PROCESS SAFETY INFORMATION PROGRAM

The purpose of this extensive data form is to assist the facility with the compilation, organization and evaluation of the information that is required to be gathered under the Process Safety Information (PSI) element of NDEP-CAPP. Having complete and accurate written information concerning process chemicals, technology, and equipment is essential to an effective process safety management program.

Section 1 – Why Process Safety Information Compilation is Important

Compilation of PSI for Developing and Implementing Other Program Requirements	The compiled process safety information is a necessary resource for developing and implementing the remainder of the program requirements. Most notably, the following activities would be impossible without complete PSI: 1. The conduct of a thorough process hazard analysis (PHA) 2. The development of standard operating procedures 3. The identification of the need to conduct a management of change, and the ability to evaluate the change 4. The ability to develop a mechanical integrity program.

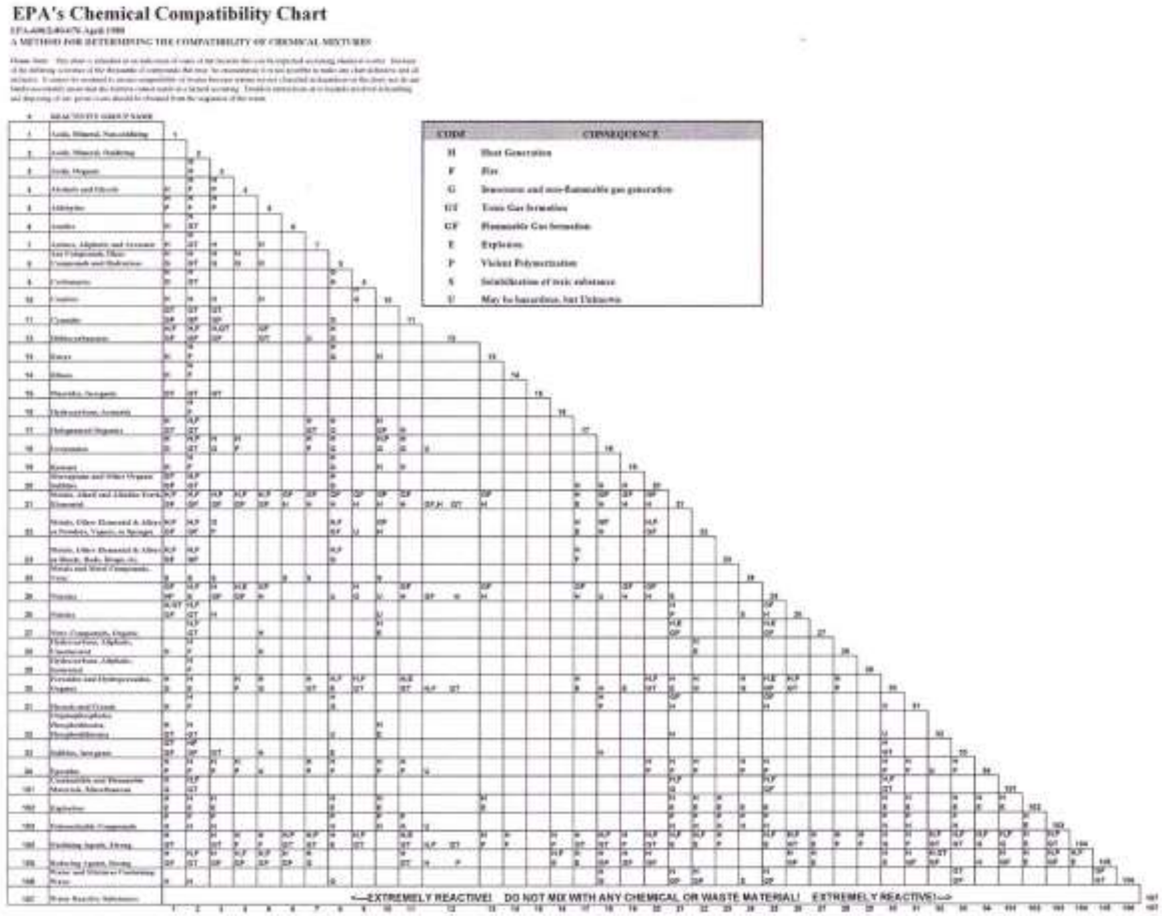
Structure of This Data Form	The following pages consist of tabular information listing data sources, equipment, and instruments that must be compiled and evaluated pursuant to the requirements of PSI. As this data form primarily contains lists of PSI, the detailed documentation that is referenced in this form must be readily available for use by the employees responsible for implementing the NDEP-CAPP program requirements and for review by the facility employees through the employee participation program. The organization of this data form generally following the format of the PSI checklist as follows: Section 2. Information Pertaining to Hazards of Substances Section 3. Information Pertaining to the Technology of the Process Section 4. Information Related to the Equipment of the Process (including safe limits) Section 5. Description of Safety Systems and Their Functions Section 6. Management Plan and Document Control Section 7. Evaluation of Code Applicability and Compliance

Section 2 – Information Pertaining to Hazards of Substances

Hazards of the Highly Hazardous Substances or Explosives	NAC 459.95255 “Highly hazardous substance” defined. (NRS 459.3818) “Highly hazardous substance” means a chemical listed in subsection 1 of NAC 459.9533, ***regardless of the amount or quantity of the chemical present.*** Information about the substances must be gathered to evaluate the potential hazards posed by its use in the regulated process. Some of this information will be available in the manufacturer’s Material Safety Data Sheets (MSDS). Much of the information will be available in other sources; such as the NIOSH Pocket Guide to Chemical Hazards; Genium’s Handbook of Safety, Health, and Environmental Data for Common Hazardous Substances; Chemical Engineers’ Handbook; etc. Information for some substances can be found on the NDEP-CAPP website at http://ndep.nv.gov. Identifying the appropriate MSDS sheets is the best way to commence this effort.

Hazards of Other Substances	While these data are required to be compiled for the highly hazardous substances as defined by regulation, compiling the same information for other substances that may potentially impact the process would be recommended under this effort as well. Generally, if the impact of a non-regulated substance may need to be considered during the PHA evaluation, the data should be compiled.

Foreseeable Hazardous Effects of Inadvertent Mixing of Different Materials	Considering the foreseeable hazardous effects of inadvertent mixing of different materials does not end with the listing of incompatibilities for the highly hazardous substance or explosives. The facility must consider what materials are on-site and if they are incompatible with the highly hazardous substance or explosive. The facility should Identify what materials are on-site, for example: • Chemicals (brought on-site) • Chemicals (produced on-site, including intermediates) • Utilities (steam, cooling water, compressed air, etc.) • Contaminants (rust, foreign objects, etc.) • Maintenance materials (solvents, lubricants, etc.) The facility should then determine which materials are incompatible. Finally, the facility should construct an incompatibility chart. Note that an incompatibility chart only considers two-component mixtures; the facility may also need to consider whether any interactions among three materials are hazardous.

Example Chart – EPA's Chemical Compatibility Chart, EPA-600/2-80-076, April 1980	
	http://www.uos.harvard.edu/ehs/environmental/EPAChemicalCompatibilityChart.pdf

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PROCESS SAFETY INFORMATION – MATERIALS SAFETY DATA SHEET SUMMARY FORM

The following table will prompt the user to locate the applicable information and identify the location of the information.
It starts with listing the relevant MSDS sheets and identifying the information that is available.
Note: Example Shown in "RED" Below

Facility:	**Process:**	**Date:**

Substance	**CAS Number**	**Reference Document**	**Revision**	**Date**	**Required Information** (see legend)						
					TI	*PEL*	*PD*	*RD*	*CD*	*T&C*	*HEM*
Chlorine	*7782-50-5*	*Matheson Tri-Gas MSDS*	*-*	*6/18/2007*	*Y*	*Y*	*Y*	*Y*		*Y*	*Y*
Chlorine	*7782-50-5*	*NIOSH Pocket Guide, 2005-149*	*-*	*9/2005*	*Y*	*Y*	*Y*				*Y*
Chlorine	*7782-50-5*	*The Chlorine Manual*	*5*	*1986*			*Y*	*Y*	*Y*		
Chlorine	*7782-50-5*	*Genium's Handbook*	*-*	*1999*	*Y*	*Y*	*Y*	*Y*			

Notes to Table:

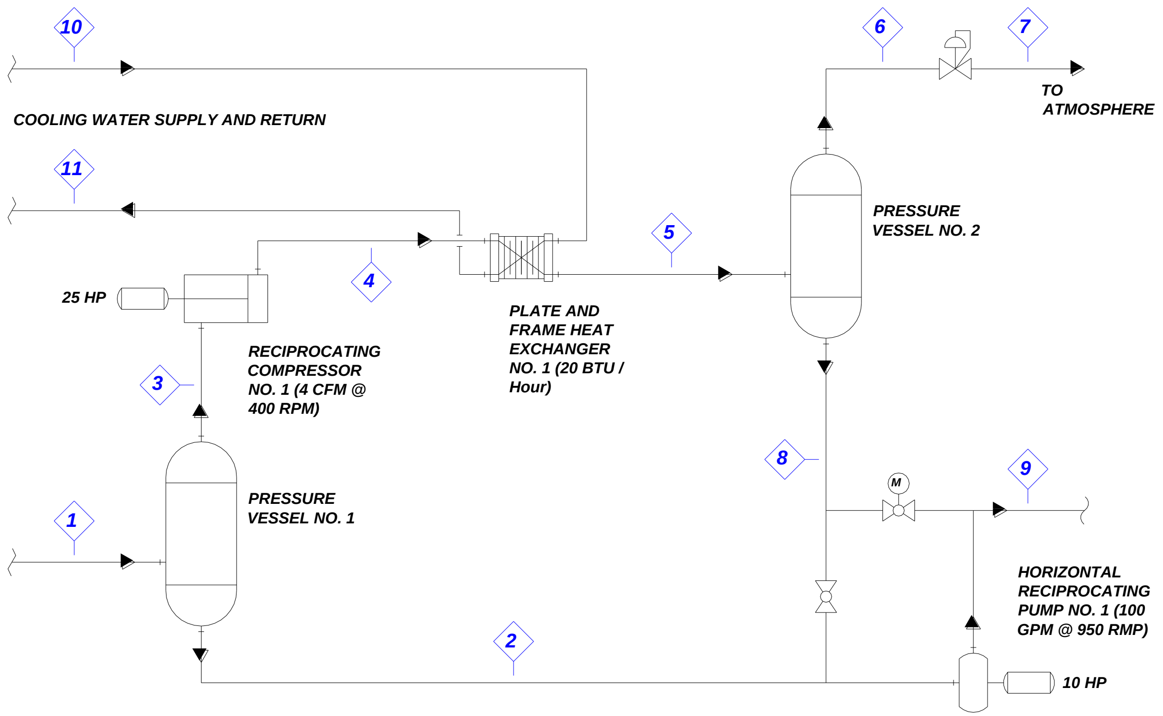
Required Information Legend:			
TI -	Toxicity Information	CD -	Corrosivity Data
PEL -	Permissible Exposure Limits	T&C -	Thermal & Chemical Stability Data
PD -	Physical Data	HEM -	Foreseeable Hazardous Effects of Inadvertent Mixing of Different Materials
RD -	Reactivity Data		

Section 3 – Information Pertaining to the Technology of the Process

Technology of the Process	Thorough development of the following drawings and data is crucial to conducting a process hazard analysis. Without this information, the consequences of many process deviations cannot be adequately defined.

Block or Simplified Process Flow Diagram	This diagram must provide an overview of the process flow. Either a block or process flow diagram is allowed by regulation. • A block flow diagram is used to show the major process equipment and interconnecting process flow lines. • Process flow diagrams are more complex and will show main flow streams, including valves, to enhance the understanding of the process, as well as points of pressure and temperature control. Also, major components of control loops and key utilities may be shown. It should be noted that a process flow diagram would lend itself better to being linked to a material and energy balance.

Example Process Flow Diagram w/Material and Energy Balance



STREAM NUMBER	1	2	3	4	5	6	7	8	9	10	11
SERVICE											
Pressure (psig)											
Temperature (°F)											
Flow											
Phase											
Composition											
Molecular Weight											
Density											

PROCESS SAFETY INFORMATION – BLOCK / PROCESS FLOW DIAGRAM SUMMARY SHEET

Note: Example Shown in "RED" Below (refer to diagram on previous page)

Facility:	**Process:**	**Date:**	
BLOCK FLOW DIAGRAM OR SIMIPLIFIED PROCESS FLOW DIAGRAM	**Diagram Title**	**Diagram No.**	**Revision No. and/or Date**

Does the Diagram include:	***Yes***	***NA***
All major equipment?	*Yes*	
Equipment names and identification numbers?	*Yes*	
Major bypass and recirculation lines?		*NA*
Control valves?	*Yes*	
Valves required demonstrating routing for all modes of operation?	*	
Interconnections to other systems?		*NA*
Equipment ratings or capacities?	*Yes*	
Correspond to the material and energy balance?	*Yes*	

** Note: This would be a deficiency that would need to be corrected (e.g., valve at the pump inlet)*

Process Chemistry	For any process that involves chemical reactions, a thorough process chemistry description must be developed. This description not only includes the normal reactions, but also must thoroughly address any potential abnormal situations. The description must include primary, secondary, side and intermediate reactions. It is particularly important to define any undesired reactions that may adversely impact process safety. If catalysts are used, the composition and properties of the catalyst should be known. The potential to form hot spots in a reactor should be identified as should the potential for runaway reactions. Kinetic data may also be important as this may impact process safety systems, including pressure relief requirements. If the only changes occurring in the process are thermodynamic, such as is the case of an anhydrous ammonia refrigeration system, this section would not be applicable.

Maximum Intended Inventory	This must be defined along with identification of how the inventory is limited. If the inventory is limited by physical storage capacity, the storage container capacities plus in-process quantities should be identified. If administrative controls are used to limit the inventory, this must be stated in some type of policy or procedure. For example, the tank filling capacity or the number of railcars of material allowed on site could be limited by such a policy.

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<table>
<tr><th colspan="4">PROCESS SAFETY INFORMATION – PROCESS CHEMISTRY AND MAXIMUM INTENDED INVENTORY SUMMARY SHEET</th></tr>
<tr><td>Facility:</td><td>Process:</td><td colspan="2">Date:</td></tr>
<tr><td rowspan="2">PROCESS CHEMISTRY</td><td>Document Title</td><td>Document No.</td><td>Revision No. and/or Date</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="2">Does the Process Chemistry Description include:</td><td>Yes</td><td>NA</td></tr>
<tr><td colspan="2">Description of chemical reactions for primary & secondary reactions?</td><td></td><td></td></tr>
<tr><td colspan="2">Description of the type and nature of catalysts used?</td><td></td><td></td></tr>
<tr><td colspan="2">Description of competing side reactions?</td><td></td><td></td></tr>
<tr><td colspan="2">Description of undesirable chemical reactions (e.g. decompositions)?</td><td></td><td></td></tr>
<tr><td rowspan="2">MAXIMUM INTENDED INVENTORY</td><td>Document Title</td><td>Document No.</td><td>Revision No. and/or Date</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="2">Does the Maximum Intended Inventory include:</td><td>Yes</td><td>NA</td></tr>
<tr><td colspan="2">Identification of storage container capacities plus in-process quantities (e.g. vessels, piping)?</td><td></td><td></td></tr>
<tr><td colspan="2">Identification of administrative controls to limit inventory?</td><td></td><td></td></tr>
</table>

Section 4 – Information Related to the Equipment of the Process

Piping and Instrument Diagrams (P&IDs)	The P&ID provides a schematic representation of the piping and control / instrumentation; which depicts the functional relationships among the system components. It accomplishes this by showing all the piping, equipment, principal instruments, instrument loops, and control interlocks; and follows the general layout of the simpler block / process flow diagram. This is a vital document for those constructing the process; those responsible for preparing flushing, testing, and blowout procedures; the process hazard analysis team; by the plant operators who operate the process system; and other program elements of the process safety management program. The first P&ID in the set should contain a legend defining all symbols used. ***Reference ISA-5.1, Instrumentation Symbols and Identification, for more information***

PROCESS SAFETY INFORMATION – PIPING AND INSTRUMENT DIAGRAMS (P&IDS) LIST

Facility:		Process:	Date:
P&ID No.	**Drawing Title**	**Process (or Process Segment / Auxiliary Process)**	**Revision No. and/or Date**

PROCESS SAFETY INFORMATION – PIPING AND INSTRUMENT DIAGRAMS (P&IDS) SUMMARY SHEET		
Facility:	**Process:**	**Date:**

Do the Piping and Instrument Diagrams include:	***Yes***	***NA***
Legend sheet?		
Cover the regulated process?		
Contain the process equipment, piping, and valves?		
Contain the process instruments?		
Cover process auxiliary systems and utilities?		
Correspond to the block / process flow diagrams?		
Correspond to the piping / valve specifications?		
Include instrument designations, equipment names / numbers, pipe and valve identification?		
Include off-sheet connectors, and do they match from drawing to drawing?		
Are specification breaks shown?		
Are size transitions shown; e.g. reducers, increasers, swages, etc.?		
Direction of flow shown?		
Is equipment design information included (e.g. pressure vessel MAWP and temperature)?		

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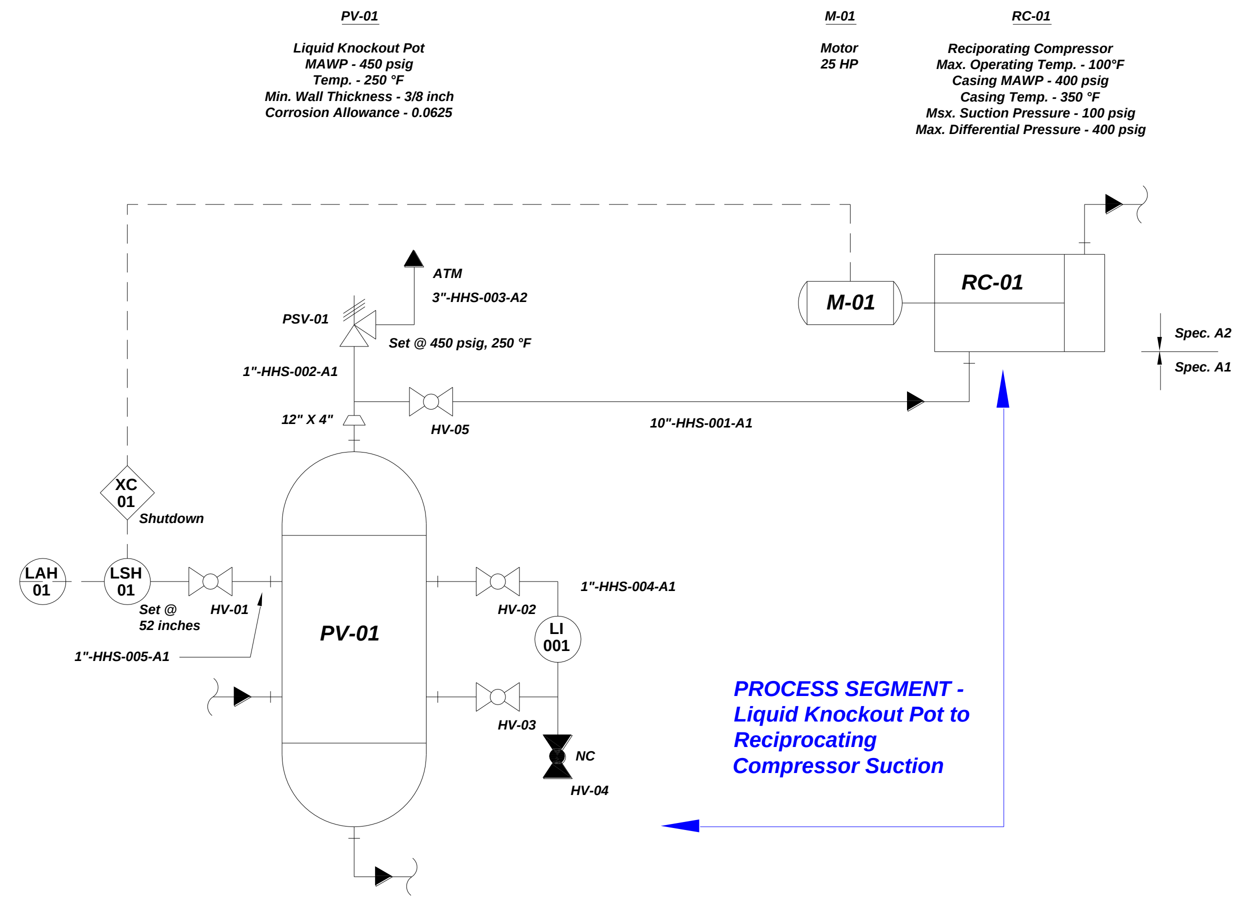
PROCESS SAFETY INFORMATION – PIPING AND INSTRUMENT DIAGRAMS (P&IDS) SUMMARY SHEET (continued)

Do the Piping and Instrument Diagrams include:	***Yes***	***NA***
Are valves specified as normally open or normally closed (if applicable)?		
Are actuated valves indicated with their failure position (e.g. FC – Closed, FO – Fail Open)?		
Are set points indicated at switches, alarms, pressure safety valves, etc.?		
Vendor and contractor interfaces; including reference to a vendor drawing for details not shown?		
Identification of components and subsystems by others?		
Intended physical sequence of equipment; e.g. branch lines, reducers, etc.?		
*Is control logic readily evident from the P&IDs?**		
Are control loops shown?		
Are flow charts used?		
Is a narrative descriptions of control and interlock systems provided?		
Are discrete functions shown?		

***** If control logic is not readily evident from the P&IDs, it must be documented in a separate format such as ladder logic diagrams, wiring schematics, SAFE charts, or a narrative description.***

Example P&ID for Illustrative Purposes in Tables Below



Equipment in the Process	Thorough development of the following data and drawings is crucial to conducting a process hazard analysis and developing a mechanical integrity program.

Materials of Construction	Materials of construction must be compiled for the equipment in the process. Equipment includes, but is not limited to, pressure vessels, storage tanks, piping systems, pressure relief valves, pumps, compressors and instrumentation. Commensurate with compiling this information is the requirement that the process and equipment comply with recognized and generally accepted good engineering practices. In order to facilitate both activities, information identified in the following tables should be compiled to provide: 1. A list of all equipment, piping and instrumentation. 2. Materials of construction for the each process component. 3. Maximum and minimum design parameters for variables such as pressure, temperature and any other pertinent parameters. 4. Other equipment design variables that result in impacts on rest of the process (examples would include centrifugal pump shut-in head and pressure relief valve set pressure and relief capacity). These tables summarize information that should be available from the supporting information. All supporting information should be readily accessible.

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PROCESS SAFETY INFORMATION – MATERIALS OF CONSTRUCTION AND DESIGN CODES AND STANDARDS EMPLOYED SUMMARY SHEET

Note: Example Shown in "RED" Below (refer to example P&ID)

Facility:	Process:	Date:

PRESSURE VESSELS (MAWP > 15 psi)	Documentation Reference that contains equipment design information (e.g. U-1A forms, shop drawings, etc.)	Design Information (i.e. safe limits)				Design codes to which the equipment was constructed and installed (e.g. ASME B&PV Code, Section VIII)	Materials of Construction	Is the Material of Construction Determined to be Compatible w/Process
		MAWP	Temp.	Minimum Wall Thickness	Corrosion Allowance			
	Revision / Date	(psi)	(°F)	(inch)	(inch)	Revision / Date		Reference
PV-01	*U-1A, 1/1/2011*	*450 psig*	*250 °F*	*3/8 inch*	*1/16 inch*	*ASME B&PV Code, Section VIII, 1994*	*ASTM A516 – Carbon Steel*	*Reference Manufacturer's Literature / Material Compatible Chart*

PROCESS SAFETY INFORMATION – MATERIALS OF CONSTRUCTION AND DESIGN CODES AND STANDARDS EMPLOYED SUMMARY SHEET

Note: Example Shown in "RED" Below (refer to example P&ID)

Facility:	Process:	Date:

STORAGE TANKS	Documentation Reference that contains equipment design information (e.g. shop drawings, etc.)	Design Information (i.e. safe limits)				Design codes to which the equipment was constructed and installed (e.g. API 650)	Materials of Construction	Is the Material of Construction Determined to be Compatible w/Process
		MAWP	Temp.	Minimum Wall Thickness	Corrosion Allowance			
	Revision / Date	(psi)	(°F)	(inch)	(inch)	Revision / Date		Reference
NA								

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PROCESS SAFETY INFORMATION – MATERIALS OF CONSTRUCTION AND DESIGN CODES AND STANDARDS EMPLOYED SUMMARY SHEET

Note: Example Shown in "RED" Below (refer to example P&ID)

Facility:	Process:	Date:

PUMPS (Equipment Identification and Type, e.g. centrifugal, screw, diaphragm, piston, etc.)	Documentation Reference that contains equipment design information (e.g. pump curve, shop drawings, etc.)	Design Information (i.e. safe limits)						Design codes to which the equipment was constructed and installed (e.g. API 610, ASME B73)	Materials of Construction	Is the Material of Construction Determined to be Compatible w/Process
		Maximum Suction Pressure	Maximum Differential Head	Maximum Operating Temperature	Casing MAWP	Casing Temperature	Motor Rating			
	Revision / Date	(psi)	(psi)	(°F)	(psi)	(°F)	HP	Revision / Date		Reference
NA										

Maximum Suction and Differential Head	The maximum head that a pump can produce, in the case of centrifugal pumps, is the head at shut-off or zero flow. This shut-off head is always greater than the operating head. The exact head for a given flow is shown on the pump's characteristic (performance) curve. In the case of positive displacement pumps, manufacturers normally give the maximum pressure or maximum differential pressure that the pump can produce instead of the maximum head. **For example**, if it is possible for a pump discharge line to become plugged or a valve closed, the pump head increases and reaches (at zero flow) the shut-off head in the case of a centrifugal pump. The maximum pressure in the pump system will then be the pressure corresponding to the shut-off head plus the pressure corresponding to the pump inlet suction head.

PROCESS SAFETY INFORMATION – MATERIALS OF CONSTRUCTION AND DESIGN CODES AND STANDARDS EMPLOYED SUMMARY SHEET

Note: Example Shown in "RED" Below (refer to example P&ID)

Facility:	Process:	Date:

COMPRESSORS (Equipment Identification and Type, e.g. centrifugal, screw, diaphragm, piston, etc.)	Documentation Reference that contains equipment design information (e.g. technical specifications, shop drawings, etc.)	Design Information (i.e. safe limits)						Design codes to which the equipment was constructed and installed	Materials of Construction	Is the Material of Construction Determined to be Compatible w/Process
		Maximum Suction Pressure	Maximum Differential Head	Maximum Operating Temperature	Casing MAWP	Casing Temperature	Motor Rating			
	Revision / Date	(psi)	(psi)	(°F)	(psi)	(°F)	HP	Revision / Date		Reference
RC-01, Reciprocating	*Manufacturer's Technical Specifications, Rev A, 9/2000*	*100 psig*	*400 psig**	*100 °F*	*400 psig*	*350 °F*	*25*	*API 618, 2001*	*Head, Cylinder, and Cylinder Cap – Ductile Iron, ASTM A536* *Crosshead Guide and Crankcase – Gray Iron, ASTM A48, Class 30*	*Manufacturer's Material Specifications, Rev 4, 3/1/2010*

** Note: This number specifies the pressure-containing abilities of the compressor cylinder and head*

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PROCESS SAFETY INFORMATION – MATERIALS OF CONSTRUCTION AND DESIGN CODES AND STANDARDS EMPLOYED SUMMARY SHEET

Note: Example Shown in "RED" Below (refer to example P&ID)

Facility:	Process:	Date:

OTHER EQUIPMENT (Not Previously Listed)	Documentation Reference that contains equipment design information	Design Information (i.e. safe limits)		Design codes to which the equipment was constructed and installed	Materials of Construction	Is the Material of Construction Determined to be Compatible w/Process
		MAWP	Temperature			
	Revision / Date	(psi)	(°F)	Revision / Date		Reference
NA						

PROCESS SAFETY INFORMATION – MATERIALS OF CONSTRUCTION AND DESIGN CODES AND STANDARDS EMPLOYED SUMMARY SHEET

Note: Example Shown in "RED" Below (refer to example P&ID)

Facility:	Process:	Date:

INTRUMENT TAG AND TYPE (i.e. Pressure Gauge, Differential Pressure Cell, Gauge Glass, etc.)	Documentation Reference that contains equipment design information Revision / Date	Design Information (i.e. safe limits)	Design codes to which the equipment was constructed and installed Revision / Date	Materials of Construction	Is the Material of Construction Determined to be Compatible w/Process Reference
LI-01 *Level Indicator*	*Manufacturer's Technical Specifications, Rev 8, 9/1/2005*	*Liquid Level Tape Measure*	*None Listed*	*Stainless Steel*	*Reference Manufacturer's Literature / Material Compatible Chart*
LSH-01 *Level Switch High*	*Manufacturer's Technical Specifications, 4/2/2009*	*300 psi Maximum Pressure; -40 °F to 300°F Operating Temperature*	*UL Recognized E177423*	*Stainless Steel*	*Reference Manufacturer's Literature / Material Compatible Chart*

Piping and Valve Specifications	A pipe specification is a menu of pipe components of the right material and the right rating for a given service. The piping specification is an essential document in each project and at each plant because not only is it used for the initial design and procurement of materials, it will also be used throughout the life of the plant to choose and procure replacement parts, and to find out what is installed long after the system has been put in service. Because a piping specification is an important design document, it should be backed-up by a detailed report and calculations that explain how the materials, fittings and ratings were selected. The piping specification must be logically tied to the plant's piping line numbers and the Piping & Instrumentation Diagrams (P&ID's). Valves are not mentioned in the pipe specification, because the pipe specification will normally remain unchanged for the life of the system. The constant improvements in valve materials, design, fabrication, and performance result in continuous changes to valve models. ***[From the Piping and Pipeline Engineering, George A. Antaki, Marcel Dekker, Inc., 2003]***

PROCESS SAFETY INFORMATION – PIPING SPECIFICATION LIST

Note: Example Shown in "RED" Below (refer to example P&ID)

Facility:									Process:	Date:
PIPING SPECIFICATION	**Documentation Reference that contains equipment design information**	**Design Information (i.e. safe limits)**					**Design codes to which the equipment was constructed and installed (e.g. ASME B31.3)**	**Materials of Construction**	**Is the Material of Construction Determined to be Compatible w/Process**
		MAWP	**Temperature**	**Class**	**Schedule**	**Corrosion Allowance**			
	Revision / Date	**(psi)**	**(°F)**	**#**	**Sch.**	**(inch)**	**Revision / Date**		**Reference**
A1	*SPEC01, Rev 10, 2/1/2011*	*740 psig*	*100 °F*	*300 lb.*	*80*	*1/16 inch*	*ASME B31.3*	*ASTM A106, Grade B, Seamless*	*Reference Manufacturer's Literature / Material Compatible Chart*

PROCESS SAFETY INFORMATION – PIPING SPECIFICATION SUMMARY SHEET

Facility:	**Process:**	**Date:**	
PIPING SPECIFICATION	**Document Title**	**Document No.**	**Revision No. and/or Date**
Does the Piping Specification include:		***Yes***	***NA***
Pipe specification number (or other identifier)?			
Piping code (e.g., ASME B31.3) and year?			
Service?			
Design Pressure and Temperature?			
Pressure class, i.e. based on the class of flange in the system?			
Corrosion allowance?			
Threaded Piping:			
Size Range?			
Pipe material and grade (e.g., ASTM A106, Grade B)?			
Schedule (and calculations available to support this selection)?			
Fittings (material, pressure rating, and dimensional standard)?			

PROCESS SAFETY INFORMATION – PIPING SPECIFICATION SUMMARY SHEET (continued)

Does the Piping Specification include:	***Yes***	***NA***
Flanges, gaskets, and bolts?		
Socket Welded Piping:		
Size Range?		
Pipe material and grade (e.g., ASTM A106, Grade B)?		
Schedule (and calculations available to support this selection)?		
Fittings (material, pressure rating, and dimensional standard)?		
Flanges, gaskets, and bolts?		
Butt Welded Piping:		
Size Range?		
Pipe material and grade (e.g., ASTM A106, Grade B)?		
Schedule (and calculations available to support this selection)?		
Fittings (material, pressure rating, and dimensional standard)?		
Flanges, gaskets, and bolts?		
Matrix of permitted branch connections?		
Calculations to support the branch connections (where applicable)?		

PROCESS SAFETY INFORMATION – VALVE SPECIFICATION LIST

Note: Example Shown in "RED" Below (refer to example P&ID)

Facility:	Process:	Date:

VALVE SPECIFICATION	Documentation Reference that contains equipment design information	Design Information (i.e. safe limits)		Design codes to which the equipment was constructed and installed (e.g. API 600, ASME B16.34)	Materials of Construction	Is the Material of Construction Determined to be Compatible w/Process
		MAWP	Temp.			
	Revision / Date	(psi)	(°F)	Revision / Date		Reference
V1 (includes HV-01 through HV-05)	*SPEC02, Rev 11, 2/1/2011*	*3000 WOG* *3000 psig* *2500 psig*	*100 °F* *300 °F*	*API 607 (certified fire test); ASME B16.34; API 598; MSS SP-25; NACE MR0103*	*Body and End Cap – A105* *Stem and Ball – SS 630* *Seat – PEEK*	*Reference Manufacturer's Literature / Material Compatible Chart*

PROCESS SAFETY INFORMATION – VALVE SPECIFICATION SUMMARY SHEET

Facility:	**Process:**	**Date:**	
VALVE SPECIFICATION	**Document Title**	**Document No.**	**Revision No. and/or Date**
Does the Valve Specification include:		***Yes***	***NA***
Function?			
Shutoff class?			
Size?			
Flow rate, noise, and cavitation restrictions?			
Valve coefficient?			
Style?			
Ends (e.g., screwed, flanged, socket, butt)?			
Material (i.e. body and trim)?			
Special qualifications (e.g., fire testing)?			
Characteristics (e.g., linear, quick opening, etc.)?			
Packing?			
Actuator style?			

Safe Upper and Lower Limits	Safe upper and lower limits define the maximum and minimum parameters that must not be exceeded. Exceeding these limits could result in a catastrophic failure. Knowledge of these limits is critical to enable adequate evaluation of consequences in the process hazard analysis. These limits could be either mechanical or process-related. ***Safe Mechanical limits*** are typically defined by codes, standards or equipment vendors and are applied to piping, equipment and instruments. Examples include design temperatures and pressures, often expressed as maximum allowable working pressure (MAWP) at a specified temperature. Another example would be upper and lower temperature limits that are defined by materials of construction. It must be noted that pressure and temperature limits are usually defined by coincident conditions (i.e. as temperature varies, the MAWP would vary). The minimum design temperature (a point often overlooked) is the lowest temperature the system is permitted to experience in service. It is important to keep in mind that each metal has a unique temperature below which the metal becomes brittle and can fracture. ***Safe Process limits*** may not be as well defined in literature as *safe mechanical limits*. These limits may be defined in industry publications or may require definition by the facility for their specific process. **For example**, a *safe process limit* would be the oxidation-reduction potential (ORP) value in a manufactured sodium hypochlorite batch. Exceeding the safe upper ORP value, would result in release of chlorine gas from the solution (i.e. decomposition), which would be considered a catastrophic failure. Safe process limits could be defined by variables such as the concentration of a reactant or the temperature of a chemical reaction. If exceeding a select limit would result in a catastrophic failure, that limit would be a safe limit. The process chemistry could be a starting point for development of some of the *safe process limits*.

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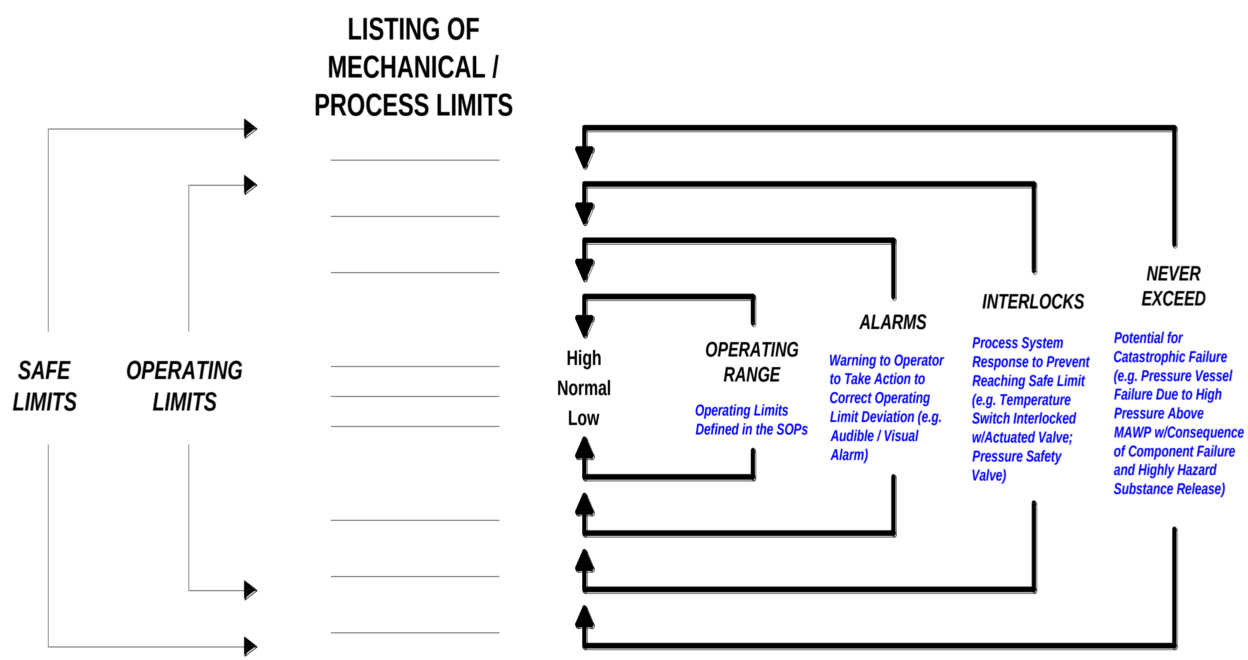
Applying Safe Upper and Lower Limits	The safe upper and lower limits must be known for all piping, equipment and instruments. Additionally, any relevant safe limits as applied to process variables must be known. To identify the *safe limits*, identify the weakest components in the process. Keep in mind "a chain is only as strong as its weakest link." **For example**, if the piping system has the narrowest range of allowable pressure and temperature and all equipment and instrumentation within that piping system is capable of operating outside the allowable piping pressure and temperatures, then the safe limits are defined by the piping system. In this case, the safe upper and lower limits would be the limits of the piping system. The limits of the piping system would render the broader limits of the other system components irrelevant since the piping would fail first. When evaluating this system through the process hazard analysis, any deviation that would result in a pressure or temperature outside the piping system limits would indicate that a safe limit had been exceeded, hence prompting the need to implement some type of safeguard or mitigation measure. **For example**, in a cryogenic system, the piping may be rated to the minimum temperatures expected; then the vessels may determine the safe temperature lower limit. Additionally, in a process where a vacuum could be created; again the piping may be rated for this pressure, but the vessels may not be. Therefore, the vessels would establish the safe pressure lower limit.

Determining the Extent of Safe Upper and Lower Limits	Once the safe limits for each component are defined, the *safe limits* should be defined for a **process segment** (process or a specific section of a process); rather than for each component. Process segments may also correspond to process hazard analysis nodes. **For example**, in a pumped liquid system, the process could conceivably be split into two sections or process segments; the pump suction section and the pump discharge section. Evaluation of the design limits for piping, equipment and instruments in each of the process segments could then proceed as noted above. The weakest component in each section would then be used to define the safe limits for that section.

Determining the Appropriate Variables for Safe Limits	There is no prescribed number of variables for which *safe limits* must be defined.

Evaluation of the Consequence of Deviation from the Safe Limits	Understanding how the consequence of deviation from a safe limit is applied in the process hazard analysis helps to explain how the consequence is defined. The consequence of deviation from a *safe mechanical limit* is typically some type of component failure, coupled with the consequence of both the component failure and the hazardous substance release. For example, the consequence of exceeding the upper pressure limit in a process where a pressure vessel is the limiting factor would be vessel rupture along with the associated personnel impacts and other onsite and offsite impacts. The consequence in this case **would not** be pressure relief valve discharge. The pressure relief valve is a safeguard that is intended to prevent the safe limit from being exceeded. In a process hazard analysis, this consequence would be ranked very severe. The presence of an appropriately sized and maintained pressure relief valve would make the likelihood of the severe consequence occurring very remote, hence, minimizing the overall risk. Assigning the appropriate consequence helps to ensure that any existing or proposed safeguard is adequately scrutinized. The consequence of deviation from a *safe process limit* must be thoroughly defined as with *safe mechanical limits*. The consequence must not only describe the direct result of the deviation, such as chlorine release to atmosphere in the example of the oxidation-reduction potential (ORP), but must also describe the associated personnel impacts and other onsite and offsite impacts.

Operating Limits as they Pertain to the Safe Limits	Operating limits are not safe limits as defined under NDEP-CAPP. Operating limits are functional values and are typically process parameters such as temperature, pressure or flow. Exceeding these limits would typically result in reduced product quality or in a process upset, not catastrophic failure. Operating limits are provided in operating procedures along with further instruction on the consequence of exceeding the limits and the steps to correct the exceeded limits. Operating limits must always be within the safe limits defined under PSI. For example, the actual operating pressure is typically kept at least 10% below the design pressure so as not to challenge the pressure relief device in normal service.



PROCESS SAFETY INFORMATION – SAFE UPPER AND LOWER LIMITS SUMMARY SHEET

Notes to Table: Repeat table for each process segment; additionally, it may be appropriate to complete the information required in Section 4 prior to completing this table.
Note: Example Shown in "RED" Below (refer to example P&ID)

Facility:	**Process:**	**Date:**	
Process Segment (Once the Safe Limits for Each Component are Defined ***(see "Information Related to the Equipment of the Process", Section 4 Below)***, the *Safe Limits* Should be Defined for Specific Sections of a Process (rather than for each component): *Liquid Knockout Pot to Reciprocating Compressor Suction*			
SAFE UPPER AND LOWER LIMITS (Including Evaluation of the Consequence of Deviation from Safe Limits) *The document(s) listed in this section refer to where the facility has documented the safe upper and lower limits for each process segment (e.g., P&IDs, Table of Safe Limits)*	**Document Title**	**Document No.**	**Revision No. and/or Date**
	Piping and Instrument Diagram	*PID0001*	*Rev 3, 2/3/2004*

PROCESS SAFETY INFORMATION – SAFE UPPER AND LOWER LIMITS SUMMARY SHEET (continued)

Notes to Table: Repeat table for each process segment; additionally, it may be appropriate to complete the information required in Section 4 prior to completing this table.
Note: Example Shown in "RED" Below (refer to example P&ID)

Equipment *Note: Equipment that Defines the Safe Limit (e.g. "The Weakest Link")*	***Variable***		***Safe Limit*** *Note: Refer to Section 4 for some Mechanical Safe Limits*	***Consequence of Deviation*** *(e.g. Vessel Rupture)*
LSH-01	*Pressure*	*Upper*	*300 psi*	*Potential Failure of Instrument and Release of Highly Hazardous Substance*
PV-01		*Lower*	*Vacuum*	*Potential for RC-01 to Create Vacuum at PV-01 and Collapse of PV-01 (is PV-01 rated for full vacuum?)*
RC-01	*Temperature*	*Upper*	*100 °F*	*Maximum Operating Temperature of RC-01; Potential Failure of RC-01 (consult manufacturer)*
Piping Specification A1		*Lower*	*-20 °F*	*Impact Testing Required per B31.3*
NA	*Flow*	*Upper*	*NA*	*NA*
RC-01		*Lower*	*4 CFM @ 400 RPM*	*Inadequate Flow of Material to RC-01; Potential Failure of RC-01 (consult manufacturer)*
PV-01	*Level*	*Upper*	*52 inches*	*Potential Overfill of PV-01 and Liquid to RC-01; Potential Catastrophic Failure of RC-01 and Release*
NA		*Lower*	*NA*	*NA*
NA	*Stream Composition*		*NA*	*NA*
PV-01; Piping Specification A1	*Corrosion Allowance*		*1/16 inch*	*Potential Reduction in Wall Thickness and Failure of PV-01 or Piping*
NA	*Vibration*	*Upper*	*NA*	*NA*
NA		*Lower*	*NA*	*NA*
NA	*Other*		*NA*	*NA*

Electrical Classification	An electrical classified area is a location where flammable gases or vapors, flammable liquids, or combustible liquids are processed or handled; and where their release into the atmosphere could result in their ignition by electrical systems or equipment.

PROCESS SAFETY INFORMATION – ELECTRICAL CLASSIFIED AREA SUMMARY SHEET				
Facility:	**Process:**		**Date:**	
ELECTRICAL CLASSIFIED AREA	**Document Title**	**Reference Standard (e.g., Article 500 of NEC)**	**Revision No. and/or Date**	
Does the Electrical Classified Area Evaluation include:			***Yes***	***NA***
Distinguish between electrically classified and unclassified areas?				
Elevations to distinguish between electrically unclassified and classified areas?				
Has the Facility:			***Yes***	***NA***
Evaluated installed components and equipment within classified area?				
How was this documented?				
Evaluate control rooms and other buildings within the classified area?				
How was this documented?				

Pressure Relief Devices	Pressure relief devices are used to protect pressure vessel or equipment from exceeding the design pressure. A pressure relief device is actuated by inlet static pressure and is designed to open during emergency or abnormal conditions to prevent a rise of internal fluid pressure in excess of a specified value. The device may also be designed to prevent excessive internal vacuum.

PROCESS SAFETY INFORMATION – PRESSURE RELIEF DEVICES LIST

Facility:		**Process:**				**Date:**		
PRESSURE RELIEF DEVICE AND TYPE	**Calculation Document Title, Revision No. and/or Date**	**Sizing Basis (e.g., fire, process upset, thermal)**	**Calculated Requirement**			**Actual Nameplate**		
			Set Pressure @ Temperature	**Capacity**	**Accumulation**	**Set Pressure @ Temperature**	**Capacity**	**Accumulation**
			(psi @ °F)	**(scfm)**	**(%)**	**(psi @ °F)**	**(scfm)**	**(%)**

	Yes	N/A
Has the capacity of pressure relief headers and associated flares been evaluated for required capacity; and has the actual capacity been determined adequate?		

Ventilation System	A ventilation system may be required by code due to the presence of a hazardous substance inside a building.

PROCESS SAFETY INFORMATION – VENTILATION SUMMARY SHEET				
Facility:	**Process:**		**Date:**	
VENTILATION SYSTEM	**Document Title**	**Uniform Fire Code (Article 80) or other Nationally Recognized Standard**	**Revision No. and/or Date**	
Does the Ventilation System include:			***Yes***	***NA***
Capacity calculations required by the applicable code or standard?				
Confirmation that the system provides the required capacity?				
Evaluation that system configuration is adequate?				
Has the capacity of scrubbers been evaluated for required capacity; and has the actual capacity been determined adequate?			***Yes***	***N/A***

Material and Energy Balance	Material quantities, as they pass through processing operations, can be described by material balances. Such balances are statements of the conservation of mass. Similarly, energy quantities can be described by energy balances, which are statements of the conservation of energy. If there is no accumulation, what goes into a process must come out. This is true for batch operations. It is equally true for continuous operation over any chosen time interval. Balances are fundamental to process control. ***See "Process Flow Diagram" section above***

PROCESS SAFETY INFORMATION – MATERIAL AND ENERGY BALANCE SUMMARY SHEET			
Facility:	**Process:**	**Date:**	
MATERIAL AND ENERGY BALANCE	**Document Title**	**Revision No. and/or Date**	
Does the Material and Energy Balance include:		***Yes***	***NA***
Cover each part of the process represented on the process flow diagram?			
Stream data around each major piece of equipment?			
Stream data around each process-altering control system?			

PROCESS SAFETY INFORMATION – MATERIAL AND ENERGY BALANCE SUMMARY SHEET (continued)		
Does the Material and Energy Balance include:	***Yes***	***NA***
Stream variables:		
Pressure?		
Temperature?		
Flow?		
Density?		
Molecular weight?		
Enthalpy?		
Phase		
Composition?		

Section 5. Description of Safety Systems and Their Functions

Safety System Description	The safety system description should provide a brief description and overview of the function of all safety systems that are present at the facility.

PROCESS SAFETY INFORMATION – SAFETY SYSTEM DESCRIPTION SUMMARY SHEET			
Facility:	**Process:**	**Date:**	
SAFETY SYSTEM DESCRIPTION	**Document Title**	**Revision No. and/or Date**	
Does the Safety System Description include:		***Yes***	***NA***
Emergency shut-down system?			
Toxic gas sensors?			
Combustible gas sensors?			
Flame Detectors?			
Firewater System?			

PROCESS SAFETY INFORMATION – SAFETY SYSTEM DESCRIPTION SUMMARY SHEET (continued)		
Does the Safety System Description include:	***Yes***	***NA***
Emergency generator?		
Uninterruptible power supply (UPS)?		
Flare system?		
Incinerator?		
Vent scrubber?		
Audible and visual alarms?		
Other?		

NDEP

Section 6. Management Plan and Document Control

Management Plan and Document Control	The process safety information procedure should answer the questions of who, what, when, where, and how of PSI compilation specific to the facility.

Section 7. Evaluation of Code Applicability and Compliance

Codes, Standards and Good Engineering Practices	Building structures, structural steel, and foundations are typically evaluated by local building codes, that are enforced by the appropriate state, county or municipal agency. The facility must obtain permits to construct and occupy the process (and associated buildings) as required by the jurisdiction they are located in. Not all design and construction codes that apply to a process regulated under NDEP-CAPP have been adopted by local building officials. NDEP-CAPP requires the regulated facility to design and construct in accordance with applicable codes and standards, or best engineering practices. While compliance with these codes or engineering practices may not be mandatory per local building officials, they become mandatory under NDEP-CAPP, and full compliance is required. The correct list of applicable codes and standards vary, based upon the type of process and the industry. The list below denotes codes and standards that may apply to the process. While it is not comprehensive, it does present a significant number of codes and standards that could apply. Actual definition of applicable codes and standards is the responsibility of the facility, as is compliance confirmation. Design and construction codes for equipment, piping and material specifications have been addressed in Section 4 of this Data Form. **For example**, pressure vessels (MAWP > 15 psi) would be addressed under ASME Boiler and Pressure Vessel Code (B&PV), Section VIII **For example**, piping could be covered under ASME B31.3 **For example**, ping leak testing could be covered under ASME B31.3, Section VI

Codes, Standards and Good Engineering Practices (continued)	**For example**, piping materials could be covered under ASTM A106 **For example**, pipe hangers and supports could be covered under MSS SP-58 Electrical Classification has been addressed in Section 4 of this Data Form. **For example**, electrical classification could be covered under NFPA 497 Pressure Safety Valves (relief devices) have been addressed in Section 4 of this Data Form. **For example**, relief devices could be covered under API Recommended Practice 520 / 521 Ventilation System has been addressed in Section 4 of this Data Form. **For example**, the ventilation system could be covered under IIAR Bulletin 111 Codes, Standards and Good Engineering Practices that have not been addressed in this Data Form, up to this point, are those that generally address installation, operations, and maintenance from an industry practice perspective. Some examples: • NFPA 59A: Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG) • Chlorine Institute Pamphlet 17: Packaging Plant Safety and Operational Guidelines • IIAR Bulletin 110 - Guidelines for: Start-Up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems

Codes, Standards and Good Engineering Practices (continued)	Once applicable codes and specifications have been defined, compliance with those codes and specifications must be evaluated. In general, the process must be in compliance with the version of the code in place at the time of construction, unless dictated otherwise by authorities having jurisdiction. Although not mandatory, differences between current code versions and the version in place at the time of construction should be understood. As an additional hazard identification step, the process should be reviewed to determine compliance with the current code version, and if not in compliance, determine if any additional hazards exist. The facility should then implement further safeguards or mitigation measures as warranted by the code deficiency.

PROCESS SAFETY INFORMATION – CODES, STANDARDS AND GOOD ENGINEERING PRACTICE SUMMARY SHEET

Facility:	Process:	Date:

Has the Facility evaluated:	***Yes***	***NA***
Required building permits for construction and occupancy of the process?		
List Building Permits (including date and applicable codes):		
Applicable codes, standards and good engineering practices?		
List Industry Practices (including date and applicable publication):		