Industrial Refrigeration Process & Instrument Diagrams (P&ID's)

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Agenda

P&ID

- Why are P&ID's necessary?
- Who creates a P&ID?
- What is on a P&ID?
- When is a P&ID needed?
- Where do you see P&ID's?

Industrial Refrigeration Process

- **Poll#1-**
- What is refrigeration?

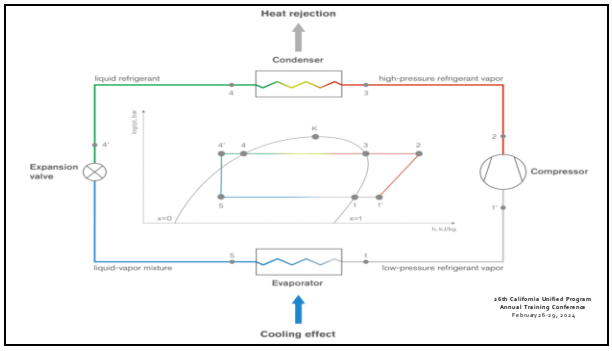
A.) Making it cold

B.) Removing heat

Industrial Refrigeration Process

Refrigeration works by:

B.) Removing HEAT from a space or product and then displacing heat.



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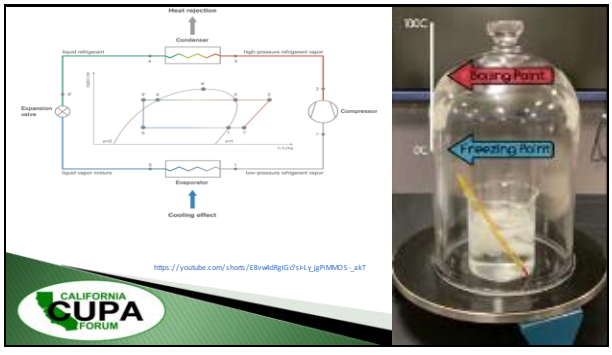
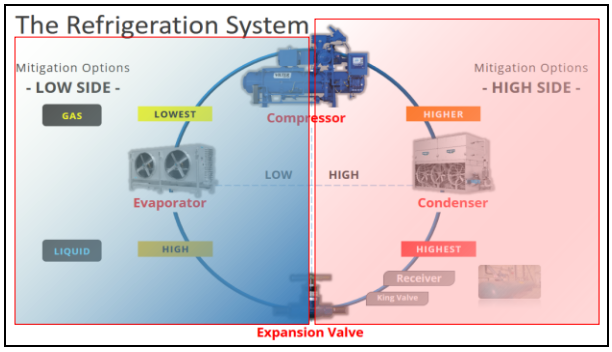
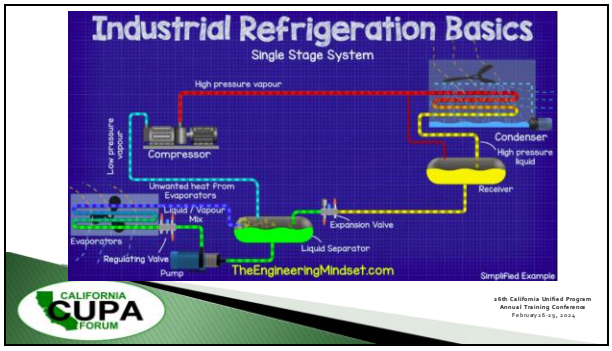



The Refrigeration System
Mitigation Options
- LOW SIDE -
Mitigation Options
- HIGH SIDE -
GAS
LOWEST
Compressor
HIGHER
LOW
HIGH
Evaporator
Condenser
LIQUID
HIGH
HIGHEST
Receiver
King Valve
Expansion Valve


Industrial Refrigeration Basics
Single Stage System
High pressure vapour
Low pressure vapour
Compressor
Condenser
High pressure liquid
Receiver
Unwanted heat from Evaporators
Liquid / Vapour Mix
Expansion Valve
Evaporators
Regulating Valve
Liquid Separator
Pump
TheEngineeringMindset.com
Simplified Example
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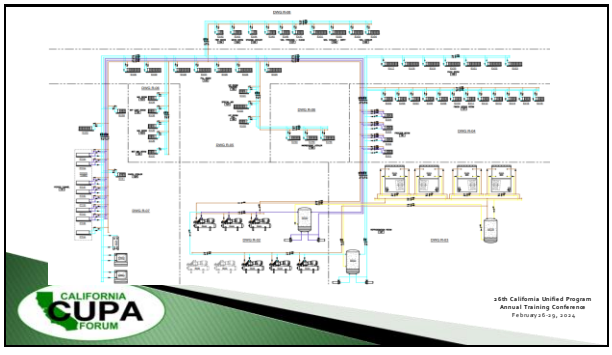
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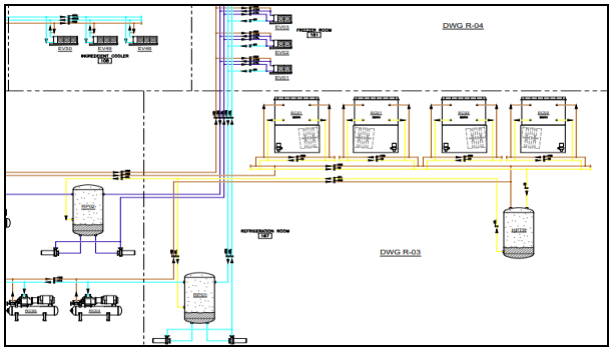

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Why are P&ID's necessary?

Governmental Agencies:

Occupational Safety and Health (Cal/FedOSHA) - Process Safety Management (PSM)

Environmental Protection Agency (EPA)- Risk Management Plan (RMP)

Unified Program Agency (UPA)- California Accidental Release Program (CalARP)

These Agencies regulate the use of hazardous chemicals, Regulated Substances (RS). Anhydrous Ammonia is identified as a RS.

Ammonia's storage and usage, if above a threshold quantity (TQ), are regulated by the agencies listed on the left.

OSHA- Process Safety Management (PSM)

OSHA 29 CFR 1910.119: A process involving chemical at or above the specified threshold quantities listed. For anhydrous ammonia, the TQ is 10,000 lbs & PSM applies. An Element of PSM is Process Safety Information (PSI). P&ID's are a part of this element and thus introducing P&ID's as a requirement.

OSHA- Process Safety Management (PSM)

Cal-OSHA Title 8 5189:
California's version of 1910.119. P&ID's required only if a facility if above the threshold quantity. For both Cal-OSHA and fed OSHA, all TQ are the same for all RS. Ammonia's TQ is also 10,000lbs for PSM.

EPA- Risk Management Plan (RMP)

EPA Title 40 CFR part 68:
RMP rule implements section 112(r) of 1990 CAA for facilities that use TQ of extremely hazardous substances. For anhydrous ammonia, the TQ is also 10,000lbs require that an RMP be filed. Based on EPA Checklist RMP has 3 program levels. Level 3 has Process Safety information that is required.

EPA- Risk Management Plan (RMP)

Cal-EPA Title 19: Rule implement as through Cal- OES as California Accidental Release Prevention Program (CalARP). The biggest difference between Fed RMP and CalARP is the TQ for any RS is typically much lower—for our example, Anhydrous Ammonia is 500lbs. Essentially, the vast majority of systems would need to develop a CalARP - RMP. Program level 3 facilities must compile PSI which includes P&ID.

CalARP Program 2 Safety Information

The owner/operator must compile and maintain this safety information:	The owner operator must ensure:	The owner/operator must update the safety information if:
• Safety Data Sheets • Maximum intended inventory • Safe upper and lower parameters • Equipment Specifications • codes and standards to design, build, and operate the process	that the process is designed in compliance with recognized codes, standards, and generally accepted good engineering practices	there is a major change at the facility that makes the safety information inaccurate

CalARP Implementation Guidance
Revised May 2020
Exhibit 5-1 Safety Information

US EPA RMP Program 2

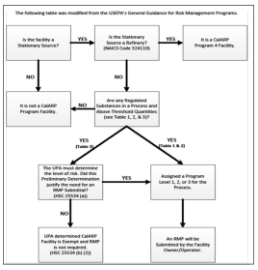
US EPA RMP Program 2 Guidance
Equipment Specifications section, page 6-4

"You are not expected to develop engineering drawings of your equipment to meet this requirement, but you must be able to document that your equipment is appropriate for the substances and activities for which it is used, and you must know what the limits of the equipment are."

EPA RMP Implementation Guidance
January 26, 1999
Page 6-4

RMP Program Chart

CalARP Implementation Guidance
Revised May 2020
Exhibit 1-3 Program Applicability



CalARP Table 3 Risk Determinations

- CalARP Implementation Guidance, revised May 2020, Appendix F
- "The California Health and Safety Code Section 25534 requires the UPA to make a preliminary determination whether there is a significant likelihood that a facility's use of a Table 3 regulated substance poses an accident risk."

CalARP Table 3 Risk Determinations

- CalARP Implementation Guidance, revised May 2020, Appendix F
- This "UPA preliminary risk determination" only applies to Table 3 facilities; it does not apply to Table 1 or Table 2 facilities. Table 1 or Table 2 facilities are automatically in the CalARP Program.

CalARP Table 3 Risk Determinations

- CalARP Implementation Guidance, revised May 2020, Appendix F, Suggestions for CalARP Program Facility Risk Ranking
- Option 1: If the facility has a chemical above the threshold quantity, in a process, an RMP is automatically required; no risk determinations are necessary. Every facility can be given the same RMP due date 12 months in advance. End of discussion.

CalARP Table 3 Risk Determinations

- CalARP Implementation Guidance, revised May 2020, Appendix F, Suggestions for CalARP Program Facility Risk Ranking
- Option 2: If administrative reality or logic necessitates a graduated approach to requesting California-only RMPs, the following approach is one way to quantify the process of ranking each facility's potential risk to health and safety and the environment. This same process could be used by the UPA to justify Program 3 requirements. See Appendix F for methodology.

CalARP Table 3 Risk Determinations

- CalARP Implementation Guidance, revised May 2020, Appendix F, Suggestions for CalARP Program Facility Risk Ranking
- Note of Caution: Whatever process is used, the UPA will need to establish and follow written policies and procedures and document each and every case where risk ranking is applied. This is to protect the UPA from possible accusations of being arbitrary and capricious, especially if competitors from the same industry are going to be impacted differently within the same jurisdiction or if environmental justice issues are raised.

CalARP Table 3 Risk Determinations

- CalARP Implementation Guidance, revised May 2020, Appendix F, Suggestions for CalARP Program Facility Risk Ranking
- Complete this process for every potential CalARP Program facility and rank the scores from highest to lowest.
- Develop criteria for establishing at what specific points RMPs (and/or Program 3) will be required.
- Commit the methodology to a written procedure and have your UPA management approve, adopt, or modify the policy

Program Elements PSM

1. Employee Participation
2. Process Safety Information (PSI)
3. Process Hazard Analysis (PHA)
4. Operating Procedures
5. Training
6. Contractors
7. Pre-startup Safety Review (PSSR)
8. Mechanical Integrity (MI)
9. Hot Work Permit
10. Management of Change (MOC)
11. Incident Investigation
12. Emergency Planning and Response
13. Compliance Audits
14. Trade Secrets

RMP

EXHIBIT 2-4
COMPARISON OF PROGRAM REQUIREMENTS

Program 1	Program 2	Program 3
Worst-case release analysis	Worst-case release analysis	Worst-case release analysis
	Alternative release analysis	Alternative release analysis
5-year accident history	5-year accident history	5-year accident history
	Document management system	Document management system
Prevention Program		
Certify no additional prevention steps needed	Safety Information	Process Safety Information
	Hazard Review	Process Hazard Analysis
	Operating Procedures	Operating Procedures
	Training	Training
	Maintenance	Mechanical Integrity
	Incident Investigation	Incident Investigation
	Compliance Audit	Compliance Audit
		Management of Change
		Pre-Startup Review
		Contractors
		Employee Participation
		Hot Work Permits
Emergency Response Program		
Coordinate with local responders	Develop plan and program and coordinate with local responders	Develop plan and program and coordinate with local responders
Submit One Risk Management Plan for All Covered Processes		

Process Safety Information

For chemicals, you must complete information on:	For process technology, you must provide:	For equipment in the process, you must include information on:
✔Toxicity ✔Permissible exposure limits ✔Physical data ✔Reactivity ✔Corrosivity ✔Thermal & chemical stability ✔Hazardous effects of inadvertent mixing of materials that could foreseeably occur	✔A block flow diagram or simplified process flow diagram ✔Information on process chemistry ✔Maximum intended inventory of the EPA-regulated chemical ✔Safe upper & lower limits for such items as temperature, pressure, flows, or composition ✔An evaluation of the consequences of deviation	✔Materials of construction ✔Piping & instrument diagrams (P&IDs) ✔Electrical classification ✔Relief system design & design basis ✔Ventilation system design ✔Design codes & standards employed ✔Safety systems ✔Material and energy balances for processes built after June 21, 1999

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P&ID

- Why are P&ID's necessary? ✓
- Who creates a P&ID?
- What is on a P&ID?
- When is a P&ID needed?
- Where do you see P&ID's?

Who creates a P&ID?

Poll#2-

Who can draw a P&ID?

A.) Mayor
B.) Anyone
C.) Engineer
D.) Operator

Who creates a P&ID?

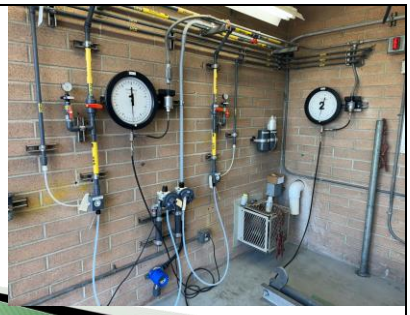
Poll#2-

Who can draw a P&ID?

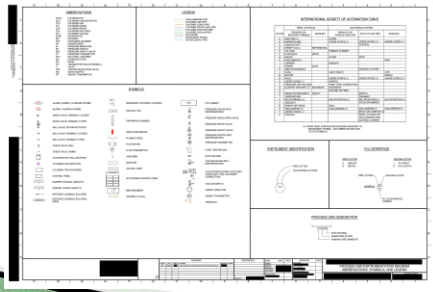
- B.) Anyone

  The PSM/ RMP/ CalARP P&ID responsibility is not specific to who creates a P&ID. The requirement is of the employer/owner or owner/ operator (employees) that a P&ID is created, updated, and made available to those who operate, maintain, and manage the system.

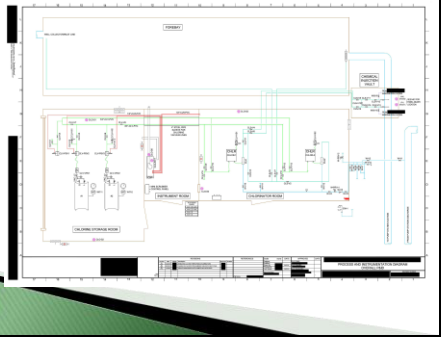
P&IDs Exercise-



P&IDs Exercise-



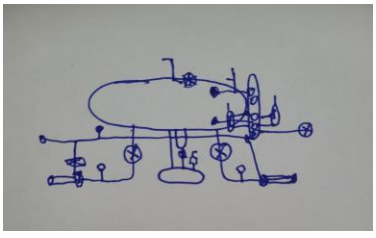
P&IDs Exercise-



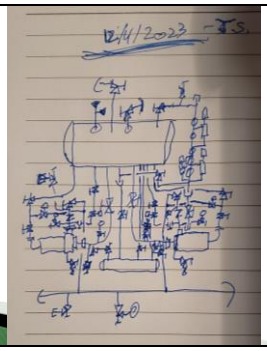
P&IDs
Exercise-

BREAK TIME!

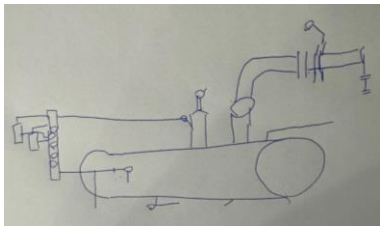
P&ID-
Eileen 10 minute
Effort



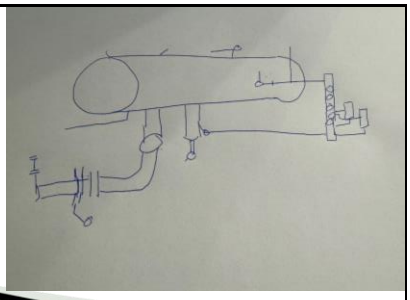
P&ID-
Jesus 10 minute
Effort



P&ID-
Alvin 10 minute
"effort"



P&ID-
Alvin 10 minute
"effort"



Agenda

P&ID

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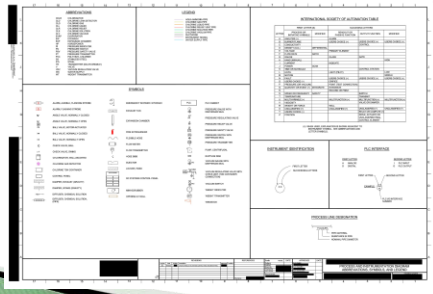
What is on a P&ID?

- PSM/ RMP Program 3/ CalARP P&ID:
- PSI requires P&ID as an element of the information pertaining to the equipment in the process.
  - Information
    - Manufacturer Name, Serial#, Model#, service specification, Pressure & Temperature Specification, size, etc.
  - Pertaining to Equipment
    - Piping- piping connecting the individual instruments.
    - Instrumentation- Press. & Temp. control equipment, Flow equipment, Compressors, Condenser, Vessels, Pumps, Valves, Sensors, etc.

P&IDs Example- Legend



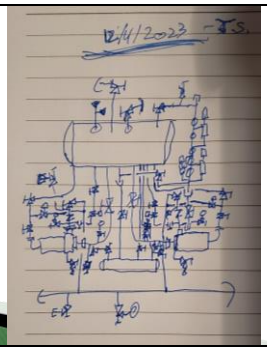
Piping & Instrumentation Diagram (P&ID)

- Title Sheet schedule listing:
  - All diagrams in the drawing set.
  - Legend with piping/mechanical symbols & abbreviations
  - General notes –
    - piping specifications
    - ANSI/ASME B31.5 or IIAR-2 references
    - pipe labeling, valve tagging, safety valve and other information relating to the refrigeration system

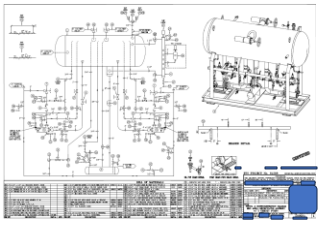
Piping & Instrumentation Diagram (P&ID)

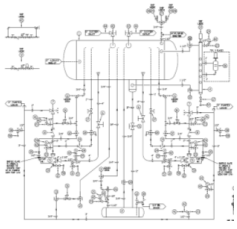
- **Poll#3-**
- As a regulator, would you, could you or should you accept a hand a drawing as a P&ID?
  - Yes
  - No

P&ID-
Jesus 10 minute
Effort



P&ID by Manufacturer-

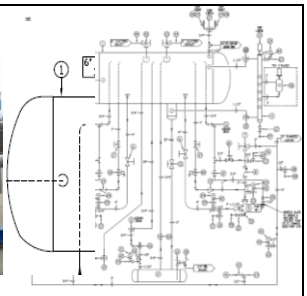




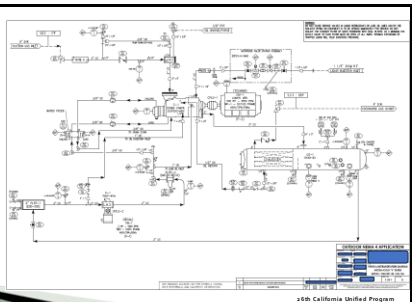
Piping & Instrumentation Diagram (P&ID)

Poll#4-

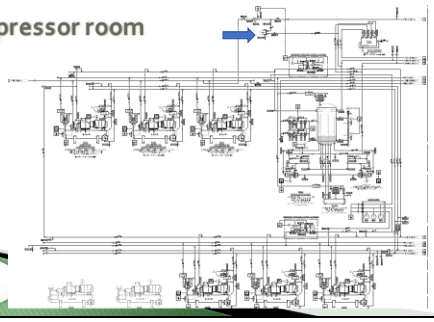
Did anyone notice any inconsistencies?



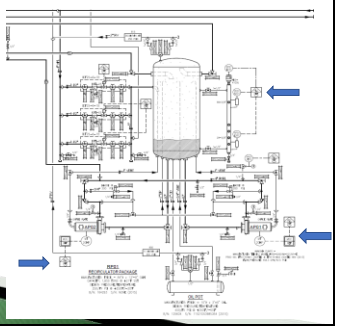
P&IDs by Manufacturers-



P&ID – compressor room



P&ID – Low Pressure Receiver



Valve Schedules

TAG#	SIZE	LINE	STAT	ABBR	DESCRIPTION	DWG	LOCATION	COMMENTS/NOTES
HS01					FRICK HIGH STAGE SCREW COMPRESSOR PKG MODEL #RWF-II-270	R-02/10	COMPRESSOR ROOM	S/N XXXXI (2018)
FF# L97004					+25°F SST / +85°F SDT - 632.4 TONS @ 579.1 BHP			
					MOTOR: 625 HP (SS)			
OS01					FRICK OIL SEPARATOR: 36"D X XX'-0" OAL	R-02/10	HS01	NIB XXXXX
FF# L97016					DESIGN PRESSURE / TEMPERATURE: XXX PSI @ +XXX°F/-XX°F			S/N XXXXI (2018)
HS01-01	8"	HTS	N.O.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	
HS01-02	8"	HTS	N.C.	CV	CHECK VALVE	R-02/10	HS01	
HS01-03	6"	HSD	N.O.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	
HS01-04	6"	HSD	N.C.	CV	STOP/CHECK VALVE	R-02/10	HS01	
HS01-05	1/4"	HSD	N.C.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	SERVICE VALVE
HS01-06	3/4"	RV	-----	WV	THREE-WAY VALVE	R-02/10	HS01	
HS01-07	3/4"	RV	-----	RV	RELIEF VALVE	R-02/10	HS01	SHANK #814 @ 300 PSI
HS01-08	3/4"	RV	-----	RV	RELIEF VALVE	R-02/10	HS01	SHANK #814 @ 300 PSI
HS01-09	3/4"	LIC	N.O.	GV	GLOBE SHUT-OFF VALVE	R-02/10	HS01	DANFOSS #CF-20B
HS01-10	3/4"	LIC	-----	MV	MOTORIZED VALVE	R-02/10	HS01	DANFOSS #CF-20B
HS01-11	3/4"	LIC	N.C.	SV	SOLENOID VALVE	R-02/10	HS01	DANFOSS #CF-20B
HS01-12								
HS01-13	3/4"	LIC	-----	ST	STRAINER	R-02/10	HS01	DANFOSS #CF-20B
HS01-14	3/8"	LIC	N.C.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	SERVICE VALVE
HS01-15	3/4"	LIC	N.O.	GV	GLOBE SHUT-OFF VALVE	R-02/10	HS01	DANFOSS #CF-20B
HS01-16	3/4"	-----	N.C.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	PUMPOUT
HS01-17	1/2"	OD	N.C.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	SERVICE VALVE
HS01-18	2-1/2"	OD	N.O.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	
HS01-19	1/4"	OD	N.O.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	TRANSDUCER VALVE
HS01-20	1/2"	OD	N.C.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	SERVICE VALVE
HS01-21	1/4"	OD	N.C.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	SERVICE VALVE
HS01-22	2-1/2"	OD	N.O.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	
HS01-23	1/4"	OD	N.O.	AV	ANGLE SHUT-OFF VALVE	R-02/10	HS01	

Compressors | Condensers | Recirculators | Vessels | Evaporators | Heat Exchangers | Chillers | Air Handling Units | Misc Equip

BREAK TIME!

Agenda

P&ID

- Why are P&ID's necessary? ✓
- Who creates a P&ID? ✓
- What is on a P&ID? ✓
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- Where do you see P&ID's?

Process Safety Information

- the owner or operator shall complete a compilation of written process safety information before conducting any Process Hazard Analysis (PHA) required by the chapter.

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Process Safety Information

For chemicals, you must complete information on:	For process technology, you must provide:	For equipment in the process, you must include information on:
✔Toxicity ✔Permissible exposure limits ✔Physical data ✔Reactivity ✔Corrosivity ✔Thermal & chemical stability ✔Hazardous effects of inadvertent mixing of materials that could foreseeably occur	✔A block flow diagram or simplified process flow diagram ✔Information on process chemistry ✔Maximum intended inventory of the EPA-regulated chemical ✔Safe upper & lower limits for such items as temperature, pressure, flows, or composition ✔An evaluation of the consequences of deviation	✔Materials of construction ✔Piping & instrument diagrams (P&IDs) ✔Electrical classification ✔Relief system design & design basis ✔Ventilation system design ✔Design codes & standards employed ✔Safety systems ✔Material and energy balances for processes built after June 21, 1999

Process Hazard Analysis

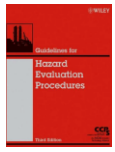
The PHA shall be appropriate to the complexity of the process and shall **identify, evaluate, and control the hazards involved in the process**.

The owner or operator **shall work closely** with UPAs in deciding which PHA methodology is best suited to determine the hazards of the process being analyzed. Ow/Op shall use one or more of the following methodologies that are appropriate to determine and evaluate the hazards of the process being analyzed:

(1) What-If*
(2) Checklist*
(3) What-If / Checklist*
(4) Hazard and Operability Study (HAZOP);
(5) Failure Mode and Effects Analysis (FMEA);
(6) Fault Tree Analysis; or,
(7) An appropriate equivalent methodology.

Process Hazard Analysis – brief overview

Goal of a PHA is to identify what could **cause a release**, what the **consequences** of the release could be in terms of **severity** and **likelihood**, determine the **safeguards**, the risks and if the system or process needs to be modified to **reduce the risk**.



Process Hazard Analysis – brief overview

consequences of the release in term of severity and likelihood = offsite impacts to **community health and safety**.

CUPA

CalEPA California Environmental Protection Agency

EPA

CALIFORNIA CUPA FORUM

Process Hazard Analysis – brief overview

- At least once every five years from the date of initial submission or most recent update;
- No later than three years after a newly regulated substance is first listed;
- No later than the date on which a new regulated substance is first present in an already covered process above a threshold quantity;
- No later than the date on which a regulated substance is first present above a threshold quantity in a new process;
- **Within six months of a change that requires a revised PHA or hazard review;**
- Within six months of a change that requires a revised OCA; and,
- Within six months of a change that alters the Program level.

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Agenda

P&ID

- Why are P&ID's necessary? ✓
- Who creates a P&ID? ✓
- What is on a P&ID? ✓
- When is a P&ID needed? ✓
- Where do you see P&ID's?

Where do you see P&ID's?

Process Safety Rules: explicitly stated

Program Requirement	CalARP	EPA	CalOSHA	OSHA
Program Levels 1, 2, and 3	Yes	Yes	No	No
Management System	2735.6	68.15		
Hazard Assessment/Offsite Consequence Analysis	2750.1-9	68.20 -42		
Process Safety Information	2760.1	68.65	5189(d)	1910.119(d)
Process Hazard Analysis	2760.2	68.67	5189(e)	1910.119(e)
Operating Procedures	2760.3	68.69	5189(f)	1910.119(f)
Training	2760.4	68.71	5189(g)	1910.119(g)
Mechanical Integrity	2760.5	68.73	5189(j)	1910.119(j)
Management of Change	2760.6	68.75	5189(l)	1910.119(l)
Pre-Startup Safety Review	2760.7	68.77	5189(i)	1910.119(i)
Compliance Audit	2760.8	68.79	*IIPP*	1910.119(o)
Incident Investigation	2760.9	68.81	5189(m)	1910.119(m)
Employee Participation	2760.10	68.83	5189(p)	1910.119(c)
Hot Work Permits	2760.11	68.85	5189(k)	1910.119(k)
Contractors	2760.12	68.87	5189(h)	1910.119(h)
Emergency Planning & Response	2765.1 – 2	68.95	5189(n)	1910.119(n)
Trade Secrets				1910.119(p)

Where do you see P&ID's?

Process Safety Rules: implied use

Program Requirement	CalARP	EPA	CalOSHA	OSHA
Program Levels 1, 2, and 3	Yes	Yes	No	No
Management System	2735.6	68.15		
Hazard Assessment/Offsite Consequence Analysis	2750.1-9	68.20 -42		
Process Safety Information	2760.1	68.65	5189(d)	1910.119(d)
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Emergency Planning & Response	2765.1 – 2	68.95	5189(n)	1910.119(n)
Trade Secrets				1910.119(p)

Chapter 4.5. California Accidental Release Prevention (CalARP) Program Detailed Analysis

Article 1. General
Article 2. Registration
Article 3. Risk Management Plan Components and Submission Requirements
Article 4. Hazard Assessment
Article 5. Program 2 Prevention Program
Article 6. Program 3 Prevention Program
Article 6.5. Program 4 Prevention Program
Article 7. Emergency Response Program
Article 8. Regulated Substances for Accidental Release Prevention
Article 9. Other Requirements
Article 10. Local Program Evaluation
Article 11. Technical Assistance

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Article 3. Risk Management Plan Components and Submission Requirements

§ 2745.1. Submission.
§ 2745.2. RMP Review Process.
§ 2745.3. RMP Executive Summary Component.
§ 2745.4. RMP Offsite Consequence Analysis Component.
§ 2745.5. RMP Five-Year Accident History Component.
§ 2745.6. RMP Program 2 Prevention Program Component.
§ 2745.7. RMP Program 3 Prevention Program Component.
§ 2745.7.5. RMP Program 4 Component.
§ 2745.8. RMP Emergency Response Program Component.
§ 2745.9. RMP Certification.
§ 2745.10. RMP Updates.
§ 2745.10.5. Required RMP Corrections.
§ 2745.11. Covered Process Modification.
§ 2745.12. Certificate of Occupancy.

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Where would you see P&IDs?
Process Modification (CCR 2745.11)

When an owner or operator **intends to make a modification to a stationary source relating to a covered process** and the modification may result in a **significant increase** in either:
the amount of regulated substances handled at the stationary source as compared to the amount of regulated substances identified in the stationary source's RMP, or the
risk of handling a regulated substance as compared to the amount of risk identified in the stationary source's RMP, then the owner or operator shall do all of the following:

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Process Modification

(1) Where reasonably possible, notify the UPA in writing of the owner or operator's intent to modify the stationary source at least five calendar days before implementing any modifications. As part of the notification process, the owner or operator shall consult with the UPA when determining whether the RMP should be reviewed and revised. Where prenotification is not reasonably possible, the owner or operator shall provide written notice to the UPA no later than 48 hours following the modification.

(2) Establish procedures to manage the proposed modification, which shall be substantially similar to the procedures specified in Sections 2760.6 and 2760.7 and notify the UPA that the procedures have been established.

(b) The owner or operator of the stationary source **shall revise the appropriate documents**, as required pursuant to section (a), expeditiously, but not later than 60 days from the date of the stationary source modification.

Process Modification

Substantially similar to the procedures specified in

- CCR Section 2760.6 Management of Change and
- CCR Section 2760.7 Pre-Startup Safety Review;

Process Modification

What is **significant**?

What is **risk**?

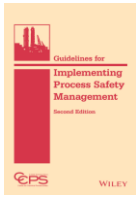
Process Modification

What is risk?

"A measure of human injury, environmental damage, or economic loss in terms of both the incident likelihood and the magnitude of the loss or injury.

A simplified version of this relationship expresses risk as the product of the likelihood and the consequences (i.e., Risk = Consequence x Likelihood) of an incident."

Risk is evaluated during a PHA (Program 3).



Process Modification

- Risk is a factor of likelihood and severity of consequences (p. 114).

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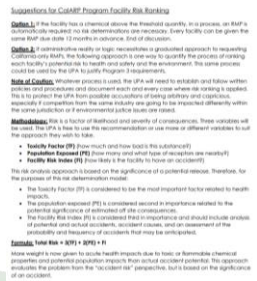
Revised May 2020



Suggestions for CalARP Program Facility Risk Ranking

Option 1: If the facility has a chemical above the threshold quantity, in a process, an RMP is automatically required; no risk determinations are necessary. Every facility can be given the same RMP due date 12 months in advance. End of discussion.

Option 2: If administrative reality or logic necessitates a graduated approach to requiring California only RMPs, the following approach is one way to quantify the process of ranking each facility's potential risk to health and safety and the environment. This same process could be used by the UPA to justify Program 3 requirements.

Note of Caution: Whatever process is used, the UPA will need to establish and follow written policies and procedures and document each and every case where risk ranking is applied. This is to protect the UPA from possible accusations of being arbitrary and capricious, especially if competitors from the same industry are going to be impacted differently within the same jurisdiction or if environmental justice issues are raised.

Methodology: Risk is a factor of likelihood and severity of consequences. Three variables will be used. The UPA is free to use this recommendation or use more or different variables to suit the approach they wish to take.

- **Toxicity Factor (TF)** (how much and how toxic is this substance?)
- **Population Exposed (PE)** (how many and what type of receptors are nearby?)
- **Facility Risk Index (FI)** (how likely is the facility to have an accident?)

This risk analysis approach is based on the significance of a potential release. Therefore, for the purposes of this risk determination model:

- The Toxicity Factor (TF) is considered to be the most important factor related to health impacts.
- The population exposed (PE) is considered second in importance related to the potential significance of estimated off-site consequences.
- The Facility Risk Index (FI) is considered third in importance and should include analysis of potential and actual accidents, accident causes, and an assessment of the probability and frequency of accidents that may be anticipated.

Formula: Total Risk = 3(TF) + 2(PE) + FI

More weight is now given to acute health impacts due to toxic or flammable chemical properties and potential population impacts than actual accident potential. This approach evaluates the problem from the "accident risk" perspective, but is based on the significance of an accident.

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Procedure:

Step 1. Calculate the Toxicity Factor (TF) for the chemical in question.

TF = Reported quantity of chemical divided by its threshold quantity, multiplied times one over the Toxic Endpoint (TE), from Appendix A of Title 19, or Appendix B of this document. If these numbers turn out to be huge, you can divide by 100 or 1000, as long as all of the TF calculations are handled the same way. Add up the TFs for multiple chemicals being used at the same facility, if applicable.

TF = (Q/TQ) X (1/TE) = ________

$TF_{total} = TF_1 + TF_2 + TF_3$...

Step 2. Calculate the best estimate for population exposure (PE).

In the absence of any other off-site consequence modeling and vulnerability analysis, try using the DOT Emergency Response Guidebook for protective action distances. Use the following questionnaire, or modify it according to conditions within the jurisdiction:

1. Can the toxic chemical become airborne rapidly (i.e., a gas, fine dust, highly volatile liquid)? Is the material highlighted in the yellow and blue indexes and listed in the green bordered pages of the DOT Emergency Response Guidebook as being Toxic by Inhalation (TIH)?

   NO = 0 YES = 2

   If answer to question #1 is No, proceed to question #6.

   If answer to question #1 is YES, determine the greatest protective action distance (or distance to toxic endpoint). Distance = ________.

2. Is there a school within the protective action (toxic endpoint) distance?

   NO = 0 YES = 2

3. Is there a hospital or nursing home within the distance?

   NO = 0 YES = 2

4. Is there residential housing within the distance?

   NO = 0 YES = 1

5. Is the population density of this area higher than average (multi-family or multi-story structures within the distance)?

   NO = 0 YES = 1

6. What is the occupancy of the facility where the chemical is being handled?

   Less than 5 people = 1

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6 to 25 people = 2

26 to 50 people = 3

More than 50 people = 4

TOTAL Population Exposure (PE) = (add the values of responses)

Step 3. Facility Process Questionnaire.

Develop a questionnaire to measure activities or conditions that increase the likelihood of a release. Add up the affirmative responses to such questions as:

1. Is the chemical manufactured or used in a chemical reaction?
2. Is there any other flammable or explosive material manufactured or used in a chemical reaction?
3. Are any of the reactions in questions 1 or 2 (above) moderately or highly exothermic (e.g., alkylation, esterification, oxidation, nitration, polymerization or condensation) or do they involve electrolysis?
4. Can an accidental release to the atmosphere result from the malfunction of a scrubbing, treatment or neutralization system or from the discharge of a pressure relief valve?
5. Does any physical or chemical process utilizing the chemical involve a batch process?
6. Does any process involving the production or use of the chemical operate at a pressure in excess of 15 psi?
7. At a pressure exceeding 275 psi?
8. Does any process involving the production or use of the chemical operate at a temperature in excess of 125 degrees F?
9. In excess of 250 degrees F?
10. Can explosive dust be present in the same building as the chemical?
11. Are there any ignition sources or open flames within 100 feet of the process, transfer or storage areas where the chemical may be present? (Areas protected by fire rated separations may warrant exclusion or predicted impact modification.)
12. Is any lined or non-metallic pipe used in the transfer of the chemical?
13. Is any equipment or piping handling the chemical more than 10 years old?
14. More than 25 years old?
15. (Delete any non-applicable questions and insert any of your own questions based on experience or local conditions.)

Total # of "Yes" answers to the questionnaire (x) =

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Step 4. Evaluate the safety record and inspection history of the facility.

This will be somewhat intuitive depending on the types and frequencies of historical accidents or violations. Put the facility in one of the three categories and assign it the corresponding value (y).

Reasonable = 0 Needs some improvement = 5 Unsatisfactory = 10

Safety Record & Inspection History (y) =

Step 5. Factor in any significant element not directly addressed in the questionnaire.

Make a note of what the complicating factor was in support of the decision. This is where, if there's a compelling reason, points may be added to require the RMP in borderline cases.

Minimal = 0 Considerable = 4 Substantial = 8

Complicating Factor (z) = (describe what the factor is and why the value)

Step 6. Assign the composite Facility Risk Index (FI)

FI = 0.5(x) + y + z FI = ________

Step 7. Assign the Total RMP Risk Score for the facility. Add up the weighted values.

Toxicity Factor (TF) from Step #1	(TF)____	x	3	=	____
Population Exposed (PE) from Step #2	(PE)____	x	2	=	____
Facility Risk Index (FI) from Step #6	(FI)____	x	1	=	____
			TOTAL RMP Risk Score		____

Example:

A farm uses Methyl Bromide in ten 150# cylinders, evaluated and considered to be in a process due to co-location. The facility exceeds the TQ (1,000 lbs) for the chemical. There are no other regulated chemicals at this stationary source.

Toxicity Factor (TF):

Quantity = 1,500; Threshold = 1,000 pounds;

1,500 lbs of methyl bromide divided by the TQ (1,000 lbs) = 1.5

TE = 0.00388 (1/TE) = 257.73

TF = 1.5 X (257.73) = 386.60

Since this is a very large number compared to the other factors, for convenience, divide it by 100. If you do this, then all of the toxicity factors for other stationary sources being compared to this one must also be divided by 100.

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TF = (386.60)/100 = 3.87

Population Exposure (PE):

DOT ERG lists methyl bromide as a Toxic by Inhalation (2 points) material with a protective distance of 0.9 miles. There is one school (2 points) and some residential housing (2 points) within this distance from the facility. There are 10 employees on site (2 points).

Therefore, Population Exposure (PE) = 8 (results from Step #2)

Facility Risk Index (FI):

There are five questions answered "yes" on the facility risk index questionnaire (x = 5). There have been no accidents, but the farm has some labeling violations and poor used oil management practices (y = 5, "Needs some improvement"). There are no other complicating factors involved (z = 0, "Minimal").

Therefore, Facility Risk Index (FI) FI = 0.5(x) + y + z
FI = 0.5(5) + 5 + 0
FI = 7.5

Total RMP Risk: (Total risk = 3(TF) + 2(PE) + FI

TF	=	3.87	x	3	=	11.61
PE	=	8	x	2	=	16
FI	=	7.5	x	1	=	7.5
	Total RMP Risk Score				=	**35.11**

Complete this process for every potential CalARP Program facility and rank the scores from highest to lowest. Develop criteria for establishing at what specific points RMPs (and/or Program 3) will be required. Commit the methodology to a written procedure and have your UPA management approve, adopt, or modify the policy.

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Emergency Response

1. HAZARD ZONE #1 - Engine Room #1

Green Playbook:™
Phase 2 Initial Response - Engaging SIMPLE checklist

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The 30-Minute Command Team
initial Response Phase

Emergency Response

CUPA CalARP rules promulgated to prevent releases of highly hazardous or <u>accidental releases</u> of extremely hazardous substances and **minimize impacts** to human health or the environment should a release occur.

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The 30-Minute Command Team
initial Response Phase

Emergency Response – Accidental Release defined

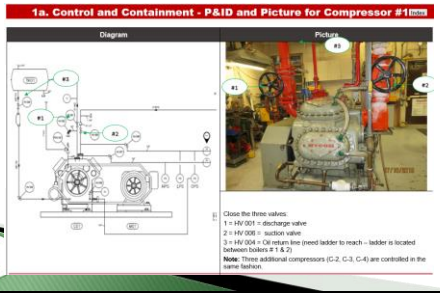
19 CCR § 2735.3

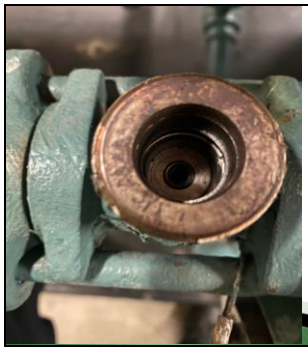
§ 2735.3. Definitions.

(a) "Accidental release" means an unanticipated emission of a regulated substance or other extremely hazardous substance into the ambient air from a stationary source.

Emergency Response

Emergency Response





Accidental Release– actual incident

A ¾" solenoid valve on one of the compressors liquid injection cooling lines blew the top off of valve (see photo) releasing liquid ammonia in Engine Room.

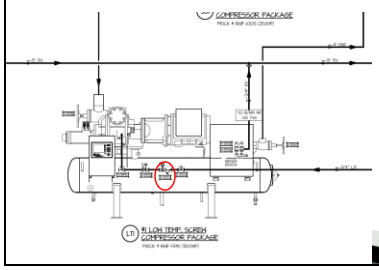
Operator hit the E-Stop as he was escaping the room.

Accidental Release– actual incident

A ¾" solenoid valve on one of the compressors liquid injection cooling lines blew the top off of valve (see photo) releasing liquid ammonia in Engine Room.

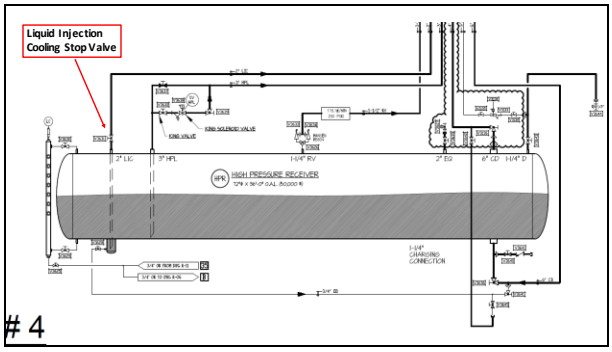
Operator hit the E-Stop as he was escaping the room.

Emergency Response

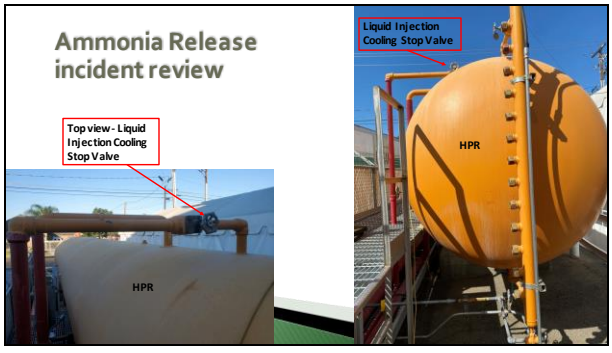


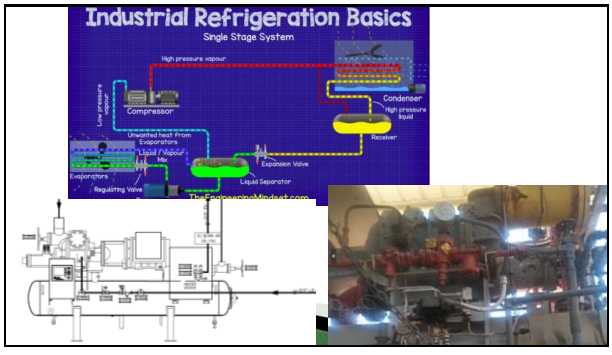
A ¾" solenoid valve on one of the compressors liquid injection cooling (SOC) lines blew the top off of valve off (see P&ID) releasing ammonia in the Engine Room.
Failed component in red circle.

Operator hit the E-Stop as he was escaping the room.


Liquid Injection
Cooling Stop Valve
HIGH PRESSURE RECEIVER

4


Ammonia Release
incident review
Top view - Liquid
Injection Cooling
Stop Valve
HPR
Liquid Injection
Cooling Stop Valve
HPR


Industrial Refrigeration Basics
Single Stage System
High pressure vapour
Compressor
Condenser
High pressure
liquid
Receiver
Unwanted heat From
Evaporators
Liquid / Vapour
Mix
Expansion Valve
Evaporators
Regulating Valve
Liquid Separator

Technical Assistance
CCR §2785.1

- The owner or operator of a stationary source **shall closely coordinate** with the UPA to ensure that **appropriate technical standards are applied** to the implementation of this chapter.
- The owner or operator of a stationary source **shall request assistance** from the UPA when necessary to address compliance with this chapter or safety issues regarding unfamiliar processes.

Agenda

P&ID

- Why are P&ID's necessary? ✓
- Who creates a P&ID? ✓
- What is on a P&ID? ✓
- When is a P&ID needed? ✓
- Where do you see P&ID's? ✓

Any Questions?

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