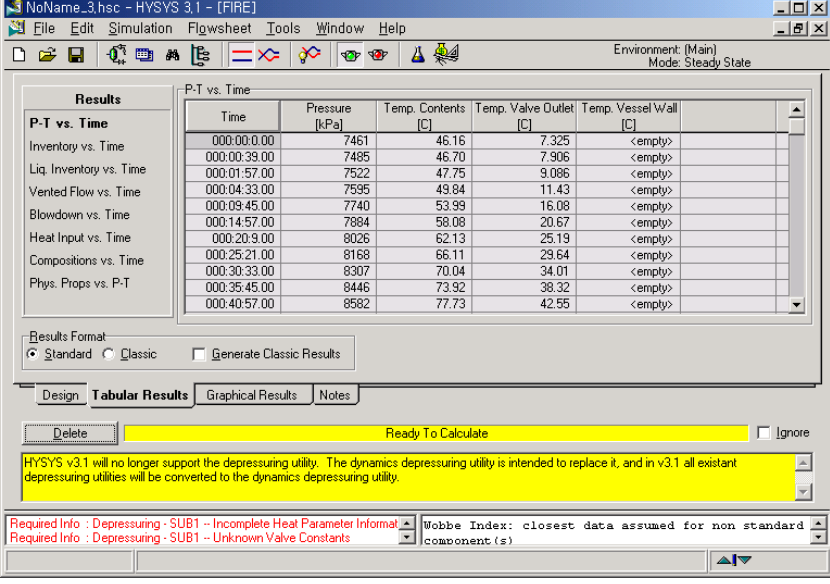
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- Check pressure-time table and adjust Cv parameter to get the required depressuring time (15 mins).



Results

P-T vs. Time

Time	Pressure [kPa]	Temp. Contents [C]	Temp. Valve Outlet [C]	Temp. Vessel Wall [C]
000:00:00.00	7461	46.16	7.325	<empty>
000:00:39.00	7485	46.70	7.906	<empty>
000:01:57.00	7522	47.75	9.086	<empty>
000:04:33.00	7595	49.84	11.43	<empty>
000:09:45.00	7740	53.99	16.08	<empty>
000:14:57.00	7884	58.08	20.67	<empty>
000:20:9.00	8026	62.13	25.19	<empty>
000:25:21.00	8168	66.11	29.64	<empty>
000:30:33.00	8307	70.04	34.01	<empty>
000:35:45.00	8446	73.92	38.32	<empty>
000:40:57.00	8582	77.73	42.55	<empty>

Results Format: ☒ Standard ☐ Classic ☐ Generate Classic Results

Design **Tabular Results** Graphical Results Notes

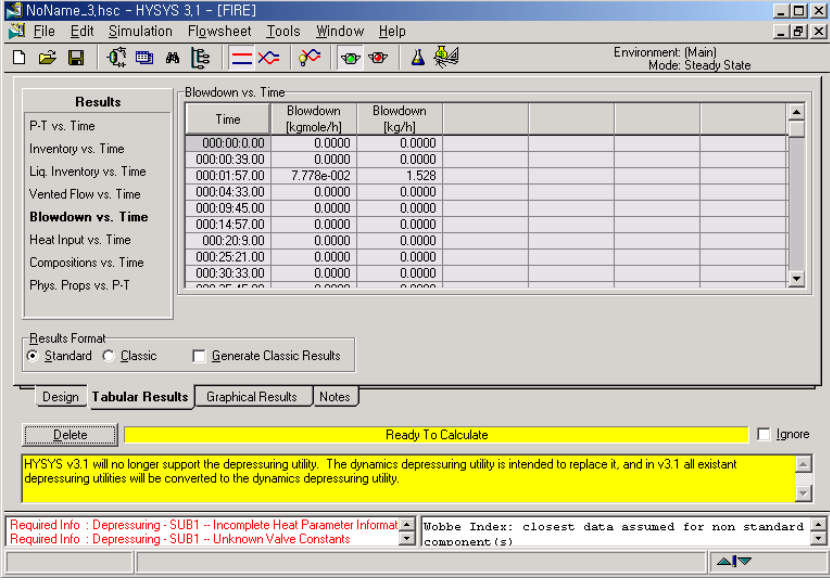
Delete Ready To Calculate ☐ Ignore

HYSYS v3.1 will no longer support the depressuring utility. The dynamics depressuring utility is intended to replace it, and in v3.1 all existent depressuring utilities will be converted to the dynamics depressuring utility.

Required Info : Depressuring - SUB1 - Incomplete Heat Parameter Information
 Required Info : Depressuring - SUB1 - Unknown Valve Constants

Wobbe Index: closest data assumed for non standard component (s)

- Obtain maximum blowdown flowrate.



Results

Blowdown vs. Time

Time	Blowdown [kgmole/h]	Blowdown [kg/h]
000:00:00.00	0.0000	0.0000
000:00:39.00	0.0000	0.0000
000:01:57.00	7.778e-002	1.528
000:04:33.00	0.0000	0.0000
000:09:45.00	0.0000	0.0000
000:14:57.00	0.0000	0.0000
000:20:9.00	0.0000	0.0000
000:25:21.00	0.0000	0.0000
000:30:33.00	0.0000	0.0000
000:35:45.00	0.0000	0.0000
000:40:57.00	0.0000	0.0000

Results Format: ☒ Standard ☐ Classic ☐ Generate Classic Results

Design **Tabular Results** Graphical Results Notes

Delete Ready To Calculate ☐ Ignore

HYSYS v3.1 will no longer support the depressuring utility. The dynamics depressuring utility is intended to replace it, and in v3.1 all existent depressuring utilities will be converted to the dynamics depressuring utility.

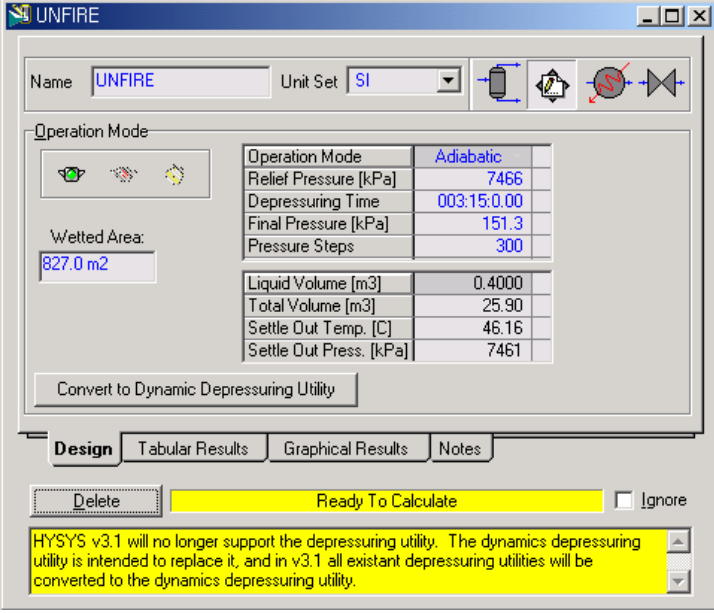
Required Info : Depressuring - SUB1 - Incomplete Heat Parameter Information
 Required Info : Depressuring - SUB1 - Unknown Valve Constants

Wobbe Index: closest data assumed for non standard component (s)

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4) Non-fire case calculation

- Input data; operation mode (adiabatic mode), initial pressure (settling-out pressure), final pressure (flare header pressure), Cv – calculated value (refer fire case), depressuring time



The UNFIRE software interface displays the following data for the Operation Mode:

Operation Mode	Adiabatic
Relief Pressure [kPa]	7466
Depressuring Time	003:15:00
Final Pressure [kPa]	151.3
Pressure Steps	300
Liquid Volume [m3]	0.4000
Total Volume [m3]	25.90
Settle Out Temp. [C]	46.16
Settle Out Press. [kPa]	7461

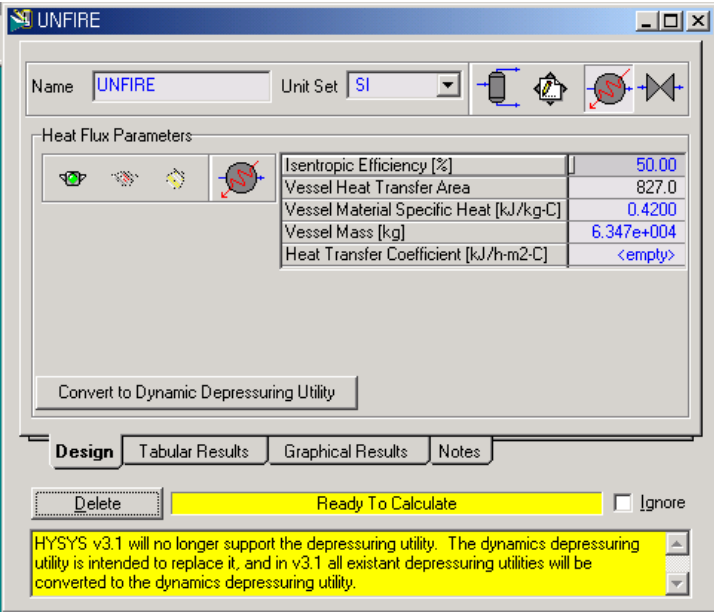
Wetted Area: 827.0 m2

Buttons: Design, Tabular Results, Graphical Results, Notes

Status: Ready To Calculate

Warning: HYSYS v3.1 will no longer support the depressuring utility. The dynamics depressuring utility is intended to replace it, and in v3.1 all existant depressuring utilities will be converted to the dynamics depressuring utility.

- Input isentropic efficiency, material heat capacity and vessel mass.



The UNFIRE software interface displays the following data for the Heat Flux Parameters:

Isentropic Efficiency [%]	50.00
Vessel Heat Transfer Area	827.0
Vessel Material Specific Heat [kJ/kg-C]	0.4200
Vessel Mass [kg]	6.347e+004
Heat Transfer Coefficient [kJ/h-m2-C]	<empty>

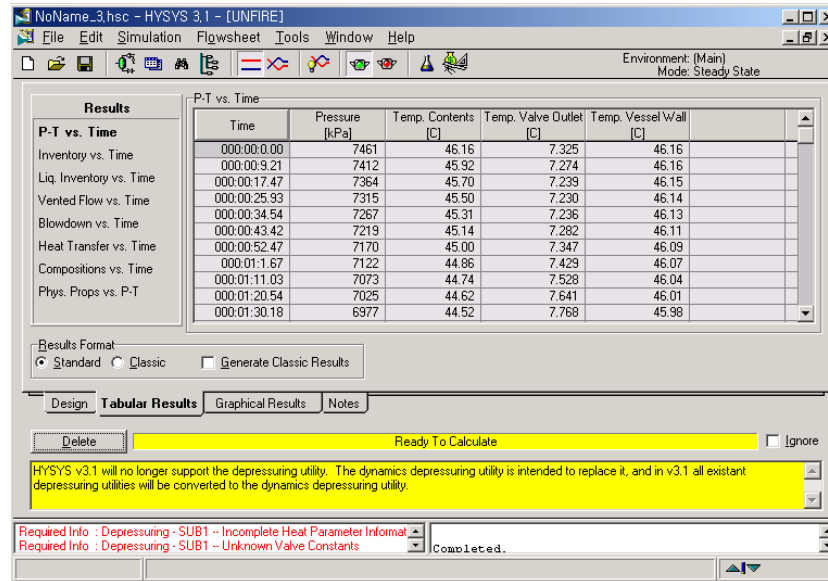
Buttons: Design, Tabular Results, Graphical Results, Notes

Status: Ready To Calculate

Warning: HYSYS v3.1 will no longer support the depressuring utility. The dynamics depressuring utility is intended to replace it, and in v3.1 all existant depressuring utilities will be converted to the dynamics depressuring utility.

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- Obtain the minimum temperature.

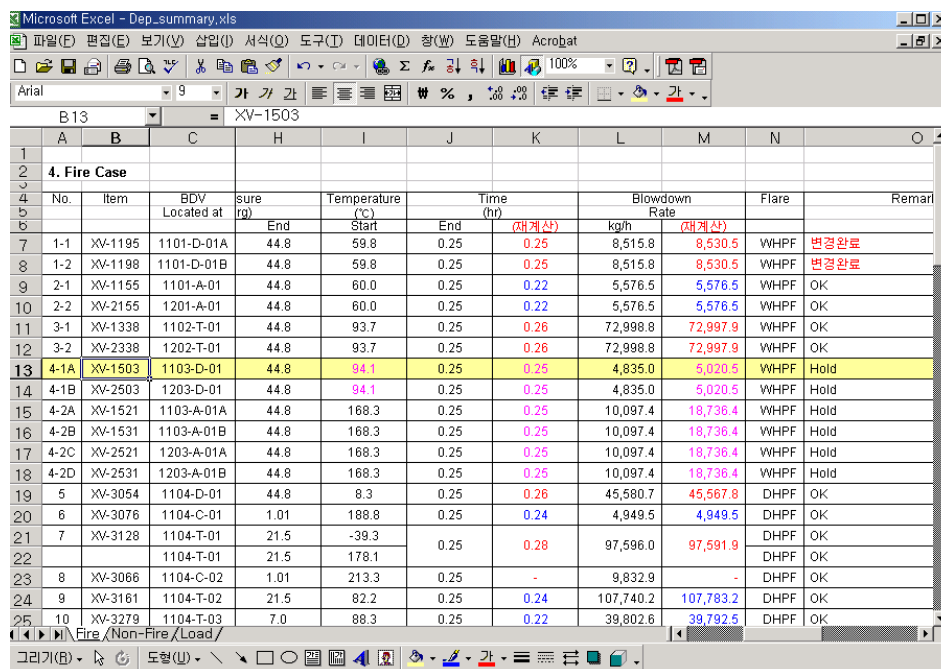


The screenshot shows the HYSYS 3.1 - [UNFIRE] Results window. The 'Results' tab is active, displaying a table of 'P-T vs. Time' data. The table includes columns for Time, Pressure (kPa), Temp. Contents (C), Temp. Valve Outlet (C), and Temp. Vessel Wall (C). The data shows a rapid increase in pressure and temperature over time, starting from 000:00:00.00 and ending at 000:01:30.18. The pressure reaches a peak of 6977 kPa, and the temperature reaches a peak of 44.52 C. The valve outlet temperature reaches 7.768 C, and the vessel wall temperature reaches 45.98 C.

Time	Pressure [kPa]	Temp. Contents [C]	Temp. Valve Outlet [C]	Temp. Vessel Wall [C]
000:00:00.00	7461	46.16	7.325	46.16
000:00:09.21	7412	45.92	7.274	46.16
000:00:17.47	7364	45.70	7.239	46.15
000:00:25.93	7315	45.50	7.230	46.14
000:00:34.54	7267	45.31	7.236	46.13
000:00:43.42	7219	45.14	7.282	46.11
000:00:52.47	7170	45.00	7.347	46.09
000:01:01.67	7122	44.86	7.429	46.07
000:01:11.03	7073	44.74	7.528	46.04
000:01:20.54	7025	44.62	7.641	46.01
000:01:30.18	6977	44.52	7.768	45.98

5) Summary

Summarize fire and non-fire results.



The screenshot shows a Microsoft Excel spreadsheet titled 'Dep_summary.xls'. The spreadsheet contains a table summarizing fire and non-fire results. The table has columns for No., Item, BDV Located at, sure (rg), Temperature (C), Time (hr), Blowdown Rate (kg/h), Flare, and Remark. The data is organized into rows, with some rows highlighted in yellow. The table includes data for various items, including XV-1195, XV-1198, XV-1155, XV-2155, XV-1338, XV-2338, XV-1503, XV-2503, XV-1521, XV-1531, XV-2521, XV-2531, XV-3054, XV-3076, XV-3128, XV-3066, XV-3161, and XV-3279. The table also includes a 'Fire/Non-Fire/Load' column.

No.	Item	BDV Located at	sure (rg)	Temperature (C)	Time (hr)	Blowdown Rate (kg/h)	Flare	Remark
1-1	XV-1195	1101-D-01A	44.8	59.8	0.25	8,515.8	WHPF	변경완료
1-2	XV-1198	1101-D-01B	44.8	59.8	0.25	8,515.8	WHPF	변경완료
2-1	XV-1155	1101-A-01	44.8	60.0	0.25	5,576.5	WHPF	OK
2-2	XV-2155	1201-A-01	44.8	60.0	0.25	5,576.5	WHPF	OK
3-1	XV-1338	1102-T-01	44.8	93.7	0.25	72,998.8	WHPF	OK
3-2	XV-2338	1202-T-01	44.8	93.7	0.25	72,998.8	WHPF	OK
4-1A	XV-1503	1103-D-01	44.8	94.1	0.25	4,835.0	WHPF	Hold
4-1B	XV-2503	1203-D-01	44.8	94.1	0.25	4,835.0	WHPF	Hold
4-2A	XV-1521	1103-A-01A	44.8	168.3	0.25	10,097.4	WHPF	Hold
4-2B	XV-1531	1103-A-01B	44.8	168.3	0.25	10,097.4	WHPF	Hold
4-2C	XV-2521	1203-A-01A	44.8	168.3	0.25	10,097.4	WHPF	Hold
4-2D	XV-2531	1203-A-01B	44.8	168.3	0.25	10,097.4	WHPF	Hold
5	XV-3054	1104-D-01	44.8	8.3	0.25	45,580.7	DHPF	OK
6	XV-3076	1104-C-01	1.01	188.8	0.25	4,949.5	DHPF	OK
7	XV-3128	1104-T-01	21.5	-39.3	0.25	97,596.0	DHPF	OK
8	XV-3066	1104-C-02	1.01	213.3	0.25	9,832.9	DHPF	OK
9	XV-3161	1104-T-02	21.5	82.2	0.25	107,740.2	DHPF	OK
10	XV-3279	1104-T-03	7.0	88.3	0.25	39,802.6	DHPF	OK

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Microsoft Excel - Dep_summary.xls

파일(F) 편집(E) 보기(V) 삽입(I) 서식(O) 도구(T) 데이터(D) 창(W) 도움말(H) Acrobat

Arial 9

B13 XV-1503

	A	B	C	D	E	F	L	M	N	O	P
1											
2											
3											
4	No.	Item	BV Located at	System Includes			Vessel Wall Temperature(°C)		Blowdown Rate		Remarks
5							End	Min	kg/h	(계산)	
7	1-1	XV-1195	1101-D-01A	LTV 1101-01			10.61	10.61	8,371.0	8,385.4	
8	1-2	XV-1198	1101-D-01B	LTV 1101-01			10.61	10.61	8,371.0	8,385.4	
9	2-1	XV-1155	1101-A-01	1101-S-01AB			6.51	6.51	5,464.5	5,464.5	
10	2-2	XV-2155	1201-A-01	1201-S-01AB			6.51	6.51	5,464.5	5,464.5	
11	3-1	XV-1338	1102-T-01	1102-E-01, 1102-D-02			81.01	81.01	67,973.6	67,973.8	
12	3-2	XV-2338	1202-T-01	1102-E-01, 1102-D-02			81.01	81.01	67,973.6	67,973.8	
13	4-1A	XV-1503	1103-D-01	1103-E-02, 1103-E-03, LTV 1103-01			40.82	40.82	4,379.3	4,490.1	
14	4-1B	XV-2503	1203-D-01	1203-E-02, 1203-E-03, LTV 1203-01			40.82	40.82	4,379.3	4,490.1	
15	4-2A	XV-1521	1103-A-01A	1103-S-01, 1103-C-01, 1103-F-01			95.55	95.55	9,494.2	17,616.9	
16	4-2B	XV-1531	1103-A-01B	1103-S-01, 1103-C-01, 1103-F-01			95.55	95.55	9,494.2	17,616.9	
17	4-2C	XV-2521	1203-A-01A	1203-S-01, 1203-C-01, 1103-F-01			95.55	95.55	9,494.2	17,616.9	
18	4-2D	XV-2531	1203-A-01B	1203-S-01, 1203-C-01, 1103-F-01			95.55	95.55	9,494.2	17,616.9	
19	5	XV-3054	1104-D-01	1104-E-01, 1104-E-02			-36.62	-36.62	37,121.6	37,121.7	
20	6	XV-3076	1104-C-01				-57.98	-57.98	4,023.6	4,023.6	
21	7	XV-3128	1104-T-01	1104-E-03			-76.17	-76.17	59,657.8	59,666.6	
22			1104-T-01	1103-E-03, 1203-E-03, 1104-E-01			28.26	28.26			
23	8	XV-3066	1104-C-02				29.54	29.54	8,258.0	-	
24	9	XV-3161	1104-T-02	1104-E-02, 1104-E-03, 1104-E-04			28.07	28.07	70,592.3	70,592.8	
25	10	XV-3279	1104-T-03	1104-E-06			55.38	49.46	33,788.7	33,788.7	

그리기(B) 도형(U) 개

6.0 REVISION HISTORY

Rev. No.	Date	Revision Page	Remarks
0	2004. 11. 29	All	- Preparation Team: Process Engineering Team Prepared by: Kyong Jin Mun Reviewed by: Young Youl Koo, Jae Chul Ro Approved by: Chan Sul Jung
1	2010. 11. 20	All	Document number revision - Prepared by : D.S. Song - Reviewed by : H. Sung, J.C. Ro, H.H. Kwak, M.H. Oh, S.U. Hong - Approved by : E.D. Lee