

ภาคผนวกที่ 10

เอกสารข้อมูลอัตราการแผ่รังสีความร้อนของโครงการ
และ Procedure Start-Stop Flare Stack
และสถิติการใช้หอเผาทิ้ง (Flare)

<h1 style="margin: 0;">ZEECO, INC</h1>		ZEECO DOCUMENT NUMBER: 17678- 1101 ZEECO S.O: 17678																					
CLIENT: PTT Asahi Chemical Co. Limited (PITAC) PLANT: AN AND MMA Project PROJECT: 07X5772A CLIENT P.O. NO: LOI#08P100A-F0005 PTTAC DOC NO: Z4-0801.01-FK7.010A-011-M		<h2 style="margin: 0;">FLARE SYSTEM</h2>																					
<h2 style="margin: 0;">RADIATION CALCULATIONS</h2>		<div style="border: 2px solid black; border-radius: 50%; padding: 10px; display: inline-block;"> <p style="margin: 0; text-align: center;">MASTER JUL 13 2009 CTCI</p> </div>																					
<div style="border: 1px solid black; padding: 5px;"> <input checked="" type="checkbox"/> E: Work May proceed. <input type="checkbox"/> F: Work May proceed, Submit final drawings. <input type="checkbox"/> G: Revise and Resubmit. Work may proceed subject to incorporation of changes indicated. <input type="checkbox"/> H: Revise and Resubmit, Work may not Proceed. <input type="checkbox"/> I: Review Not Required, Work May proceed. Submit / Resubmit with _____ Days </div>		<div style="border: 1px solid black; padding: 5px;"> <p>THIS REVIEW DOES NOT RELIEVE THE CONTRACTOR OF HIS RESPONSIBILITY FOR ERRORS IN DESIGN</p> <p>By: [REDACTED] Date: 7/19/09</p> </div>																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>REV</th> <th>DATE</th> <th>BY</th> <th>APPROVED</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>09-JUL-09</td> <td>DLL</td> <td>SLK</td> <td>FOR APPROVAL</td> </tr> <tr> <td>1</td> <td>08-APR-09</td> <td>DLL</td> <td>KAN</td> <td>FOR APPROVAL</td> </tr> <tr> <td>0</td> <td>31-MAR-09</td> <td>DLL</td> <td>KAN</td> <td>FOR APPROVAL</td> </tr> </tbody> </table>				REV	DATE	BY	APPROVED	DESCRIPTION	2	09-JUL-09	DLL	SLK	FOR APPROVAL	1	08-APR-09	DLL	KAN	FOR APPROVAL	0	31-MAR-09	DLL	KAN	FOR APPROVAL
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Client:	CTCI	Zesco Document Number:	T70439F-RAD-CALC
End User:	AN-MMA	Zesco Ref:	T70439F Rev. Final
Project Name:	AN and MMA Project	Date:	July 9, 2009
Client Ref:	AN-MMA	Location:	Thailand

**Stack Height Calculations Per API RP-521
Fourth Edition, March 1997
Appendix 'C', Section C.3**

Design Basis

Maximum Cumulative Allowable Radiation:
Solar Radiation (Included in Maximum Cumulative Allowable Radiation above):

NOTE: API RP-521 radiation calculation does not include solar radiation, therefore the design basis for radiation used in these calculations shall be:

Max. Cumulative Allowable Radiation - Solar Radiation: $1500 - 300 = 1,200 \text{ Btu/hr-ft}^2$

Wind Velocity:	30 ft/sec
Flare Tip Diameter:	54 inches
Flare Gas Flow:	220,460 lb/hr
Flare Gas MW:	44.1
Flare Gas Temperature:	122 Fahrenheit
Relative Humidity:	60.8 %

Specified Radiation Point of Interest: 98.4ft (30) from base of flare stack

[illegible]

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Basic Radiation Calculation Formula: $D^2 = \tau FQ / 4 \pi K$ where:

D = distance from center of flare flame to point of interest for radiation in feet
 τ = fraction of heat intensity transmitted, (cannot be greater than 1.0) Value decreases with increase in humidity.
 τ = fraction of total heat release emitted as radiant heat. This value is typically set by the flare system supplier based on testing data.
 Q = total heat release based on lower heating value of the gases being flared. This is expressed in Btu/hr units.
 Π = constant with value of 3.14159
 k = allowable or resultant radiation value at the point of interest given in Btu/hr-ft²
 R = radius from stack base to point of interest

D =	unknown
$\tau =$	unknown
F =	0.33
Q =	4094569860 Btu/hr
$\Pi =$	3.14159
K =	1,200 Btu/hr-ft ²
R =	98.4ft (30m)

Calculation of Flame Center

Gas Discharge Velocity = U_g

For the Zeeco flare tip, the exit velocity for this case is: $U_j = 42$ ft/sec
The design wind speed is: $U_a = 30$ ft/sec

Therefore: $U_i / U_a = 1.4$


We also know that:

And that:

$M_j = \text{Flare Gas MW} =$	44.1
$M_a = \text{Ambient Air MW} =$	29

Therefore: $M_j / M_a = 1.521$

[illegible]



Zeeco, Inc.

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Calculation of Flare Stack Height

$$D = [(\tau \times F \times Q) / (4 \times 3.14159 \times K)]^{1/2}$$
$$\tau = 0.79 \times (100/r)^{1/16} \times (100/D)^{1/16}$$

Solving for D using tau is an iterative process, typically started at tau = 1.0.

For: r = 61 % and D = 271 ft

tau = 0.766

Checking D, using calculated tau: $D = [(0.766 \times 0.33 \times 409456960 \text{ Btu/hr}) / (4 \times 3.14159 \times 1200)]^{0.5}$

D = 262 ft

Determination of Flare Stack Height

Referencing API RP-521, Appendix 'C', C.3.5

Stack Height is defined as "H".


$H = D - Y_c$

H = 262 - 36.7 = **225.3 feet tall** 68.7m

The above height (H), is the height of the flare stack required to meet the required radiation at any grade level location.

If there is a specific point of interest for radiation on this project, proceed to the next section.

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Calculation of Flame Center (Continued)

Reference: API RP-521, Appendix C.3, Location of Flame Center C.3.3.

$$CL = C_{L1} (U_i/U_d) \times (W_i/M_d)$$
$$C_{L1} = 0.021 \text{ (for the 44.1MW flare gas on this project) = L.E.L. (As Required by NCRA)}$$
$$CL = 0.021 (42 / 30) \times (44.1 / 29)$$


CL = 0.045

$$dJR = d[(U_i/U_d) \times (T_{ar}/T) \times M]^{1/2}$$
$$dJR = (54/12) (42/30) \times (520/582 \times 44.1)^{0.5}$$

dJR = 40

From Figure C-2a: Xc = 179.7 ft
From Figure C-3a: Yc = 36.7 ft

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Determination of Flare Stack Height Using a Specific Point of Interest

From Figure C.1 of the API RP-521, we know the following:

$$D^2 = R^2 + H^2$$
$$H' = H + Y_c$$
$$R' = R + X_c$$

Solving for R', we get: $R' = 98.4 - 179.7 = -81.3$ feet

Now, solving for H': $H' = (D^2 - R'^2)^{1/2} = (271.3^2 - (-81.3)^2)^{0.5}$

$$H' = 249 \text{ feet} \quad (75.9\text{m})$$

Therefore, the stack height required is:

$$H = H' - Y_c$$
$$H = 249 - 36.7$$
$$H = 212.3 \text{ feet tall} \quad (64.7\text{m})$$

Rev	Date	By	Approved	Description

 PTT Asahi Chemical Company Limited	
Title: Start-Stop Flare stack (VR-220)	Effective date: 16-Jul-18
Document No: WI-AN-8063	Revision No: 1

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สถิติการใช้งานอุปกรณ์ห่อเผา (Flare) ในกรณีฉุกเฉิน ย้อนหลัง 3 ปี ตั้งแต่ปีพ.ศ. 2563 – 2565
บริษัท พีทีที อาซาฮี เคมิคอล จำกัด

ปี	สถิติการใช้งานอุปกรณ์ห่อเผา (Flare) ในกรณีฉุกเฉิน (ครั้ง)	ระยะเวลา	สาเหตุ
2563	0	-	-
2564	0	-	-
2565	0	-	-