Nevada Hazardous Commodity Flow Study

Chemical Selection Process

prepared for

Nevada Department of Transportation

prepared by

Cambridge Systematics, Inc.

NEVADA DOT

SAFE AND CONNECTED

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Overview

There are thousands of chemicals transported every day in Nevada by motor carrier, rail and pipeline. Since it is not feasible to assess the hazards of every chemical, the Study Team employed a chemical selection process to prioritize hazardous materials for transport. This report documents the chemical selection process presented to Nevada DOT and the State Emergency Response Commission (SERC) for review.

The process focused on hazardous materials that if released in storage or in transport will have the greatest impact on health and safety. Using the information collected from multiple sources, the Study Team identified all the extremely hazardous substances (EHS) stored at hazmat facilities. Then a chemical selection process was used to identify chemicals which pose the greatest hazard to the public. This process helps to prioritize transportation investments, evaluate response team locations, provide public protective actions, and prioritize hazmat response resources.

Data Sources

The primary data sources for this process included the Nevada Chemical Action Protection Program (CAPP) data, EPA's Toxics Release Inventory (TRI) and the Nevada Statewide Database from the State Fire Marshal's Office. CAPP requires companies that store or process "Highly Hazardous Substances" (HHS) to submit annual stored volumes of toxic and flammable chemicals. CAPP is similar to what EPA requires for companies required to file Risk Management Plans (RMP), based on threshold planning quantities of certain chemicals stored on site. TRI reporting tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. Tier II reporting is conducted through the Nevada State Fire Marshal's Office (SFMO). Private, public, and Government facilities must submit annual Tier II reports on their inventories of hazardous and toxic chemicals if they meet established thresholds and requirements. Facilities are required to submit Tier II reports to the Local Emergency Planning Committee (LEPC), the SERC and their local fire department.

Methodology

Using the data collected from CAPP, TRI, and Tier II, the Study Team focused on toxic and high volume flammable chemicals and applied selection criteria to organize the chemicals into a "top ten" list of priority chemicals for analysis. The criteria used to rank the hazardous materials included isolation protection distance, threshold planning quantity, lower flammable limit, and flash point. Additional professional judgment was applied to determine final hazmat priority. Table 1 describes each criterion, description and source.

Table 1 Chemical Selection Criteria

Criterion	Description	Source
Isolation Distance	Recommended distance from a spill source within which first responders should position emergency assets.	Emergency Response Guidebook
Threshold Planning Quantity	Minimum amount of chemical that if present at a facility poses a hazard.	EPA/CAMEO
Lower Flammable Limit (LFL)	Lower limit of a concentration range of a gas or vapor that will burn if exposed to an ignition source.	Engineering Toolbox
Flash Point	Temperature at which vapor from gas ignites	NFPA

Using the list of hazardous materials stored at Nevada facilities, the CS Team conducted a hazmat analysis using the criteria above to sort and rank the hazardous materials in order of impact to health and safety. For example, the larger the isolation distances for large spills, the higher the ranking. The hazmat analysis provides justification for contacting companies that store or transport priority chemicals to determine transport routing, frequencies and volumes. An input dataset comprising of CAPP, TRI, and Tier II datasets was created for hazmat analysis. The input dataset included all facilities with HHS and Extremely Hazardous Substances (EHS). First, all of CAPP data was added to the input dataset since it was available from NDEP. Next, all the facilities with EHS were selected from TRI data, which was available from EPA. These facilities were compared to the facilities existing already in the input data and duplicate facilities were removed. Finally, all the facilities from the Nevada Statewide Hazmat Database were added to the input dataset and additional duplicate facilities removed.

The input dataset was divided into “toxic” and “flammable” chemicals. This separation was necessary due to the differences in chemical characteristics and types of hazards they pose. In addition, toxic chemicals can create a hazard immediately upon release, whereas flammable chemicals require an additional agent (i.e., ignition source) after a release to create a hazard.

For both toxic and flammable chemicals, two characteristics were considered for isolation distance. They included: 1) Isolation Distance for Large Spills from Truck (in feet); and 2) Isolation Distance for Large Spills from Rail (in feet). Isolation distance is defined as the recommended distance from a spill source within which first responder should position emergency assets. These two characteristics along with other characteristics specific to either toxic chemicals or flammable chemicals were obtained from the CAMEO Chemicals website.[1]

Next, distance ranges were established to help with the scoring process. The isolation distance was divided into four ranges: 0-500 ft., 501-1,000 ft., 1,001-2,000 ft., and 2,001-3,000 ft. The greater the isolation distance, the higher the resulting score. The rail and truck isolation distance ranges are shown in Tables 2 and 3.

Table 2 Rail Isolation Distance Ranges for Toxic Chemicals

Isolation Distance (feet)	Score
0–500	1
501–1,000	2
1,001–2,000	3
2,001–3,000	4

[1] https://cameochemicals.noaa.gov/.

Table 3 Truck Isolation Distance Ranges for Toxic Chemicals

Isolation Distance (feet)	Score
0–500	1
501–1,000	2
1,001–2,000	3
2,001–3,000	4

Similar to toxic chemicals, truck and rail isolation distances were scored for flammable chemicals. The rail and truck isolation distance ranges for flammable chemicals are shown in Tables 4 and 5.

Table 4 Rail Isolation Distance Ranges for Flammable Chemicals

Isolation Distance (feet)	Score
1,000	1
2,500	2

Table 5 Truck Isolation Distance Ranges for Flammable Chemicals

Isolation Distance (feet)	Score
1,000	1
2,500	2

In addition to isolation distances, the Study Team examined Threshold Planning Quantity TPQ (in lbs.). TPQ is defined as the minimum amount of chemical that if present at a facility, the EPA requires the development of a Risk Management Plan (RMP). Consequently, the lower the level of TPQ, the more hazardous the chemical. Similar to isolation distances, TPQ was divided into the following ranges: 0-100 lbs., 101-500 lbs., and 501-1,000 lbs. Scores were assigns based on each range. The lower the TPQ, the higher the score. The ranges for TPQ are shown in Table 6.

Table 6 Threshold Planning Quantity (TPQ) Ranges for Toxic Chemicals

TPQ (lbs.)	Score
0–100	3
101–500	2
501–1,000	1

For flammable chemicals, Lower Flammable Limit (% by volume of air) was considered in addition to isolation distances. The Flammable Range (explosive range) is the concentration range within which a gas or vapor that will burn if exposed to an ignition source. Below the explosive or flammable range the mixture is too lean to burn, and above the upper explosive or flammable limit the mixture is too rich to burn. The limits are commonly called the "Lower Explosive or Flammable Limit" (LEL/LFL) and the "Upper Explosive or Flammable Limit" (UEL/UFL). LFL for flammable chemicals in the input data was obtained from The Engineering Toolbox website.[2] Similar to TPQ, the lower the level of LFL, the higher the score. LFL was divided into four ranges: 0–2, 2–4, 4–6, and 6–8. Scores were subsequently developed using these ranges. Table 7 display LFL ranges below.

Table 7 Lower Flammable Limit (LFL) Ranges for Flammable Chemicals

Lower Flammable Limit Range	Score
0–2	2
2–4	1.5
4–6	1
6–8	0.5

For flammable chemicals, Flash Point was also considered. The Flash Point is the temperature at which vapor from flammable liquids ignite. This can be a positive or negative number. For example, the flash point for Butane is -76° F and for ethanol is 61.9° F. Table 8 displays Flash Point ranges.

Table 8 Flash Point Ranges for Flammable Chemicals

Flash Point	Score
-100+° F	1.5
0 to -100° F	1
0-100° F	0.5

The final score for toxic chemicals was calculated by summing the score of isolation distance and TPQ, and for flammable chemicals was calculated by summing the score of Isolation Distance and LFL.

Chemical Selection Results

The Study team used the results of this analysis to generate a list consisting the chemical final score, stored amount, number of corresponding facilities and EHS designation. The higher the score, the more hazardous the toxic or flammable chemical. Table presents the preliminary list of chemicals in priority order based on the results of the analysis.

[2] https://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html.

Table 9 Preliminary Chemicals for Study

	Chemical Name	Isolation distance (ft.)	TPQ (lbs.)	LFL	Flash Point (°F)	Isolation Dist. Score	TPQ Score	LFL Score	Flash Point Score	Final Score	On-Site (lbs.)	Facilities	EHS[3]
1	Chlorine	3,000	100	0		4	3	0	0	7	5,461,350	6	Yes
2	Sulfur Dioxide, Anhydrous	3,000	500	0		4	2	0	0	6	288,521	1	Yes
3	Nitrogen Dioxide	1,250	100	0		3	3	0	0	6	69	2	Yes
4	Isobutane	2,640	0	1.8	-117	2	0	2	1.5	5.5	2,128,779	4	No
5	Hydrocyanic Acid	1,000	100	0		2	3	0	0	5	19,194	1	Yes
6	Butane	2,640	0	1.86	-76	2	0	2	1	5	2,450,876	6	No
7	Propane	2,640	0	2.1	-155	2	0	1.5	1.5	5	4,545,685	7	No
8	Methane	2,640	0	4.4	-36.4	2	0	1	1	4	296,347	4	No
9	Titanium Tetrachloride	100	100	0		1	3	0	0	4	6,519,723	4	Yes
10	Ammonia, Anhydrous	1,000	500	0		2	2	0	0	4	5,506,188	18	Yes
11	Sodium Cyanide	300	100	0		1	3	0	0	4	7,094,766	26	Yes
12	Potassium Cyanide	300	100	0		1	3	0	0	4	270,021	3	Yes
13	Methyl Ether	2,640	0	0		4	0	0	0	4	48,508	1	No
14	Difluoroethane	2,640	0	0		4	0	0	0	4	10,000	1	No
15	Hydrofluoric Acid	150	100	0		1	3	0	0	4	5,708	8	Yes
16	Tetraethyl Lead	150	100	0		1	3	0	0	4	1,377	1	Yes
17	Nitrogen Oxide	300	100	0		1	3	0	0	4	715	1	Yes
18	Hydrofluoric Acid Solution	150	100	0		1	3	0	0	4	562	1	Yes
19	Cyanide	300	100	0		1	3	0	0	4	330	1	Yes
20	Hydrochloric Acid	150	100	0		1	3	0	0	4	167	1	Yes
21	Nitric Oxide	300	100	0		1	3	0	0	4	100	2	Yes

[3] EHS=**Extremely Hazardous Substance** as defined by EPA: chemicals subject to reporting requirements under the Emergency Planning and Community Right-to-Know Act (EPCRA) https://www.epa.gov/sites/production/files/2015-03/documents/list_of_lists.pdf

	Chemical Name	Isolation distance (ft.)	TPQ (lbs.)	LFL	Flash Point (°F)	Isolation Dist. Score	TPQ Score	LFL Score	Flash Point Score	Final Score	On-Site (lbs.)	Facilities	EHS[3]
22	Pentane	1,000	0	1.4	-56.2	1	0	2	1	4	3,562,099	13	No
23	Isopentane	1,000	0	1.32	-6	1	0	2	1	4	847,264	4	No
24	Hydrogen	2,640	0	4		2	0	1.5	0	3.5	8,693	1	No
25	Ammonia Solution	330	500	0		1	2	0	0	3	148,590	3	Yes
26	Boron Trichloride	100	500	0		1	2	0	0	3	104,890	1	Yes
27	Ethanol	1000		3.3	61.9	1		1.5	0.5	3	148,590	37	No
28	Acetylene	150	0	2.5		1	0	1.5	0	2.5	2,530,707	7	Yes
29	Hydrogen Peroxide Solution	150	1,000	0		1	1	0	0	2	650,000	1	Yes
30	Sulfuric Acid	150	1,000	0		1	1	0	0	2	–	1	Yes
31	Oleum Solution	1,000	0	0		2	0	0	0	2	–	1	No
32	Nitromethane	1,000	0	7.3	95	1	0	0.5	0	1.5	2,088	1	No
33	Red Phosphorus	330	0	N/A		1	0	0.5	0	1.5	229	2	Yes
34	Mercury	330	0	0		1	0	0	0	1	9,785,988	1	No

Top Ten Chemical Selection

From the list of 34 preliminary chemicals in Table 9, the Study Team examined the stored volumes at facilities and the number of facilities storing chemicals and used professional judgment from previous studies to determine a proposed “top ten” list of chemicals for study. Several “non-EHS” chemicals were included as part of the “top ten” list. These include ethanol and butane since these fuels are transported in larger volumes and have been subject to new Federal and State regulations pertaining to transport by “High-Hazard Flammable Trains.” Ethanol is transported by rail in large volumes from the Midwest to urban areas for fuel blending and to ports for export. Butane is used to supplement gasoline stocks and also to increase fuel octane levels. Table displays the proposed “top ten” chemicals for study. The Study Team will conduct additional outreach to the facilities storing these chemicals to determine routing, frequencies and volumes.

Table 10 Top Ten Chemicals for Study

#	Chemical Name	Score	Chemical Uses	Facilities	EHS
1	Anhydrous Ammonia	4	Refrigerant, fertilizer	18	Yes
2	Butane	5	Fuel and blending	6	No
3	Chlorine	7	Water treatment	6	Yes
4	Ethanol	3	Biofuel	5	No
5	Hydrofluoric acid	4	Manufacturing	8	Yes
6	Nitrogen Dioxide	6	Catalyst, oxidizing agent	2	Yes
7	Potassium Cyanide	4	Mining and electroplating	2	Yes
8	Propane	5	Fuel and heating	7	No
9	Sodium Cyanide	4	Mining operations	18	Yes
10	Titanium tetrachloride	4	Titanium, whitening	4	Yes