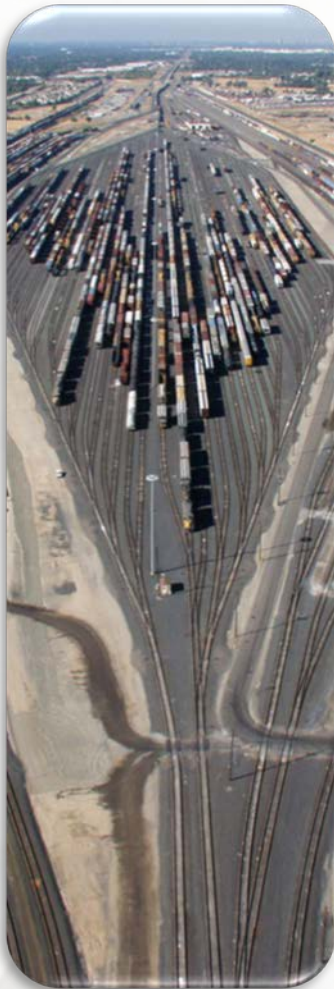U.S. Department of Transportation

Federal Railroad Administration

SHIPPER RISK MODEL
[DATA DRIVEN, SHIPPERS' RANKING FOR FACILITY INSPECTION]

BY

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HAZARDOUS MATERIALS TRAINING SEMINAR

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DISCLAIMER

➢ **All references to companies, their names, addresses and other attributes indicated in this presentation are for example purposes ONLY and should NOT be construed as facilities in any FRA or PHMSA action plan.**

➢ **The data used for illustrating the features of the Shipper Risk Model are to be considered as fictitious, some even generated by random number generators, and are NOT based on actual data from any of the official or other databases.**

ITEMS IN THIS PRESENTATION

➢ Historical Perspective of the Shipper Risk Model

➢ Why do we need it and What is in it?

➢ Data on shipper attributes – Where do we get the data from [RISPC, DataMart(HIP), HMIS]

➢ Illustration of shipper data display [text & map]

➢ Shipper Risk Model – Introduction, Model Parameters, Score Tables

➢ Current model on XL-Worksheet – demo

➢ Model being incorporated into DataMart – demo with GIS

➢ What data are missing and what are we doing about it.

➢ How would a regional specialist use the result.

HISTORICAL PERSPECTIVE

➢ FRA initiated the development of the Shipper Risk Model in mid 2015.

➢ The objective of this effort was to use several types of data to assess the compliance of Shippers with 49CFR requirements and the effect of compliance on (reduction in) NARs.

➢ The DOT – OIG conducted a "HazMat Program Audit" of the Office of Safety (RRS) in early 2016.

➢ The OIG report made several recommendations for improving RRS' oversight to enhance safety in rail shipments of HazMat.

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➢ **OIG Recommendations**

1. RRS periodically perform a comprehensive "hazardous materials transportation risk assessment" that identifies and assesses the relationship among the regional and national risks associated with achieving program objectives.

2. Issue **guidance to regions** that provides detailed information on the tools available **to guide resource allocation decisions** and the data feeding each tool and sets expectations for how regions should incorporate these tools, including the comprehensive risk assessment conducted by the Office of Safety, into resource allocation decisions.

OIG Email 2/23/2017 --- We reviewed the materials provided. The shipper risk ranking model is responsive to our recommendations.

➢ Supports the Regions' objectives - Optimizing inspection resources to realize improved safety.

➢ Provides guidance to schedule Shipper Inspection Visits, based on risk-based ranking of shippers.

➢ Considers several items of historical data; (a) Past inspection dates and findings, (b) hazmat type and volumes of shipments, (c) NARs attributable to the shipper, etc.

➢ Enumerates number and type of defects, assigns risk scores based on the severity and repetition of defects.

➢ Assigns risk scores based on volume handled and the physio-chemical nature of hazmat shipped.

➢ Shipper Risk Model (SRM) data are from RISPC (Form 96), NAR (HMIS) and other resources.

➢ Model uses these data and calculates a Risk Score for each Shipper facility. The higher the RISK SCORE the worse is the safety performance of the shipper.

➢ Model output for each Region includes a RANK ORDERED list of high risk score shippers.

➢ Output helps in identifying particular "metric" due to which a high risk score shipper facility ended up in the list.

➢ Model out put guides the facilities to inspect first and what the focus of inspection should be.

ORGANIZATION OF FORM 96 DEFECTS DATA BY SHIPPER

	A	B	C	D	E	F	G	H	I	J	K	L	M	AK	AL	AM	AN
Sheet Name:	"RISPC Data" [Form 96 Data in RISPC]																
															-Calculated Interim Risk Scores by Category--		
	Shipper Region #	Fiscal Year	Shipper Name	Shipper Code	Address 1	City	State	Zip	# of Units Expended	# of Sub Units	# of Violation Reports	# of Violation defects	# of Defects Identified	Total of Counts	Weighted total counts	Avg Score from defects	Score due to # of defects
											Risk weightage factors on defects (D$_J$) ---->			"N$_i$"	"$\sum$D$_i$ N$_i$"	"D$_{J,Avg}$"	"C"
	1	2015	3M	3MQ	1400 STATE DOCKS RD	Decatur	AL	35609	6	3	0	0		5	11	2.20	1
	1	2016	3M	3MQ	1400 STATE DOCKS RD	Decatur	AL	35609	6	7	0	5		5	11	2.20	1
	1	2014	ADVANCED AROMATICS L.P. (WAS CHEMICAL CO.)	AARZ	5501 BAKER ROAD	Baytown	TX	77520	0	2	0	1		1	1	1.00	1

<----------------------------Number of counts of defects or violations Indicated by the Inspector in each Inspection, by HM Manual Category------------------------->

N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
107B	107G	171	172C	172H	172I	174A	174B	BP 172.302 172.304 172.326 172.502 172.516 174.50	FC 174.55 174.61 174.81 177.834	HMII 5800.1 NARs & Notification by NRC	NB	NFY	ORI	QAP 179.7	RADX 174.86	RAM 173.410 to 173.477	SWT 174.82 174.83 and 174.86	TCT & TCL 172.302(a)(1) 172.304 172.502(a)(1)(i) 172.516(c)(2) and (6), 173.31, 174.50 179 & 180	TPLH 174.84 and 174.85	TRHM 174.9	ULT 173.31(g) or 174.67	SHIP
3	3	3	1	3	1	1	1	1	1	5	1	5	3	5	3	5	1	1	1	1	3	5
	1		1	1	1																1	
	1		1	1	1																1	
			1																			

THE SHIPPER RISK MODEL [SRM]

$$RS = \left\{ \left[T + D_{avg}\left(C_{avg} + R \right) + F_{NAR} \right] * F_{RE} + SE \right\}$$

RS　　= Risk score (an open ended numerical score)

T　　= A risk number for time elapsed since most recent inspection

D_{avg}　= Average risk factor based on numbers of defects, defect weights, and inspections

C_{avg}　= Mean value of multiple defects risk factor over all inspections; =　　$C_{avg} = \dfrac{\sum\limits_{j=1}^{j=M} C_j}{M}$

R　　= Repeat non-compliance offense (of defects) factor. This is based on the maximum number of inspections (or years) in which the same type of defect is found, considering all categories of defects.

F_{NAR}　= Risk score for non-accident releases

F_{RE}　= A factor that considers other risk enhancing factors; $F_{RE} = F_{HM} \times F_V \times F_{LR} \times F_{RP}$

SE　　= Score attribution from Emerging Issues

RISK SCORE FACTORS BY AGE OF INSPECTION, NAR'S AND DEFECT TYPES

Risk	Score (T)	Time since last inspection (t), in months
High	10	t > 60
Medium	5	12 < t < 60
Low	0	t < 12

Maximum number of counts in any defect category ($1<i<K$) in any inspection visit (j) (N_j)	Risk factor (C_i)
$N_i > 10$	2.0
$3 < N_j \le 10$	1.5
$N_i \le 3$	1.0

Risk	Score (NAR)	Number of NARs (N_{NAR}), attributable to a shipper, which occurred over the previous		
		12 months	36 months	60 months
High	5	$N_{NAR} \ge 2$	$N_{NAR} \ge 4$	$N_{NAR} \ge 6$
Medium	3	$N_{NAR} = 1$	$2 \le N_{NAR} < 4$	$4 \le N_{NAR} < 6$
Low	0	$N_{NAR} = 0$	$N_{NAR} = 0$	$N_{NAR} = 0$

EXAMPLES OF SHIPPER RISK FACTORS WITH FICTITIOUS DATA

Sheet Name:	"DLIV" [Date of Last Inspection Visit]				
Region #	Shipper Code	Shipper Name	Date of Last Inspection Visit	Number of months to last inspection date	DLIV Score "T"
1	3MQ	3M	8/13/2014	32	5
1	AARZ	ADVANCED AROMATICS L.P. (WAS CHEMICAL CO.)	9/23/2013	43	5
1	ACYZ	ARCH CHEMICAL COMPANY	3/16/2016	13	5
1	AEZ	AEROPRES	5/24/2014	35	5
1	AFQQ	AFTON CHEMICAL	9/4/2012	56	5
1	AHZ	ASHTA CHEMICAL INCORPORATED (ZACH)	10/6/2015	18	5

Sheet Name:	"NAR" [Non-Accident Releases]				
Region #	Shipper Code	Shipper Name	NARS in Past 12 months	NARS in Past 36 months	NARS in Past 60 months	NAR Score "F_{NAR}"
1	3MQ	3M	3	6	9	5
1	AARZ	ADVANCED AROMATICS L.P. (WAS CHEMICAL CO.)	2	4	6	5
1	ACYZ	ARCH CHEMICAL COMPANY	4	8	12	5
1	AEZ	AEROPRES	4	8	12	5
1	AFQQ	AFTON CHEMICAL	5	10	15	5
1	AHZ	ASHTA CHEMICAL INCORPORATED (ZACH)	2	4	6	5
1	ALCO	ALCOA ALUMINUM, INC.	3	6	9	5
1	ALPI	ALPINE PLANT FOOD	5	10	15	5

EXAMPLES OF SHIPPER RISK FACTORS WITH FICTITIOUS DATA

Sheet Name:	"RD" [Repeat Defects]															

Region #	Shipper Code	Shipper Name	<----------Number of inspection trips in which the s												Max Number Counts	Score due to repeat of most violated defects
			107B	107G	171	172C	172H	172I	174A	174B	BP	FC	HMII	NB		("R")
1	3MQ	3M	0	2	0	2	2	2	0	0	0	0	0	0	2	1.5
1	AARZ	ADVANCED AROMATICS L.P. (WAS CHEMICAL CO.)	0	0	0	1	0	0	0	0	0	0	0	0	1	1
1	ACYZ	ARCH CHEMICAL COMPANY	1	3	2	3	3	3	0	0	0	0	0	0	3	2
1	AEZ	AEROPRES	0	6	0	6	6	6	0	0	0	0	0	0	6	3
1	AFQQ	AFTON CHEMICAL	0	0	0	3	0	0	0	0	0	0	1	0	3	2
1	AHZ	ASHTA CHEMICAL INCORPORATED (ZACH)	0	0	0	0	0	0	0	0	0	0	1	0	1	1
1	ALCO	ALCOA ALUMINUM, INC.	1	1	0	1	1	1	0	0	0	0	0	0	1	1

Risk Factor by Hazmat Class

[Risk Factor due to the Class or Division of Hazmat - F_{HM}]

Class #	Division #	Hazardous Materials (HM) Category	HM Risk Factor (F_{HM})
1	1.1	Explosives (mass explosion hazard)	5
1	1.2	Explosives (projection hazard)	5
1	1.3	Explosives (fire hazard)	5
1	1.4	Explosives (no significant blast hazard)	3
1	1.5	Very insensitive explosives (blasting agents)	2
1	1.6	Detonating substances (extremely insensitive)	2
2	2.1	Flammable gas	4
2	2.2	Non-flammable compressed gas	2
2	2.3	Poisonous gas	5
3		Flammable and combustible liquid	3
4	4.1	Flammable solid	3
4	4.2	Spontaneously combustible material	3
4	4.3	Dangerous when wet material	3
5	5.1	Oxidizer	3
5	5.2	Organic peroxide	3
6	6.1	Poisonous material	4
6	6.2	Infectious substance (Etiologic agent)	1.5
7		Radioactive material	4
8		Corrosive material	3

[Risk Factor due to Annual Volume of Shipments - F_V]

Volume of hazmat shipments (Carloads/year)	Hazmat volume risk factor (F_V)
1 to 50	1
51 to 250	2
251 to 1000	3
1001 and higher	4
N/A	1.5

Note: N/A is assigned 1.5 because if recordkeeping is not practiced by the shipper on how many shipments are made annually that represents a failure.

[Risk Factor due to Loaded or Empty Car - F_{LR}]

Types of packaging handled at the shipper facility	Car load condition risk factor (F_{LR})
Loaded only	1.00
Empties/residue only	0.50
Loaded and empties/residue	0.75
N/A	1.00

EXAMPLES OF SHIPPER RISK FACTORS WITH FICTITIOUS DATA

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Sheet Name:	"HMSV" (HM Shipment Volumes)															Maximum of product of HM & Shipment Volume Risk Factors
				<----------- Annual Shipments in Tank Car Loads of -----------						<----------- Annual Shipments in Ta						
				Hazmat Class 1							Class 2			Class 3			
Region #	Fiscal Year	Shipper Name	Shipper Code	1.1 Mass Explosion Hazard	1.2 Projection Hazard	1.3 Fire Hazard	1.4 Non-significant Blast Hazard	1.5 Insensitive - Blasting Agents	1.6 Extremely Insensitive Detonating Agents	2.1 Flammable Gas	2.2 Non-Flammable Compressed Gas	2.3 Poisonous Gas	Flammable & Combustible Liquid	4.1 Flammable Solid		
		HM Risk Factor (FHM) ----->		5	5	5	3	2	2	4	2	5	3	3		$(F_{HM} \times F_V)_{Max}$
1	2015	3M	3MQ	225	1425	1437	685	1057	378	590	1062	206	1120	1276		20
1	2016	3M	3MQ	820	559	870	154	973	77	898	999	152	77	685		16
1	2014	ADVANCED AROMATICS L.P. (WAS	AARZ	1431	29	836	1363	26	1398	863	635	503	1105	1287		20
1	2011	ARCH CHEMICAL COMPANY	ACYZ	956	230	19	657	440	600	483	887	475	1331	1059		15
1	2013	ARCH CHEMICAL COMPANY	ACYZ	615	1485	277	521	417	1247	756	1325	161	1211	927		20

EXAMPLES OF SHIPPER RISK FACTORS WITH FICTITIOUS DATA

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Region #	Shipper Code	Shipper Name	Score indicating when most recent inspection was done	Avgerage Score by defects	Average Score due to # of defects	Score due to repeat of most violated defects	Risk Score due to NARs	Maximum combined HM & shipment volume risk factor over all Inspection visits	Factor indicating Loaded or Empty or both types of Shipments handled	Factor indicating Route Planning Requirement for Shipments	Score attribution from Emerging Issues	Total RISK Score	Scaled Risk Index (%)
			("T")	("D_{Avg}")	("C_{AVG}")	("R")	("F_{NAR}")	("F_{HM} x F_V")	("F_{LR}")	("F_{RP}")	("SE")	("RS")	("RI")
		Max value of scores-->	10	5	2	3	5	20	1	1.5	9	1209	100
1	3MQ	3M	0	2.67	1.00	1.5	3	20	1	1.5	1	291	24.1
1	AARZ	ADVANCED AROMATICS L.P. (WAS CHEMICAL CO.)	5	3.00	1.00	1.0	5	20	0.75	1.5	5	365	30.2
1	ACYZ	ARCH CHEMICAL COMPANY	5	2.82	1.00	2.0	5	20	0.75	1.5	0	415	34.3
1	AEZ	AEROPRES	5	2.61	1.00	3.0	3	20	0.75	1.5	7	422	34.9
1	AFQQ	AFTON CHEMICAL	5	2.78	1.00	2.0	5	20	1	1.5	0	550	45.5
1	AHZ	ASHTA CHEMICAL INCORPORATED (ZACH)	10	5.00	1.00	1.0	3	20	0.5	1.5	2	347	28.7

SHIPPER RISK SCORE
BY FACILITY AND REGION
WITH FICTITIOUS DATA

Sheet Name:	"RS" [Risk Scores by different attributes]			
Region #	Shipper Code	Shipper Name	Total RISK Score ("RS")	Scaled Risk Index (%) ("RI")
		Max value of scores-->	1,209	100
1	MUSQ	MUSKET CORPORATION	909	75.19
1	ZMXF	MEXICHEM FLUOR	750	62.03
1	ZSST	STROBEL STAROSTKA TRANSFER	741	61.26
1	GLPZ	GLOBAL PETROLEUM CO. (ZGLB)	733	60.60
1	XASA	ALL STATES ASPHALT, INC.	710	58.73
1	ZDCS	DUPONT CHEMICAL SOLUTIONS E	703	58.15
1	ZDPM	DCP MAINSTEAM	698	57.74
1	CELQ	CELANESE LTD.	697	57.65
1	DANA	DANA TRANSPORT, INC.	696	57.56
1	ZPHN	PHILADELPHIA ENERGY SOLUTIOI	688	56.91
2	PRAZ	PRAXAIR (ZPRX)	909	75.20
2	SAVZ	SAVAGE SERVICES CORPORATIO	860	71.15
2	ZUTC	UNION TANK CAR	846	69.97
2	ASSQ	ASSOCIATED ASPHALT	844	69.82
2	WWTQ	WESTWAY TERMINALS CO. (ZWS1	800	66.19

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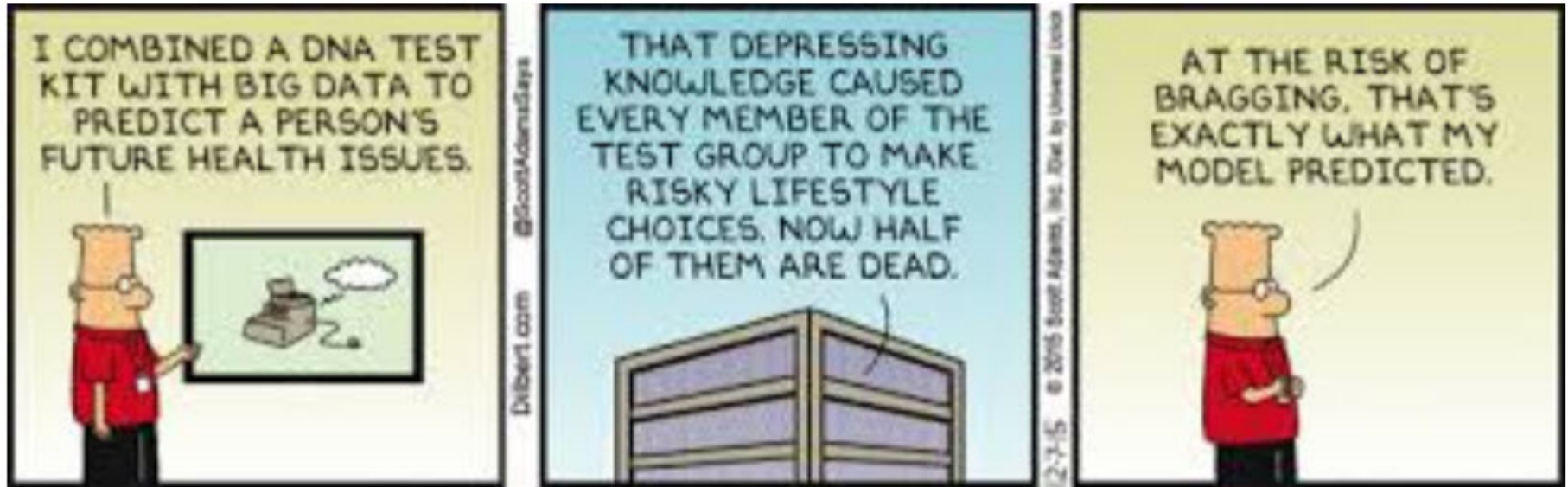
➢ FRA and PHMSA are working together to implement SRM on PHMSA's DATAMART system [formerly known as HIP- Hazmat Intelligence Portal]

➢ Advantages of implementation on DATAMART are

  ✓ Uniform applicability to other DOT modes,

  ✓ Common User Interfaces,

  ✓ Common input schemes,

  ✓ General facility information gathered by PHMSA

  ✓ Graphical display of results on national, regional or local maps, with company attribute.

What is PHMSA's datamart
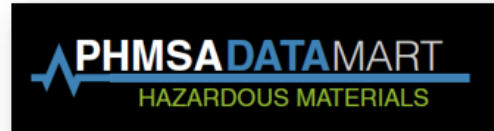
The PHMSA DataMart (formerly known as the Hazmat Intelligence Portal), provides a 360 degree view into the movement of hazardous materials across all transportation modes. It integrates millions of hazardous material events such as Hazmat incidents, inspections, regulations, etc. from over 60 data sources. This web-base hazardous materials intelligence data warehouse provides PHMSA and its modal partners with centralized access to actionable information which supports the DOT's mission critical objectives of risk management, decision support and transparency.

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CUSTOMIZED FRA HOME PAGE ON DATAMART'S DASHBOARD

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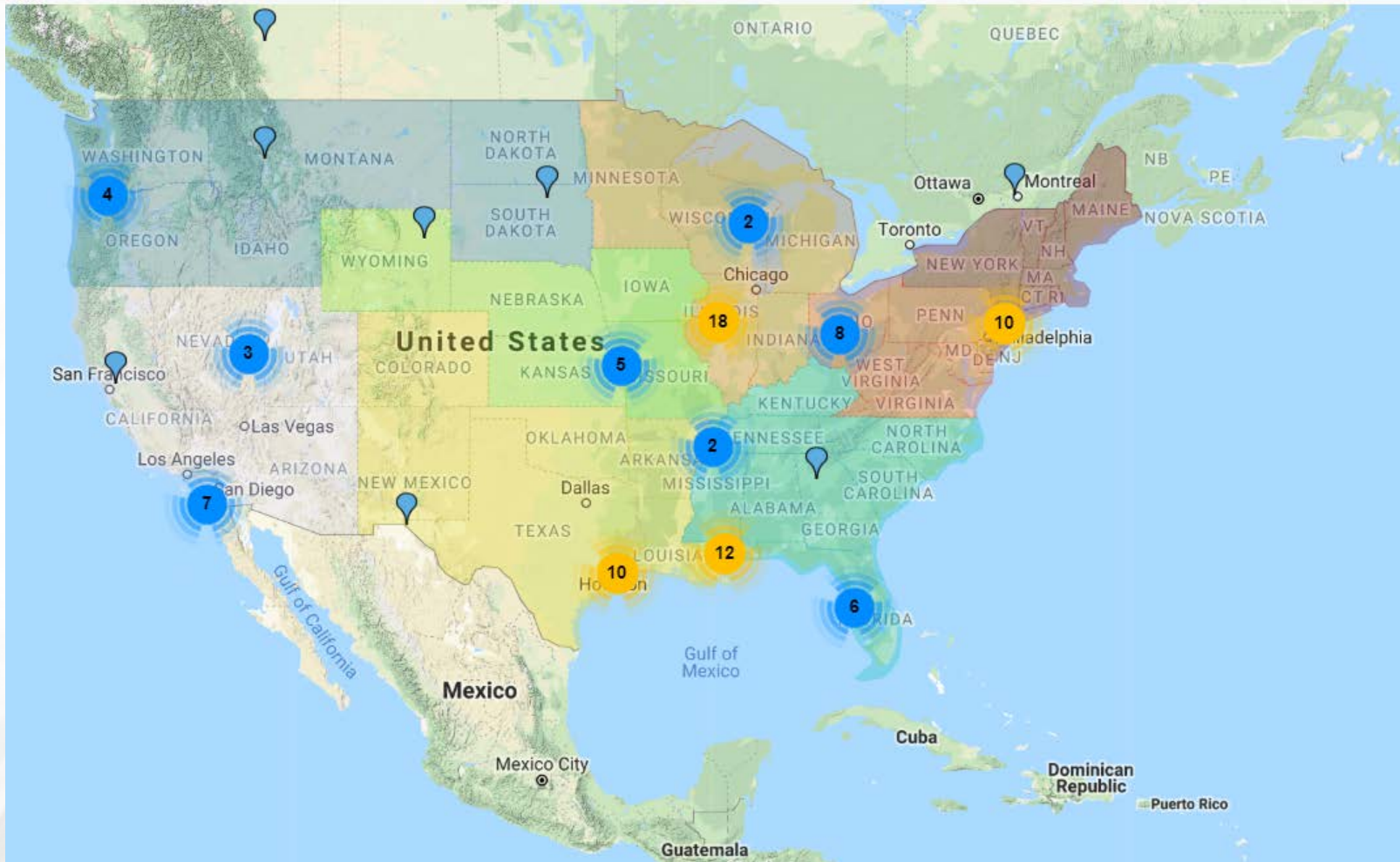Do not distribute outside FRA or State Agency pursuant to 49 CFR Part 212.

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Domestic Ultimate DUNS Number	Domestic Ultimate Name	Company Name	Company Facility Name	Company Known As Names	Company Telephone Number	Company DUNS Number	HM Registration (Active)	Special Permits	NRC/URI	Inspections and Violations	Agency	Activity	Activity Type	Mode	Latest Transaction Date	NAICS Code(2 digit)	Facility Risk Rank
002182228	REAGENT CHEMICAL & RESEARCH, INC.	REAGENT CHEMICAL & RESEARCH, INC.	REAGENT CHEMICAL & RESEARCH, INC. : - 36335 HIGHWAY 30, GEISMAR, LA 70734	REAGENT CHEMICAL & RESEARCH, INC.	(225) 744-9200	080177675	Y	N	Y	Y	FRA-RAILWAY	INCIDENTS - NON-SERIOUS	SHIPPER	RAIL	2/17/2018	31-33-MANUFACTURING	8
															2/17/2018	42-WHOLESALE TRADE	8
												INCIDENTS - SERIOUS	SHIPPER	RAIL	1/18/2017	31-33-MANUFACTURING	8
															1/18/2017	42-WHOLESALE TRADE	8
												INCIDENTS - TOTAL	SHIPPER	RAIL	2/17/2018	31-33-MANUFACTURING	8
															2/17/2018	42-WHOLESALE TRADE	8
												INSPECTION / REVIEW	FRA INSPECTIONS	RAIL	4/3/2018	31-33-MANUFACTURING	8
															4/3/2018	42-WHOLESALE TRADE	8
												VIOLATIONS	FRA DEFECTS	RAIL	4/3/2018	31-33-MANUFACTURING	8
															4/3/2018	42-WHOLESALE TRADE	8

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Thank you
Any questions?