ALA Natural Hazards Matrix Summary

OIL PRODUCTS SYSTEMS		NATURAL HAZARD PROVISIONS[8]		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
System Reliability[6]				
Buried Pipelines	ASME/ANSI B31.4	none[2]	none	
	ASCE TCLEE 1984	earthquake	earthquake	●
Aboveground Piping	ASME/ANSI B31.4	none[2]	none	
	ASME/ANSI B31.3	none[2]	earthquake, wind, ice	
	API 2510			
	API 2508			
	ASCE TCLEE 1984	earthquake	none	●
Pumping Station Piping	ASME/ANSI B31.3	none[2]	earthquake, wind, ice	
	ASME/ANSI B31.4	none[2]	none	
	API 2510			
	ASCE TCLEE 1984	earthquake	none	●
Well Facilities	ASME/ANSI B31.4	none[2]	none	
	ASME/ANSI B31.3	none[2]	earthquake, wind, ice	
	API RP 14E			
Refineries	API 2508			
	ASCE Petrochem.	earthquake, wind	earthquake, wind	●
	ASME/ANSI B31.3	none[2]	earthquake, wind, ice	
	ASME BPV[3]	none[2]	earthquake, wind, ice	
Storage Tanks	API 620	earthquake, wind	earthquake, wind	●
	API 650	earthquake, wind	earthquake, wind	●
	NFPA 59			
	API 2508			
	ASCE TCLEE 1984	earthquake	earthquake	●

NATURAL GAS SYSTEMS		NATURAL HAZARD PROVISIONS[8]		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
System Reliability[6]				
Buried Pipelines	ASME/ANSI B31.8	none[2]	none	
	PRCI (2000)	earthquake	earthquake	●
	ASCE TCLEE 1984	earthquake	earthquake	●
Aboveground Piping	ASME/ANSI B31.3	none[2]	earthquake, wind, ice	
	ASME/ANSI B31.8	none[2]	none	
	ANSI Z223.1	none[2]		
	NFPA 54, SGC, IFGC	none[2]		
	ASCE TCLEE 1984	earthquake	none	●
Compressor Station Piping	ASME/ANSI B31.3	none[2]	earthquake, wind, ice	
	ASME/ANSI B31.8	none[2]	none	
	ASCE TCLEE 1984	earthquake	none	●
Well Facilities	ASME/ANSI B31.8	none[2]	none	
	API RP 14E			
LNG Facilites				
System Reliability[6]	NFPA 59A	earthquake	earthquake	
Piping	NFPA 59A	earthquake	earthquake	
Storage Tanks	***API 620***	earthquake, wind	earthquake, wind	
	API 650	earthquake, wind	earthquake, wind	
	ASME BPV[3]	none[2]	earthquake, wind, ice	
	NFPA 59A	earthquake, ref. ANSI A58.1 for wind and snow	earthquake, ref. ANSI A58.1 for wind and snow	
	ASCE 1984	earthquake	earthquake	

WATER SYSTEMS (Potable & Raw)		NATURAL HAZARD PROVISIONS[8]		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
System Reliability[6]				
Buried Pipelines	AWWA M11	none[2]	none	
	ASCE TCLEE 15	earthquake	earthquake	●
Aboveground Pipelines	ASME/ANSI B31.3	none[2]	earthquake, wind, ice	
Pumping Plants	ASME B31.3	none[2]	earthquake, wind, ice	
Storage Tanks	ACI 350	earthquake	earthquake	●
	AWWA D[5]	earthquake, wind, snow	earthquake, wind, snow	●
	ASCE 1984	earthquake	earthquake	●
Well Facilities				
Canals				

WASTE WATER SYSTEMS		NATURAL HAZARD PROVISIONS[8]		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
System Reliability[6]				
Buried Pipelines	AWWA M11	none[2]	none	
	ASCE TCLEE 15	earthquake	earthquake	●
Aboveground Pipelines	ASME/ANSI B31.3	none[2]	earthquake, wind, ice	
Treatment Plants	ASME B31.3	none[2]	earthquake, wind, ice	●
	WEF	earthquake, flood		●
Storage Tanks	ACI 350	earthquake	earthquake	●
	AWWA D[5]	earthquake, wind, snow	earthquake, wind, snow	●
	ASCE 1984	earthquake	earthquake	●

ELECTRIC POWER SYSTEMS		NATURAL HAZARD PROVISIONS[8]		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
System Reliability[6]				
Substations	IEEE-693	earthquake	earthquake	●
	RUS 1724e-300*	wind, ice, earthquake	wind, ice, earthquake	●
Transmission Towers & Poles	ASCE-10*	wind, ice, earthquake	wind, ice	●
	ASCE Manual 72*	wind, ice, earthquake	wind, ice, earthquake	●
	ASCE Manual 74	wind, ice, earthquake	wind, ice	●
	ASCE Manual 91*	wind, ice, earthquake	wind, ice, earthquake	●
	ASCE Conc. Poles*	wind, ice, earthquake	wind, ice, earthquake	●
	RUS 1724e-200*	wind, ice, earthquake	wind, ice, earthquake	●
	PCI Conc. Poles*	wind, ice, earthquake	wind, ice, earthquake	●
	IEEE-691*	none	wind, ice, earthquake	●
	IEEE*	wind, ice, earthquake	wind, ice, earthquake	●
	NESC	wind, ice, earthquake	wind, ice	●
Distribution Poles	NESC	wind, ice, earthquake	wind, ice	●
	RUS 160-2*	wind, ice, earthquake	wind, ice, earthquake	●
Buried Conduits				

* This document refers to NESC and ASCE Manual 74

TELECOMMUNICATION SYSTEMS		NATURAL HAZARD PROVISIONS[8]		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
System Reliability[6]				
Towers, Masts and Poles	TIA/EIA 222G (2003)	Earthquake, wind, ice	Earthquake, wind, ice	●
	TIA/EIA 222F	Wind, ice	Wind, ice	●
Buried Cables	***Bell Core***	Earthquake, flood	Earthquake, flood	
Underwater Cables				
Aboveground Cables	***Bell Core***	Earthquake, wind, ice, snow	Earthquake, wind, ice, snow	
Switching Equipment	***Bell Core***	Earthquake, fire	Earthquake, fire	
Cable Trays	***SMACNA***	none	earthquake	
	BSP (Bell System Practice)	none	earthquake	
	ASCE 7	Earthquake, wind, ice, snow	Earthquake, wind, ice, snow	

PORTS AND INLAND WATERWAYS		NATURAL HAZARD PROVISIONS[8]		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
System Reliabilty[6]	***ASCE TCLEE 12***	Earthquake		●
Piers/Wharves	***NCEL R-939***	Earthquake	Earthquake	
	NAVFAC DM-25.1			
	ASCE TCLEE 12	earthquake	earthquake	●
	NFESC TR-2069SHR	earthquake	earthquake	
Breakwaters/Jetties	***NCEL R-939***	Earthquake	Earthquake	
	ASCE TCLEE 12	Earthquake	Earthquake	●
Sea Walls	***NCEL R-939***	Earthquake	Earthquake	
	ASCE TCLEE 12	Earthquake	Earthquake	●
Container Handling	ASCE-7	earthquake, wind, snow, ice	earthquake, wind, snow, ice	
	IBC, SBC, UBC	earthquake, wind, snow, ice	earthquake, wind, snow, ice	
	ASCE TCLEE 12	earthquake	earthquake	●
	AISC	none[2]	earthquake, wind, snow, ice	
Cargo Movement	ASCE-7	earthquake, wind, snow, ice	earthquake, wind, snow, ice	
	IBC, SBC, UBC	earthquake, wind, snow, ice	earthquake, wind, snow, ice	
	ASCE-ASCE TCLEE 12	earthquake	earthquake	●
Marine Oil Terminals	***CSLC***	Earthquake	Earthquake	
	NFESC, TR-2103-SHR	Earthquake	Earthquake	
	ASCE-7	earthquake, wind, snow, ice	earthquake, wind, snow, ice	
	NFPA[4]	earthquake	earthquake	

HIGHWAYS AND ROADS		NATURAL HAZARD PROVISIONS[8]		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
System Reliability[6]	***FHWA 106***	Earthquake	Earthquake	
Bridges	***AASHTO***	earthquake, wind, snow, Ice, flood	earthquake, wind, snow, Ice, flood	●
	CALTRANS	earthquake, wind, snow, Ice, flood	earthquake, wind, snow, Ice, flood	●
	FHWA-RD-94-052	earthquake	earthquake	●
	FHWA 106	earthquake	earthquake	●
Embankments	***CALTRANS***	earthquake	earthquake	●
Road Beds				
Culverts	***AASHTO***	none[2]	none	
	CALTRANS	none[2]	none	
Tunnels	***AASHTO***	none[2]	none	
	CALTRANS	none[2]	none	
Retaining Walls	***FHWA 106***	Earthquake	Earthquake	
Signs	ASCE-7	earthquake, wind, snow, ice	earthquake, wind, snow, ice	
	IBC, SBC, UBC	earthquake, wind, snow, ice	earthquake, wind, snow, ice	

RAILROAD		NATURAL HAZARD PROVISIONS[8]		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
System Reliability[6]	AREMA Ch. 9			
Bridges	AREMA Ch. 7	wind	wind	
	AREMA Ch. 8	wind, ice	wind, ice	●
	AREMA Ch. 9	earthquake	earthquake	●
	AREMA Ch. 15	wind	wind	●
Embankments	AREMA Ch. 9	earthquake	earthquake	earthquake
Rails, Ties, and Ballast	AREMA Ch. 9	earthquake	earthquake	earthquake
Culverts	AREMA Ch. 9	earthquake	earthquake	earthquake
Tunnels	AREMA Ch. 9	earthquake	earthquake	earthquake
Signs	ASCE-7	earthquake, wind, snow, ice	earthquake, wind, snow, ice	
	IBC, SBC, UBC	earthquake, wind, snow, ice	earthquake, wind, snow, ice	

ELECTRICAL, MECHANICAL, AND ARCHITECTURAL COMPONENTS		NATURAL HAZARD PROVISIONS		
COMPONENT	GUIDE/STANDARD[1]	LOADING	DESIGN	EXISTING[7]
Elect./Mech. Equip	ASCE-7	earthquake, wind, ice	earthquake, wind, ice	
	ASCE TCLEE 1984	earthquake	earthquake	●
	ASME BPV[3]	none[2]	earthquake, wind	
	NFPA[4]	earthquake	earthquake	
	IBC, SBC, UBC	earthquake, wind	earthquake, wind	
	SMACNA	earthquake	earthquake	●
Suspended Ceilings	***IBC, SBC, UBC***	earthquake	earthquake	
Elevated Floors				

NOTES

1. Documents in by ***bold italics*** indicate that the guidelines were not produced by a consensus process as defined for SDO's approved by the American National Standards Institute
2. "none" applies if a guideline or standard does not specifically identify how loads are to be obtained; if a group of standards is referenced, the natural hazard listed may be only covered in one document
3. ASME BPV refers to the ASME Boiler and Pressure Vessel Code that typically governs the design of all pressurized containers
4. NFPA refers to various NFPA standards governing fire protection systems
5. AWWA D refers to various AWWA standards governing water storage tanks
6. "System Reliability" is a component of design referring to practices that are specifically developed to provide reasonable assurance that consequences of a natural hazard on system service will meet the goals established by stakeholders (owners, operators, regulators, insurers, customers, and users). Consequences are defined by multiple performance requirements but typically include impact on public safety, duration of service interruption, and costs to repair damage.
7. **Existing** indicates that analysis or design procedures (NOT LOADS) could be applied for existing components
8. **Loading** refers to whether or not specific loads for various natural hazards are defined; "Design" refers to the existence of design and/or analysis procedures that account for loads arising from natural hazards
9. Shaded boxes indicate that the indicated natural hazard is not an applicable load condition for the lifeline component

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ALA Manmade Hazards Matrix Summary

ELECTRIC POWER		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability	$ Ø	Radiological, Blast, Cyber	Biological, Blast, Cyber	
Transmission Towers	Ø	Blast	Blast	
Distribution Poles	Ø	Blast	Blast	
Buried Conduits	Ø	Radiological	Radiological	
Substations	**IEEE (1)** $ Ø	Chemical Radiological	Radiological	
Elect./Mechanical Equipment	Ø	Radiological, Cyber	Radiological, Cyber	

NATURAL GAS		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability	**NPC (2)** Ø	Radiological, Blast	Cyber Radiological	
Buried Pipelines	**DOT (3)** **DOT (4)** **DOT (5)** **DOT (6)**	Blast Blast Blast	Chemical Blast	
Aboveground Piping	**DOT (7)** **DOT (8)** **DOT (9)** **DOT (10)**	Blast Blast Blast	Chemical Blast	
Compressor Station Piping				
Well Facilities				
Offshore Production Installations	**ISO (11)** $	Chemical, Blast		
Elect./Mechanical Equipment	$ Ø	Radiological	Radiological	

OIL PRODUCTS		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability	NPC (12) $ Ø	Cyber Radiological, Blast	Cyber Radiological, Blast	
Buried Pipelines	Ø	Blast	Blast	
Aboveground Piping	Ø	Blast	Blast	
Pumping Station Piping	Ø	Blast	Blast	
Well Facilities	Ø	Blast	Blast	
Refineries	Ø	Blast	Blast	
Storage Tanks	$ Ø	Blast		
Elect./Mechanical Equipment	Ø	Radiological, Blast, Cyber		

LNG SYSTEMS		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability	$ Ø	Radiological, Blast, Cyber	Radiological, Blast, Cyber	
Piping	Ø	Blast	Blast	
Storage Tanks	Ø	Blast	Blast	
Elect./Mechanical Equipment	Ø	Radiological, Blast, Cyber	Radiological, Blast, Cyber	

WATER SYSTEMS (POTABLE & RAW)		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
Treatment Units	(13) USACHPPM (14)		Chemical, Biological Biological	
System Reliability	(15) (16)		Chemical, Biological, Radiological, Cyber Chemical, Biological	
Buried Pipelines				
Aboveground Pipelines				
Pumping Plants	$			
Storage Tanks	$			
Well Facilities				

WASTEWATER SYSTEMS		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability				
Buried Pipelines				
Aboveground Pipelines				
Pumping Plants	NFPA (17) $	Chemical, Blast		
Storage Tanks	$			

TELECOMMUNICATIONS SYSTEMS		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability	**SEI (18)** $ Ø	Cyber Radiological, Blast	Cyber Radiological, Blast	
Towers, Masts and Poles	Ø	Biological	Biological	
Buried Cables				
Underwater Cables				
Aboveground Cables				
Switching Equipment	Ø	Radiological, Cyber	Radiological, Cyber	
Cable Trays				

PORTS AND INLAND WATERWAYS		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability	$ Ø		Blast	
Piers/Wharves	$ Ø		Blast	
Breakwaters/Jetties	Ø		Blast	
Sea Walls	Ø		Blast	
Container Handling				
Cargo Movement				
Marine Oil Terminals	$ Ø		Blast	

HIGHWAYS AND ROADS		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability				
Bridges	$			
Embankments				
Road Beds				
Culverts				
Tunnels				
Retaining Walls				
Signs				

RAILROAD		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability				
Bridges	$			
Embankments				
Rails, Ties, and Ballast	$			
Culverts				
Tunnels				
Signs				

INFRASTRUCTURE INTERDEPENDENCIES		MANMADE HAZARD PROVISIONS		
COMPONENT	**GUIDE/STANDARD**	**LOADING**	**DESIGN**	**EXISTING**
System Reliability	Ø	Chemical, Biological, Radiological, Blast, Cyber	Chemical, Biological, Radiological, Blast, Cyber	

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KEY TO TABLE

*** =** Guidelines & Standards **not** produced by an ANSI approved standard developing organization.
A = Guidelines & Standards produced by an ANSI approved standard developing organization.
_ = Empty box indicates guidelines and standards related to the specified hazards are not available.
$ = Standards have been identified, but must be purchased for review. See appendices B-M.
∅ = Government standards exist, but are issued fro a controlled or sensitive source.
Loading: Whether or not specific loads for various identified hazards are defined.
Design: Existence of design and/or analysis that account for loads arising specified hazards.
Existing: Analysis or design procedures (not loads) could be applied for existing components.
IEEE (1): Guide for Containment and Control of Oil Spills in Substations.
NPC (2): Securing Oil and Natural Gas Infrastructures in the New Economy.
DOT (3): CFR 49, 195.8, Transportation of Hazardous Liquids or CO_2 in Pipelines Constructed with other than Steel Pipe.
DOT (4): CFR 49, 192.755, Transportation of Natural Gas by Pipeline, Minimum Federal Safety Standards, Protecting Cast Iron Pipelines.
DOT (5): CFR 49, 192.614, Damage Prevention Program.
DOT (6): CFR 49, 149.442, Damage Prevention Program.
DOT (7): CFR 49, 195.8, Transportation of Hazardous Liquids or CO_2 in Pipelines Constructed with other than Steel Pipe.
DOT (8): CFR 49, 195.55 Protecting Cast Iron Pipelines.
DOT (9): CFR 49, 192.614, Damage Prevention Program.
DOT (10): CFR 49, 149.442, Damage Prevention Program.
ISO (11): Petroleum and Gas industries- Control and mitigation of fires and explosions on offshore production installations.
NPC (12): Securing Oil & Natural Gas Infrastructures in the New Economy.
US Congress (13): Safe Drinking Water Act.
USACHPPM (14): Biological Warfare Agents as Threats to Potable Water, Environ Health Perspectives 107:975-984.
US Congress (15): Water Infrastructure Security and Research Development Act.
US Congress (16): HR 3178 and the Development of Anti-Terrorism Tools for Water Infrastructure.
NFPA (17): Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
SEI (18): The CERT Guide to System and Network Security Practices.