

# VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

**CARGO FV, TANK FV (Excl. Oil Barges),  
and Oil Barge  
VTRA 2015 Model Accident Callibration**

**Dr. J. Rene van Dorp and Dr. Jason R.W Merrick**

**June 1<sup>st</sup> – 2<sup>nd</sup> 2016**

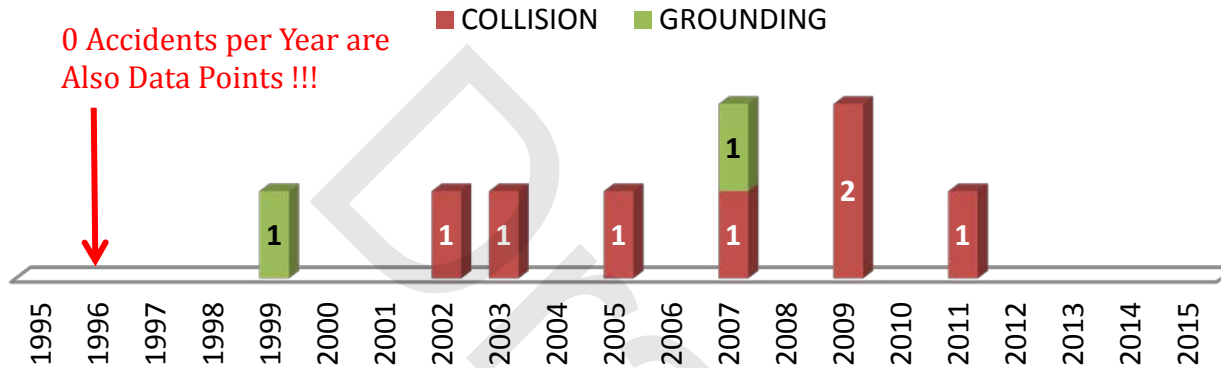


## OUTLINE

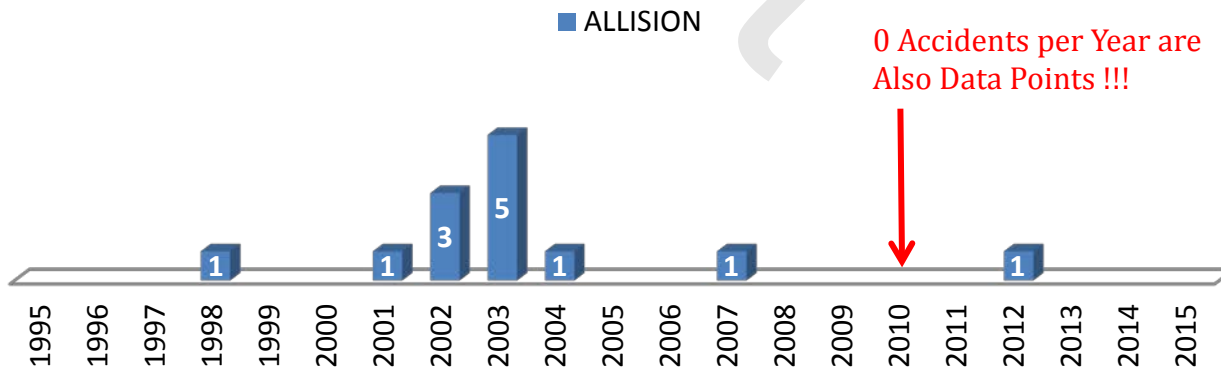
1. **Uncertainty in Average # Accidents per Year**
2. VTRA 2015 Data for Model Calibration
3. VTRA 2015 Model Calibration Analysis
4. Summary Accident Data Reconciliation

# VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

## TANK FV Coll. + Grou. by YEAR - VTRA 2015 Calibration Accidents 0 m<sup>3</sup> - 1 m<sup>3</sup> Spill Category - 9 Total



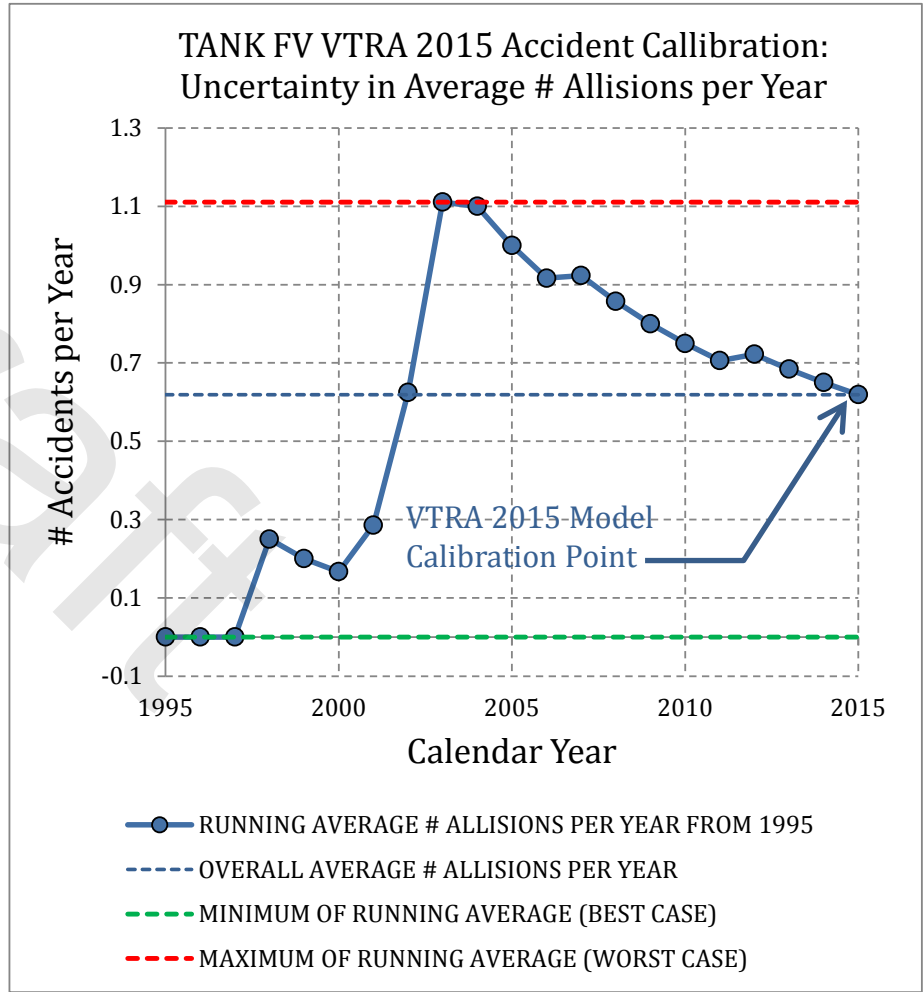
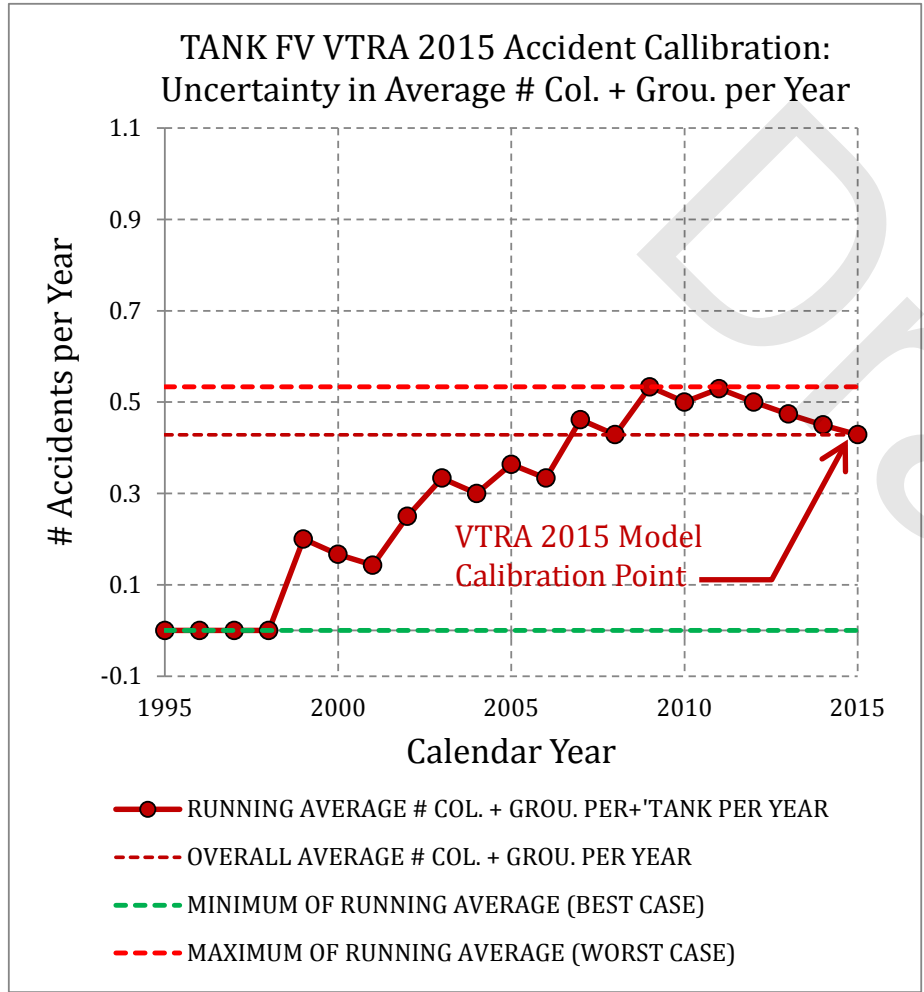
## TANK FV Allisions by YEAR - VTRA 2015 Calibration Accidents 0 m<sup>3</sup> - 1 m<sup>3</sup> Spill Category - 13 Total



# VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)



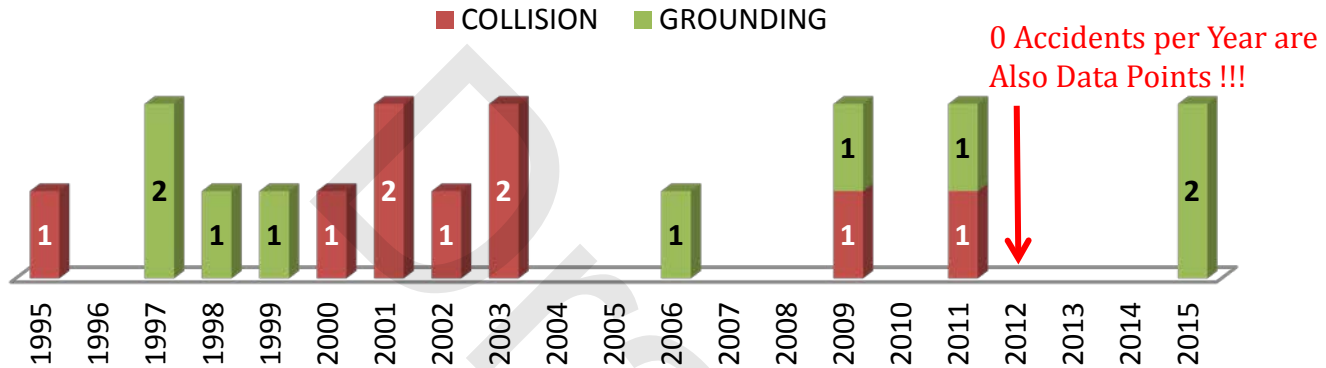
## Spill Size Category 0 m<sup>3</sup> – 1 m<sup>3</sup>



# VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

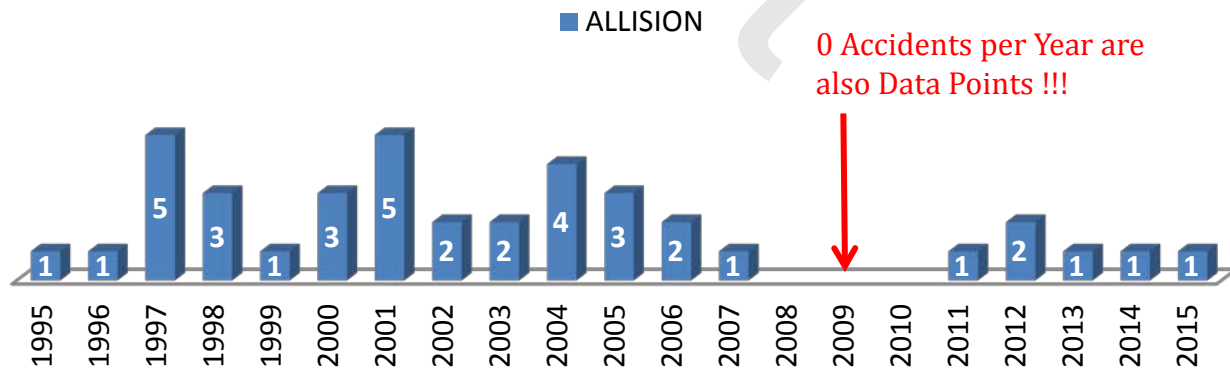
## CARGO FV Coll. + Grou. by YEAR - VTRA 2015

Callibration Accidents 0 m<sup>3</sup> - 1 m<sup>3</sup> Spill Category - 18 Total



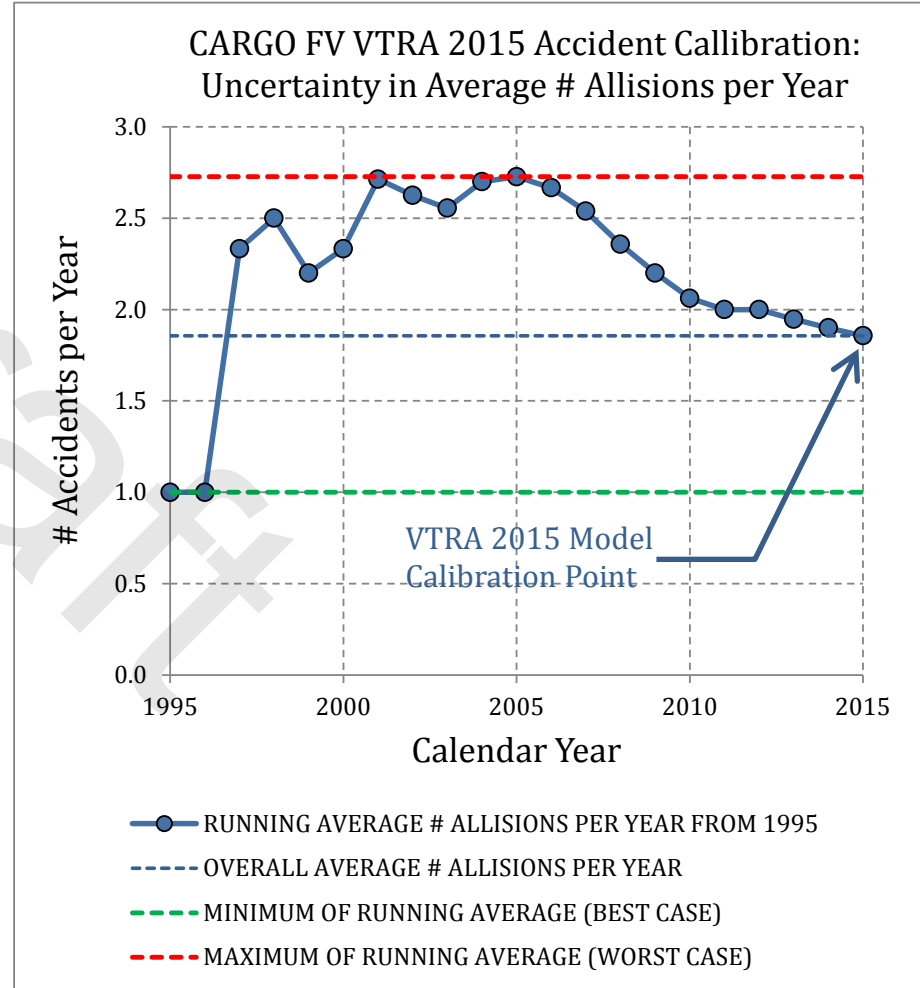
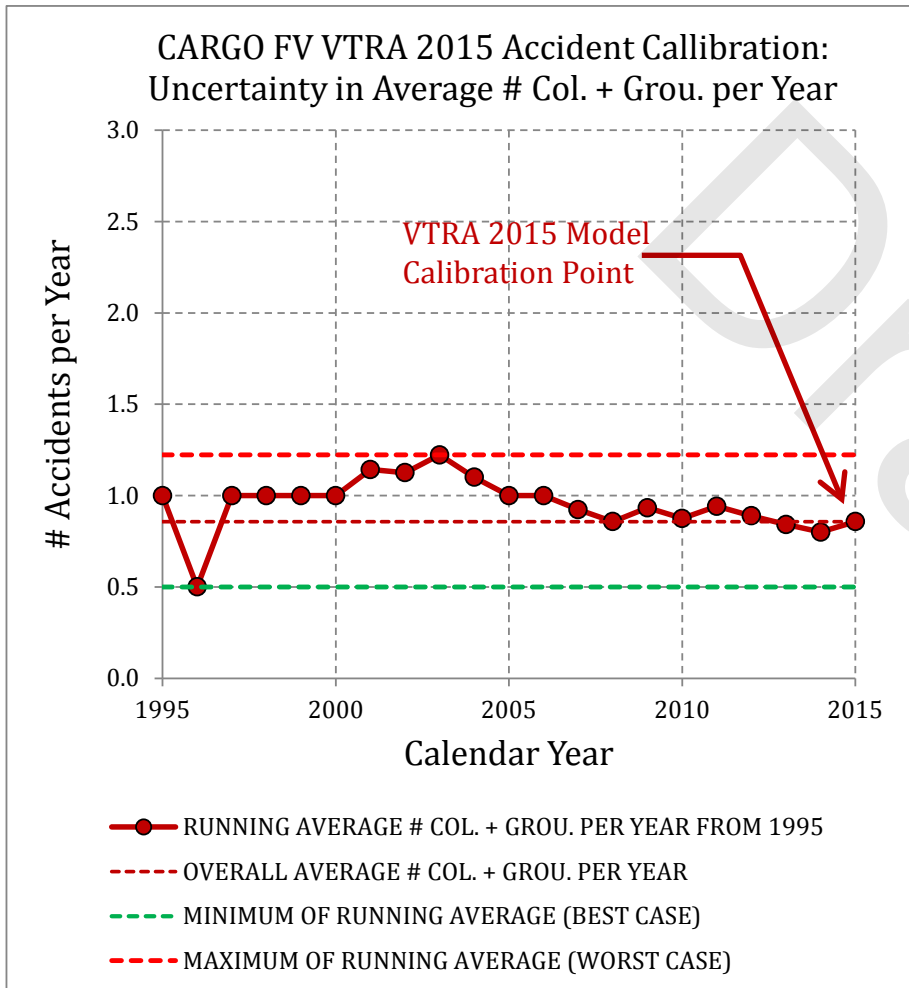
## Cargo FV Allisions by YEAR - VTRA 2015

Callibration Accidents 0 m<sup>3</sup> - 1 m<sup>3</sup> Spill Category - 39 Total



# VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

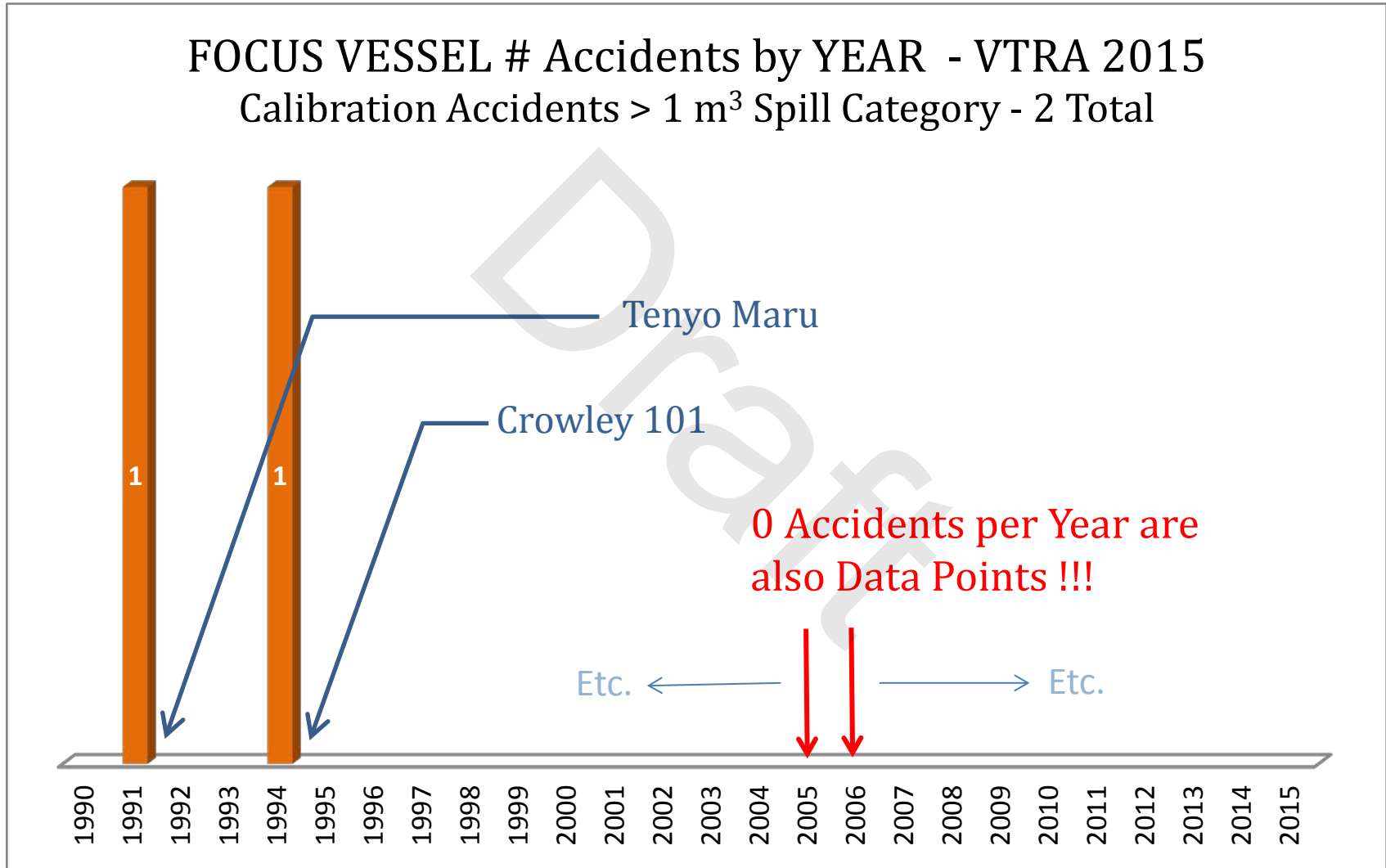
## Spill Size Category 0 m<sup>3</sup> – 1 m<sup>3</sup>



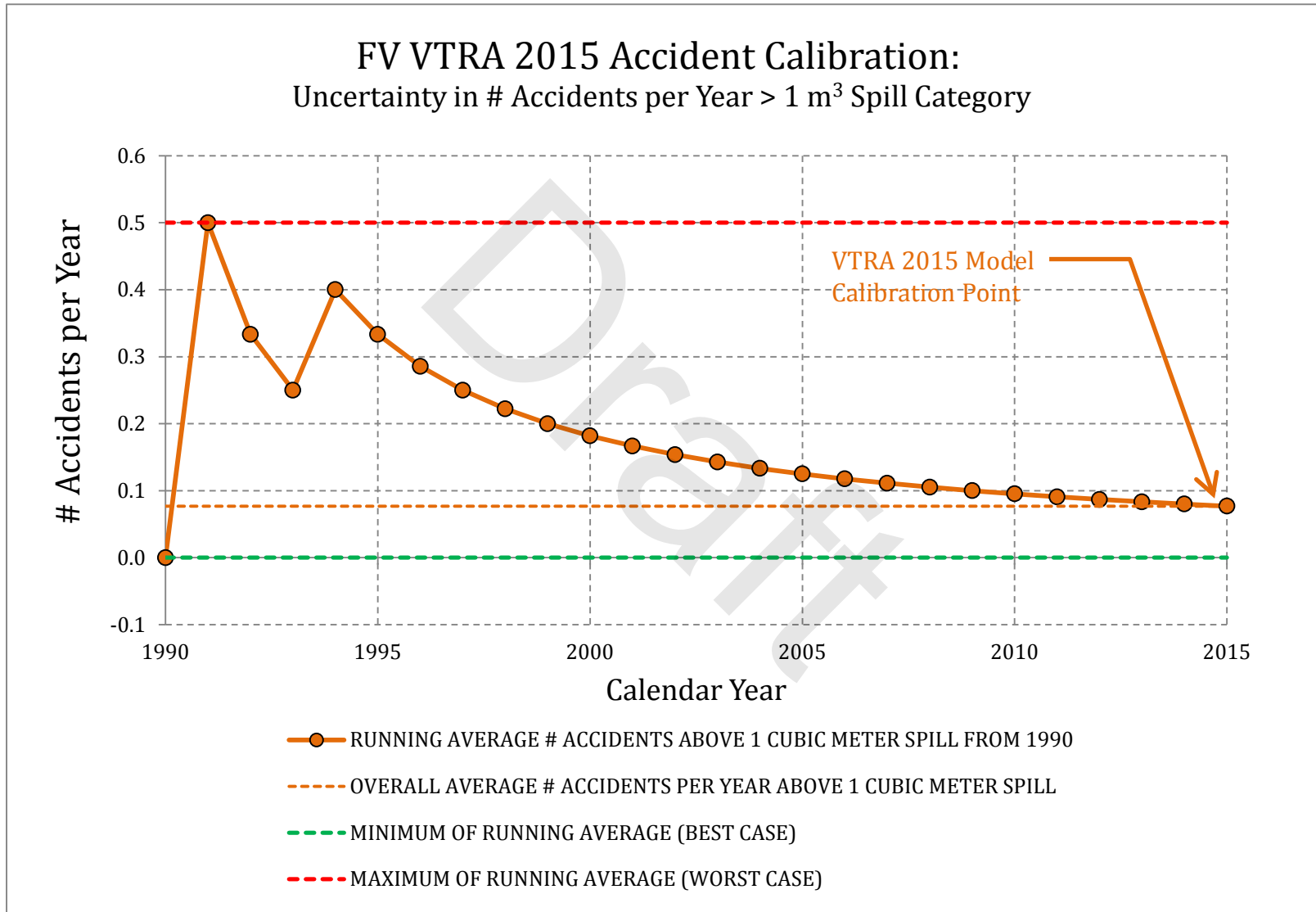
# VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

## FOCUS VESSEL # Accidents by YEAR - VTRA 2015

Calibration Accidents > 1 m<sup>3</sup> Spill Category - 2 Total



# VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)





## Conclusions

1. The Number of Accidents per Year is Uncertain and Varies from Year to Year.
2. It's hard to say why **The Average Number of Accidents per Year goes Up or Down over Time**, the reasons for change can be many, e.g.:
  - For some types of vessels, the traffic volume goes up,
  - For other types of vessels, the traffic volume goes down,
  - While safety measures are being implemented over time!

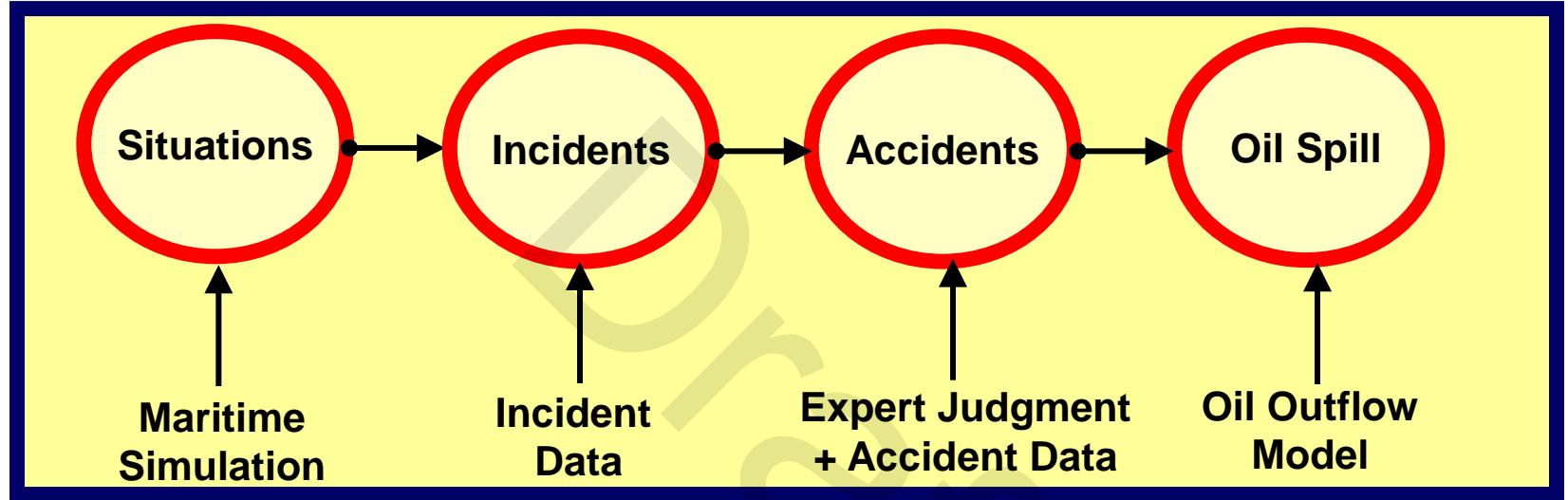


Calibrate the VTRA 2015 Model to Running Average of Accident Data that we have at the End of the Period 1990 – 2015

## OUTLINE

1. Uncertainty in Average # Accidents per Year
2. **VTRA 2015 Data for Model Calibration**
3. VTRA 2015 Model Calibration Analysis
4. Summary Accident Data Reconciliation

## PSP Study: VTRA 2010 CALIBRATION STEPS



**↑**  
**VTOSS 2015 DATA**

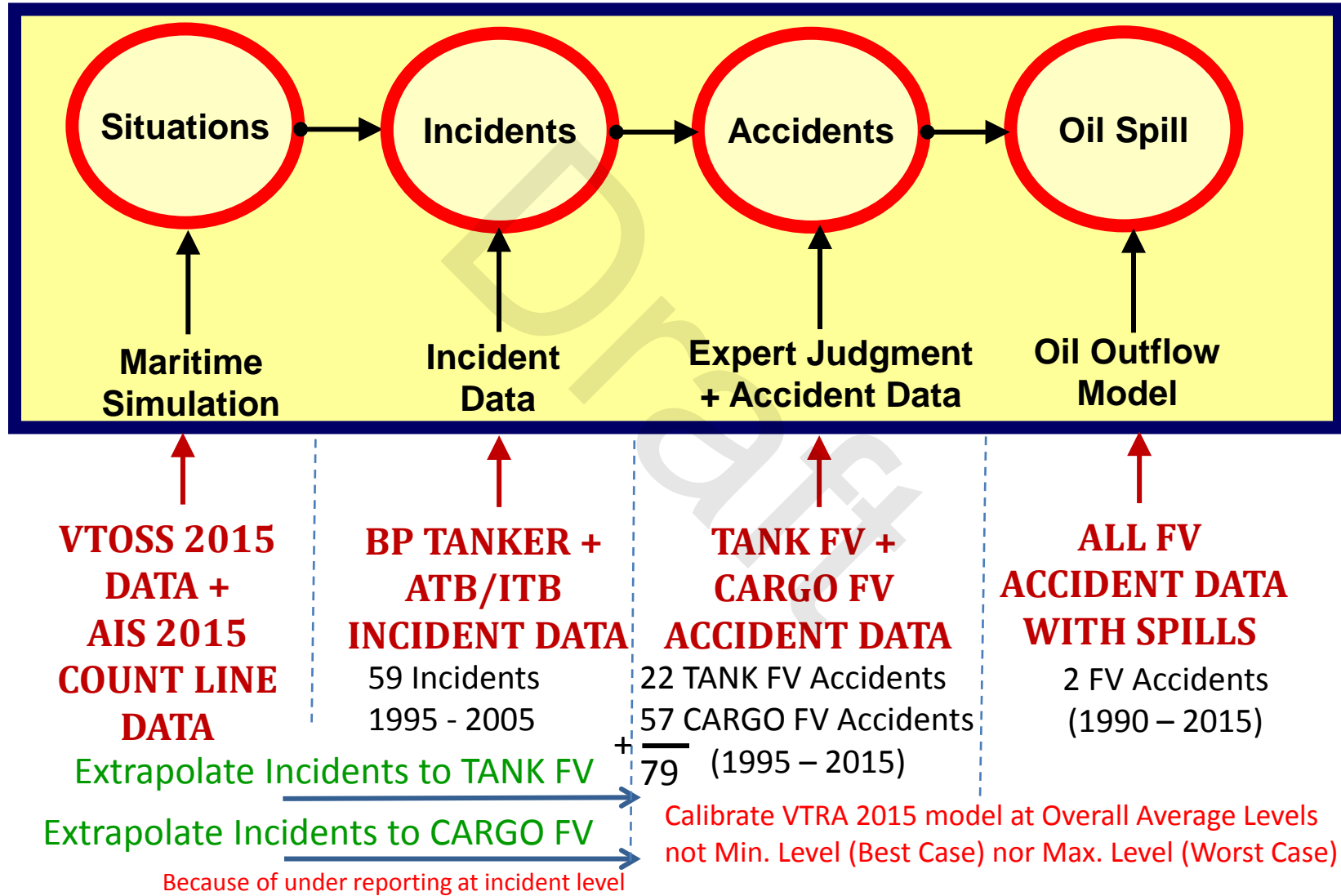
**↑**  
**BP TANKER + ATB/ITB INCIDENT DATA**  
 59 Incidents  
 1995 - 2005

**↑**  
**BP TANKER + ATB/ITB ACCIDENT DATA**  
 4 Accidents  
 1995 - 2005

**→**  
 No Accident Calibration at Oil Spill Level

**VTRA 2010** Extrapolate to OTHER TANK FV (Tankers, ATB's, Chem. C, Oil Barges)  
 Extrapolate to CARGO FV (BULK, CONT., OTHER CARGO).

## Ecology Study: VTRA 2015 CALIBRATION STEPS



## OUTLINE

1. Uncertainty in Average # Accidents per Year
2. VTRA 2015 Data for Model Calibration
3. **VTRA 2015 Model Calibration Analysis**
4. Summary Accident Data Reconciliation

# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015



## VTRA 2015 Model Accident Calibration of the 0 m<sup>3</sup> - 1 m<sup>3</sup> Spill Category

Source: VTRA Data from 1995 - 2015

US	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup>			CA	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup>		
	ALLISION	GROUNDING	COLLISION		ALLISION	GROUNDING	COLLISION
CARGO FV	36	6	8	CARGO FV	2	4	1
TANK FV (Excl. Oil Barge)	5	1	1	TANK FV (Excl. Oil Barge)	0	0	0
OIL BARGE	8	1	6	OIL BARGE	0	0	0

US	NUMBER OF DATABASE YEARS			CA	NUMBER OF DATABASE YEARS		
	ALLISION	GROUNDING	COLLISION		ALLISION	GROUNDING	COLLISION
CARGO FV	21	21	21	CARGO FV	12	12	12
TANK FV (Excl. Oil Barge)	21	18	21	TANK FV (Excl. Oil Barge)	12	12	12
OIL BARGE	15	15	15	OIL BARGE	12	12	12

US	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup> PER YEAR			CA	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup> PER YEAR		
	ALLISION	GROUNDING	COLLISION		ALLISION	GROUNDING	COLLISION
CARGO FV	1.714	0.286	0.381	CARGO FV	0.167	0.333	0.083
TANK FV (Excl. Oil Barge)	0.238	0.056	0.048	TANK FV (Excl. Oil Barge)	0.000	0.000	0.000
OIL BARGE	0.533	0.067	0.400	OIL BARGE	0.000	0.000	0.000

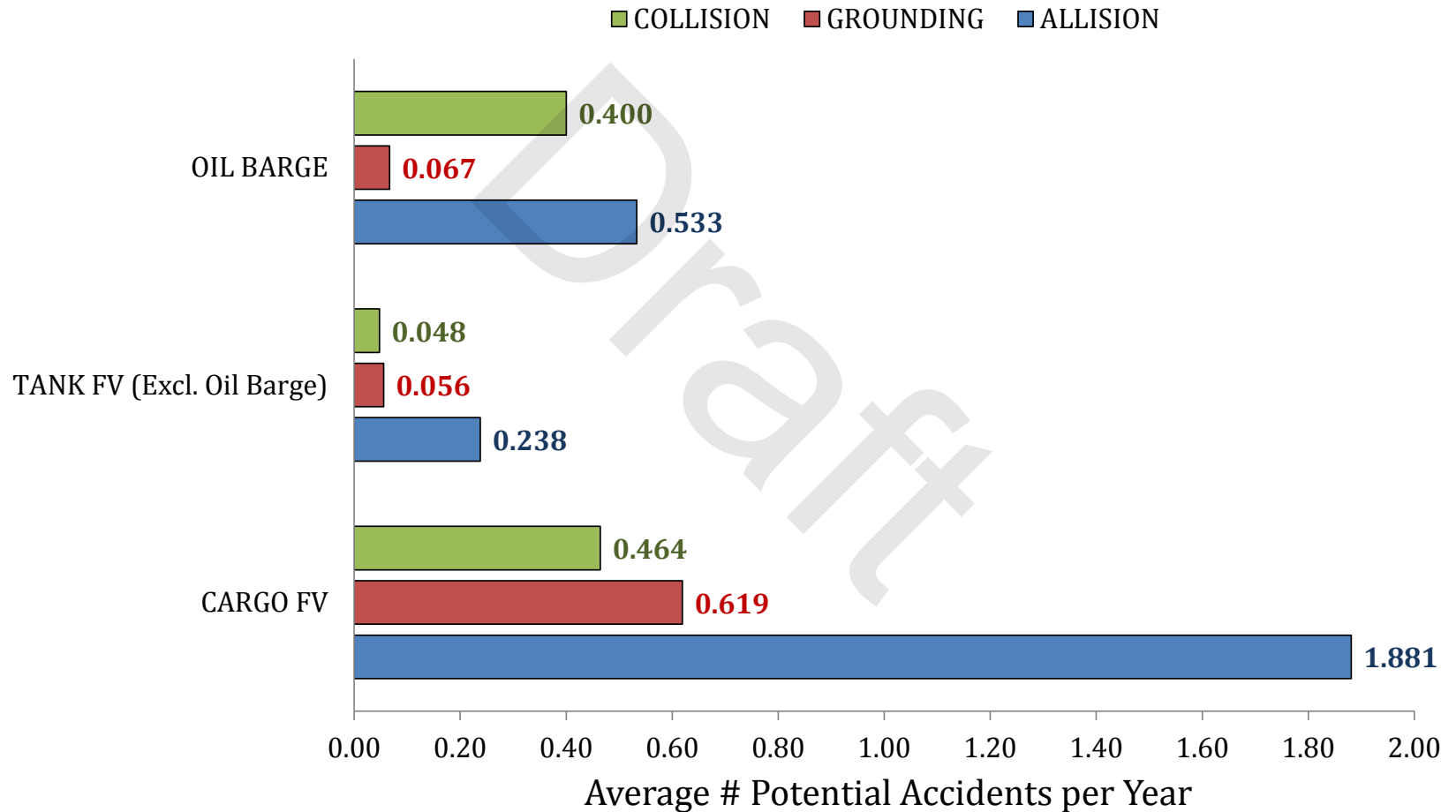
additive

US + CA	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup> PER YEAR			TOTAL
	ALLISION	GROUNDING	COLLISION	
CARGO FV	1.881	0.619	0.464	2.964
TANK FV (Excl. Oil Barge)	0.238	0.056	0.048	0.341
OIL BARGE	0.533	0.067	0.400	1.000
TOTAL	2.652	0.741	0.912	4.306

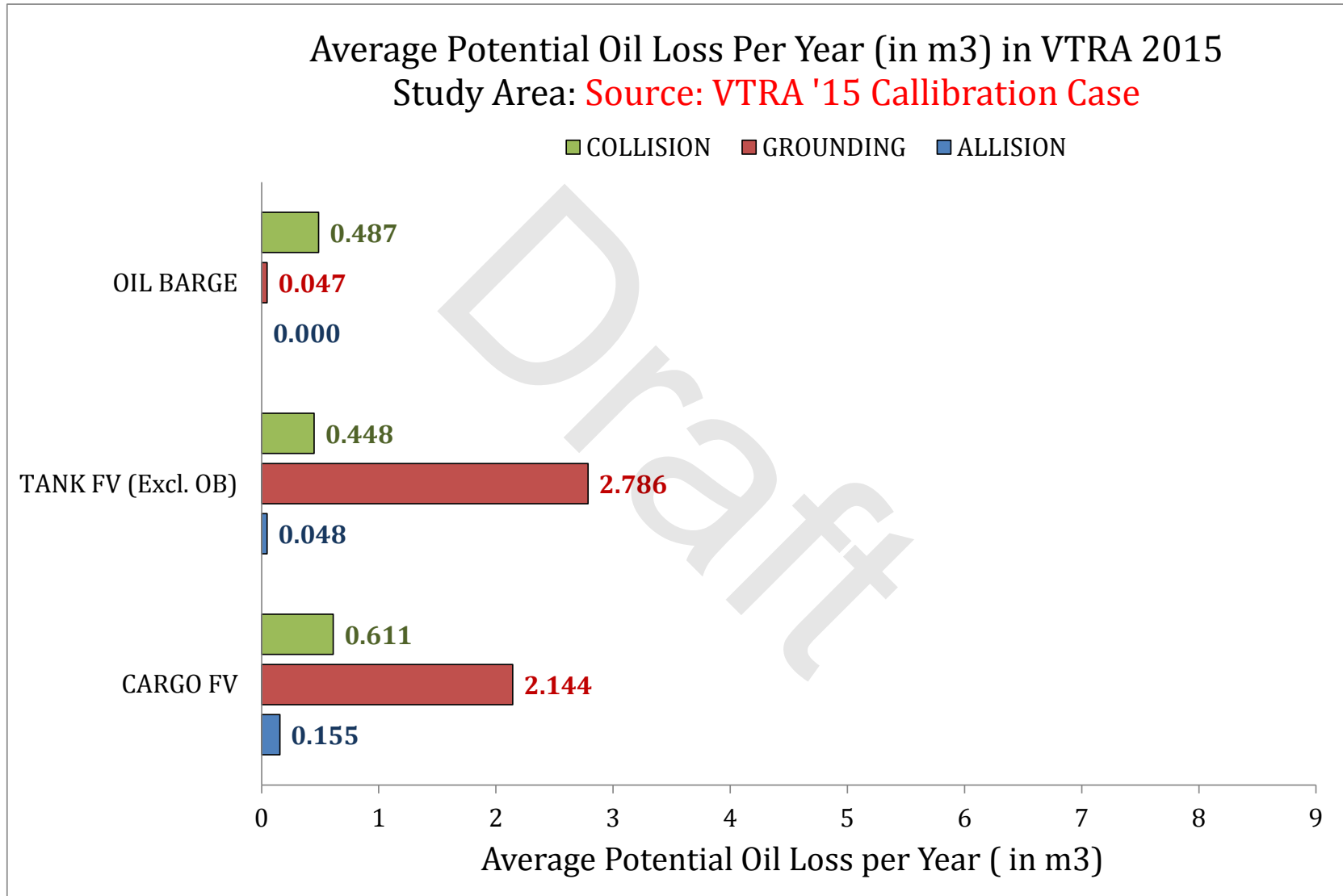
additive

# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

Average # Accidents per Year in 0 - 1 m3 Spill Category in VTRA  
2015 Study Area: **Source: VTRA Accident Database 1995 - 2015**

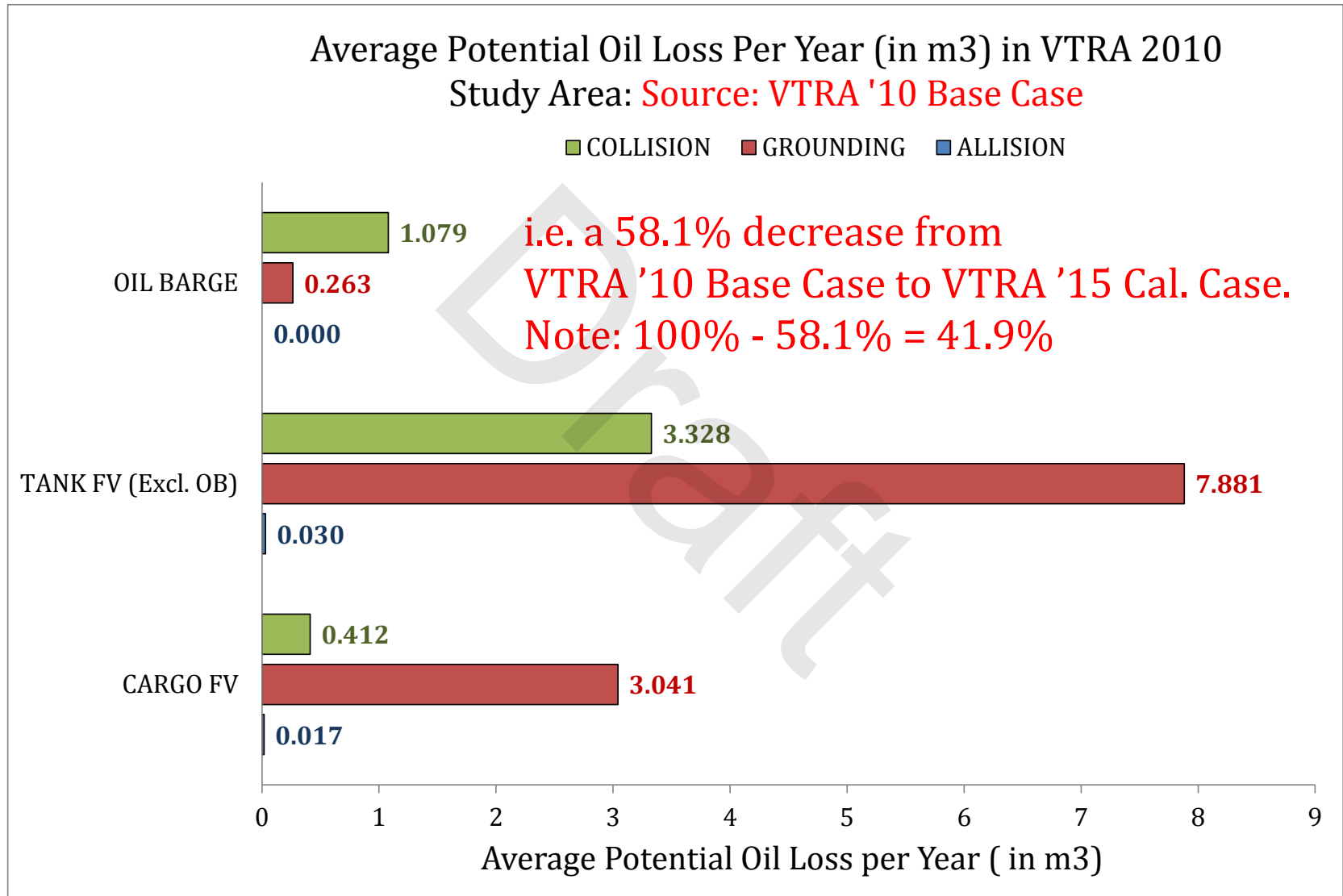


# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015





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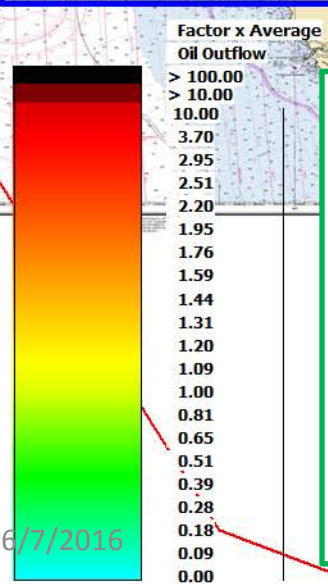


## VTRA 2015 CALIBRATION CASE - ALL FV

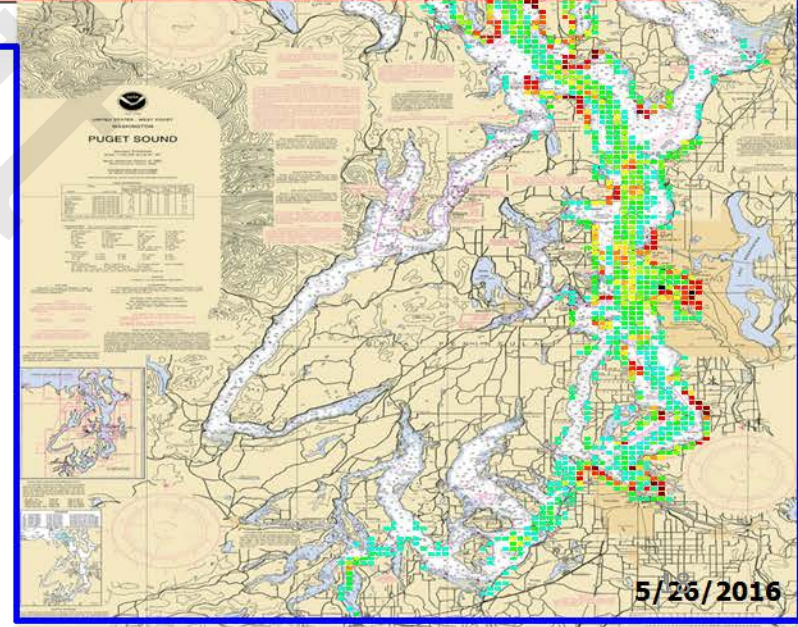
**41.9% of VTRA 2010 Base Case Total Annual Potential Oil Loss: ALL SPILL SIZES (including accid. with no oil loss)**

**30.9%**  
**23.3%**

**0.7%**



**VTRA '15 Calibration Case**  
GEOGRAPHIC PROFILE OF POTENTIAL ANNUAL OIL LOSS OF ACCIDENTS IN SPILL SIZE CATEGORY **ALL SPILL SIZES**



6/7/2016

5/26/2016

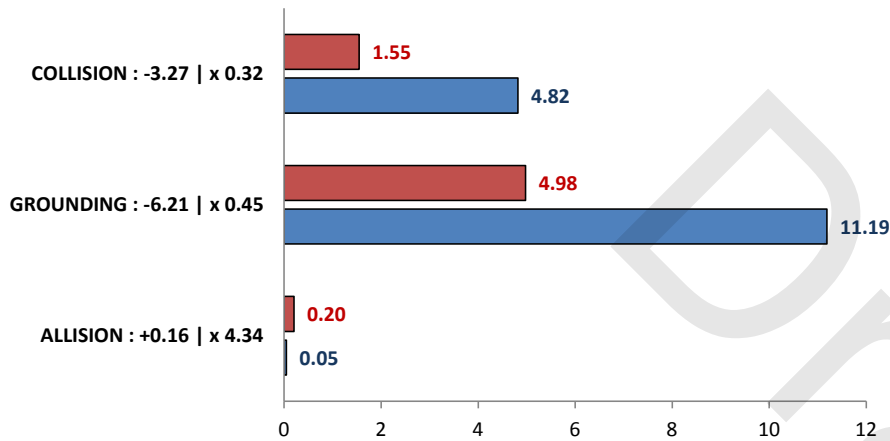
# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015



## Pot. Oil Loss per Year- ALL FV

Source: VTRA 2015 Cal. Case and VTRA 2010 Base Case

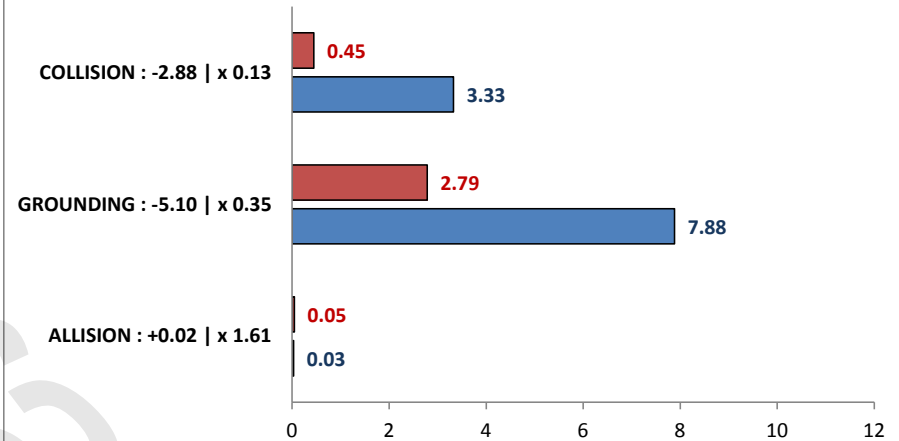
■ ALL FV (VTRA '15 Call. Case) ■ ALL FV (VTRA '10 Base Case)



## Pot. Oil Loss per Year - TANK FV (Excl. Oil Barges)

Source: VTRA 2015 Cal. Case and VTRA 2010 Base Case

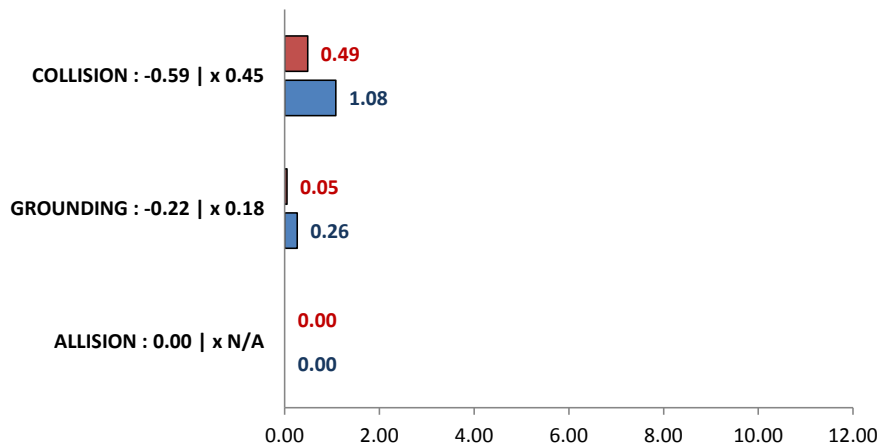
■ TANK FV (VTRA '15 Call. Case) ■ TANK FV (VTRA '10 Base Case)



## Pot. Oil Loss per Year - Oil Barges

Source: VTRA 2015 Cal. Case and VTRA 2010 Base Case

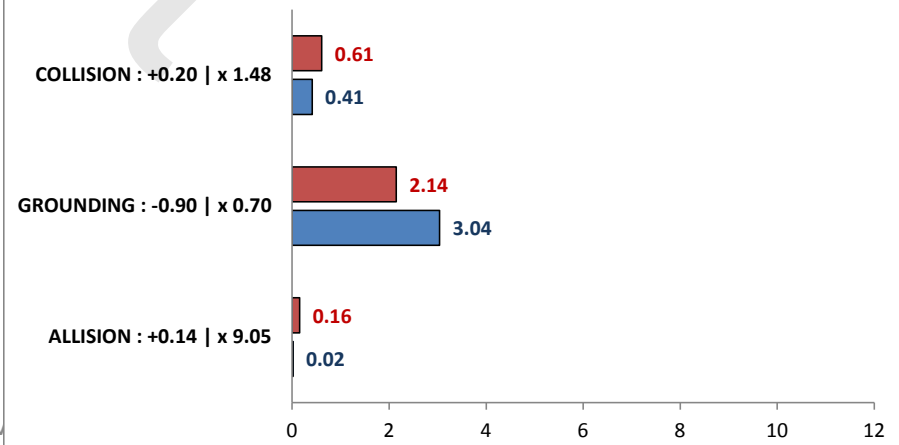
■ OIL BARGE FV (VTRA '15 Call. Case) ■ OIL BARGE (VTRA '10 Base Case)



## Pot. Oil Loss per Year- CARGO FV

Source: VTRA 2015 Cal. Case and VTRA 2010 Base Case

■ CARGO FV (VTRA '15 Call. Case) ■ CARGO FV (VTRA '10 Base Case)





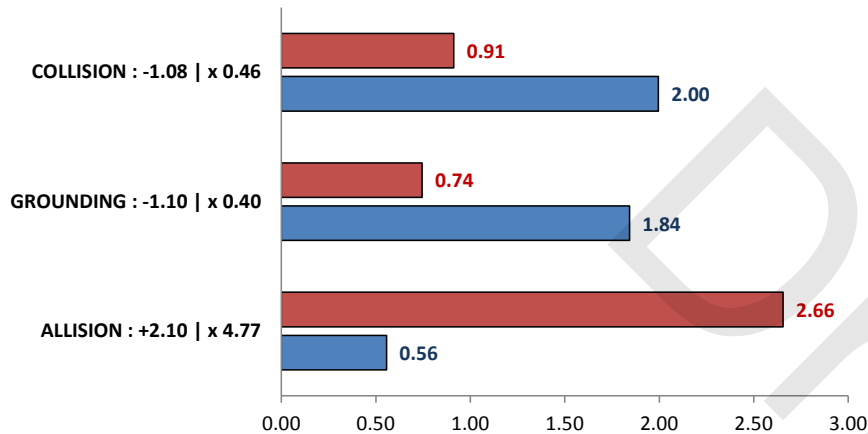
# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015



## Pot. # Accidents per Year - ALL FV

Source: VTRA 2015 Cal. Case and VTRA 2010 Base Case

■ CARGO FV (VTRA 2015 Calibration) ■ CARGO FV (VTRA 2010)

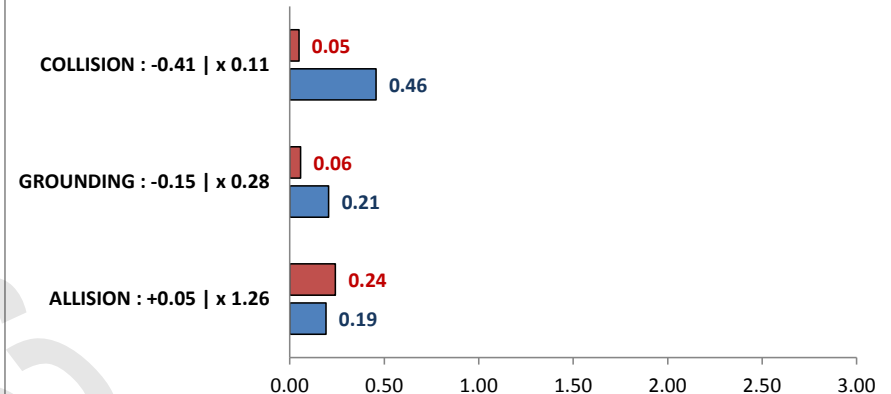


## Potential # Accidents per Year

### TANK FV (Excl. Oil Barges)

Source: VTRA 2015 Cal. Case and VTRA 2010 Base Case

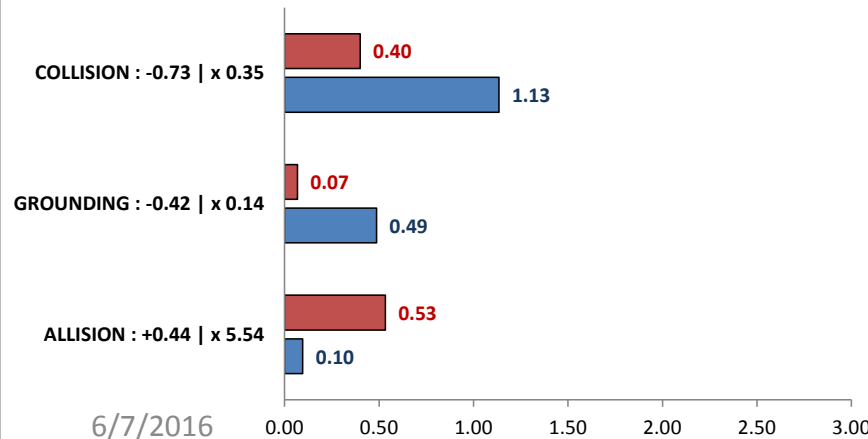
■ TANK FV (VTRA 2015 Calibration) ■ TANK FV (VTRA 2010)



## Pot. # Accidents per Year - Oil Barges

Source: VTRA 2015 Cal. Case and VTRA 2010 Base Case

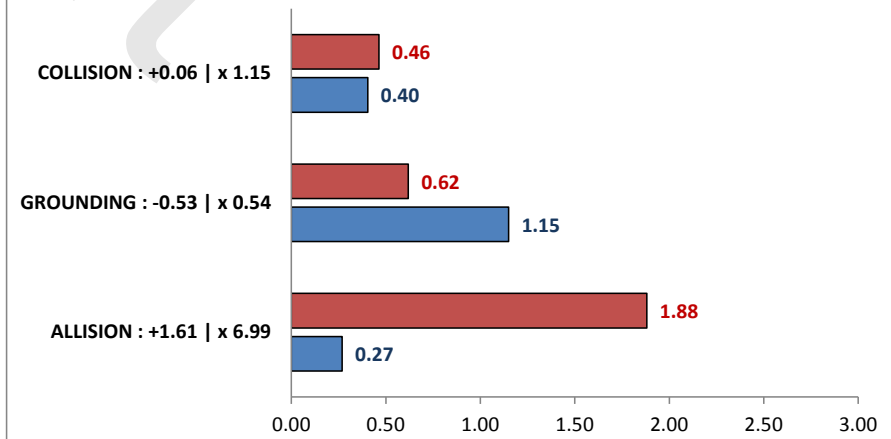
■ OIL BARGE (VTRA 2015 Calibration) ■ OIL BARGE (VTRA 2010)



## Pot. # Accidents per Year - CARGO FV

Source: VTRA 2015 Cal. Case and VTRA 2010 Base Case

■ CARGO FV (VTRA 2015 Calibration) ■ CARGO FV (VTRA 2010)



6/7/2016

# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

## VTRA 2015 Model Accident Calibration of the 0 m<sup>3</sup> - 1 m<sup>3</sup> Spill and the 1 m<sup>3</sup> or more Spill Category

Source: VTRA Data from 1990 - 2015

US + CA	NUMBER OF ACCIDENTS		TOTAL
	0 - 1 m <sup>3</sup>	1 m <sup>3</sup> or More	
ALL FOCUS VESSELS	111.94	2	113.94

US + CA	NUMBER OF DATABASE YEARS		TOTAL
	0 - 1 m <sup>3</sup>	1 m <sup>3</sup> or More	
ALL FOCUS VESSELS	26	26	26

US + CA	NUMBER OF ACCIDENT PER YEAR		TOTAL
	0 - 1 m <sup>3</sup>	1 m <sup>3</sup> or More	
ALL FOCUS VESSELS	4.31	0.08	4.38

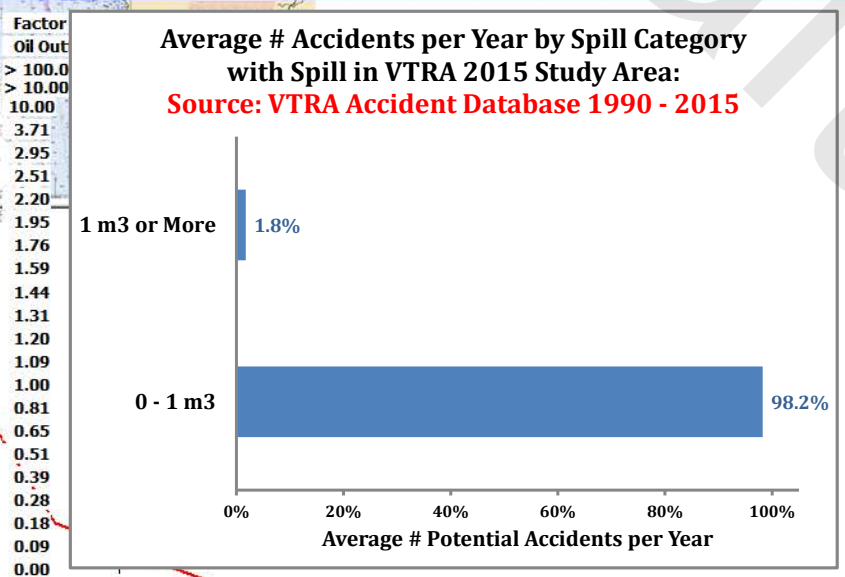
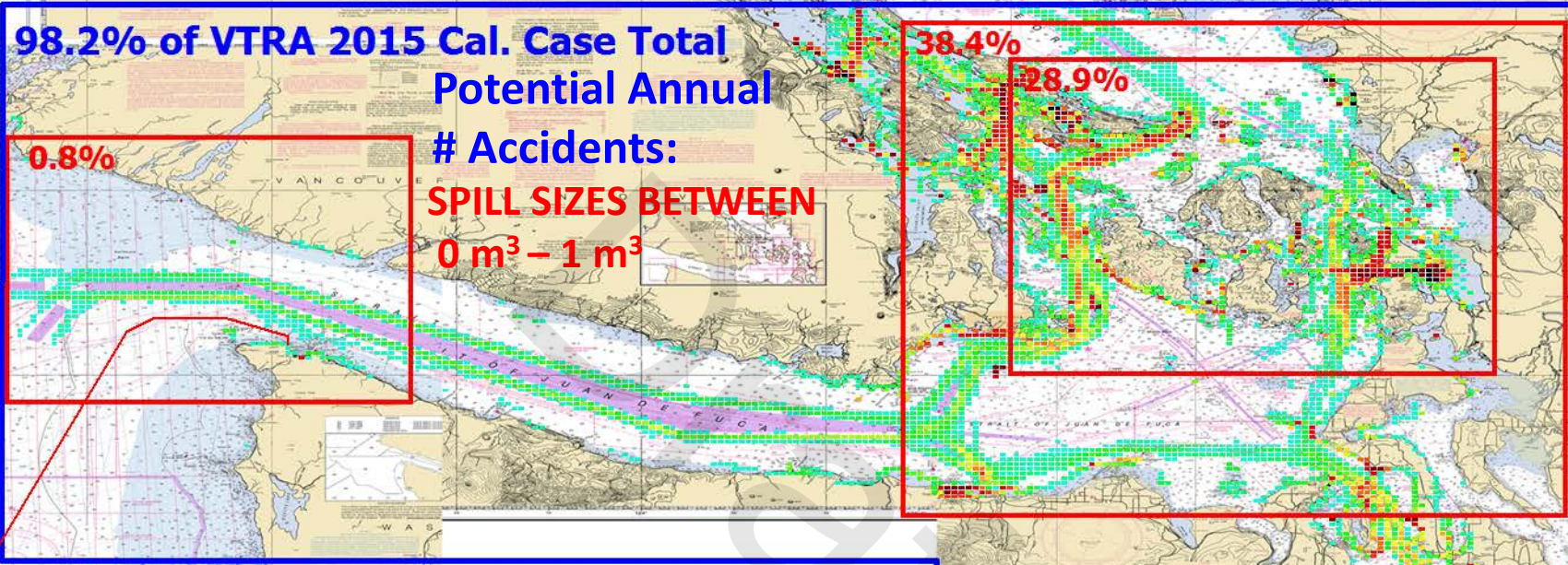
US + CA	NUMBER OF ACCIDENT PER YEAR		TOTAL
	0 - 1 m <sup>3</sup>	1 m <sup>3</sup> or More	
ALL FOCUS VESSELS	98.2%	1.8%	100%

??? Why not 79

1. Recall 4.306 Per Year in 0 - 1 m<sup>3</sup> Cat.
2. and 4.306 x 26 years = 111.94

# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

## VTRA 2015 CALIBRATION CASE - ALL FV



≈ 100% Probability of Spill Occurrence in 10 years

Average of ≈ 0.01 m<sup>3</sup> Per Potential Spill (≈ 2.4 gallons)

6/7/2016

5/24/2016

## OUTLINE

1. Uncertainty in Average # Accidents per Year
2. VTRA 2015 Data for Model Calibration
3. VTRA 2015 Model Calibration Analysis
4. **Summary Accident Data Reconciliation**



### Data Sources merged for Calibration at Accident Level of Causal Chain

1. 1995 – 2005 VTRA 2005 Accident Data – **65 Accident Records**
  2. 5/9/1998 Missing Accident Record provided by Mike Moore – **1 Accident Record**
  3. 2005 – 2016 Accident Data provided by Matt Edwards (USCG) Sector Seattle – **23 Accident Records**
  4. 2001 – 2012 USCG MISLE Data Base – **32 Accident Records added by GWU/VCU**
  5. 2004 – 2015 Canadian Accident Data Base Transportation Safety Board of Canada – **8 Accident Records added by GWU/VCU**
- **Merging of these datasets resulted in a total of 129 accident records: removed 25 records because of double counting – 104 records left, 18% reduction from original 129 records.**
  - **Review of VTRA 2005 Accident Data by Matt Edwards (USCG) resulted in a suggested disqualification of 28 records for Accident Calibration – 37 records left, 43.1% reduction from original 65 records.**
  - **Review of 2001 – 2004 USCG MISLE Data by Matt Edwards (USCG) resulted in a suggested disqualification of 1 record for Accident Calibration from 8 records – 7 records left, 12.5% Reduction**
  - **Review of 2005 – 2016 USCG Sector Seattle provided Accident Data by Matt Edwards (USCG) resulted in a suggested disqualification of 10 records for Accident Calibration – 13 records left, 43.5% reduction from original 23 records.**
  - **Review of 2005 – 2012 USCG MISLE Data Base by Matt Edwards (USCG) resulted in a suggested disqualification of 1 record for Accident Calibration from 3 accident records – 2 records left, 33% Reduction**
  - **Review of 2004 – 2015 Canadian Data Base by Rene van Dorp (GWU) resulted in a suggested disqualification of 1 record for Accident Calibration – 12.5% Reduction**
  - **Further Review of 66 disqualified and double counted records by Jason Merrick and Rene van Dorp (GWU/VCU) resulted in 12 records being retained for Accident Calibration because (1) vessel were moving at time of accident (drifting or under power) or (2) precautionary principle dictates requires keeping a record when insufficient evidence deemed present to disqualify an accident record.**
  - **End result of data reconciliation process above resulted in 79 Remaining Records for Calibration at Accident Level – Table provided on next Slide**



# VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

## 1990 - 2015 Data for Model Calibration



Record	Data	Accident Type	Latitude	Longitude	Vessel Type	FV Type	Waterway	Vessel Name	Record	Data	Accident Type	Latitude	Longitude	Vessel Type	FV Type	Waterway	Vessel Name
1	4/13/1995	ALLISION	N47360	W122190	FREIGHTER	CARGO FV	US	EASTERN WIND	41	5/21/2003	ALLISION	47.28	-122.41	TANK BARGE	OIL BARGE	US	SCT 282
2	9/3/1995	COLLISION	N47243	W122216	FREIGHTER	CARGO FV	US	SEALAND INNOVATOR	42	5/27/2003	ALLISION	47.58	-122.33	TANK BARGE	OIL BARGE	US	NAVY OIL BARGE
3	9/11/1996	ALLISION	N47394	W122224	BULK CARRIER	CARGO FV	US	MOKUHANA	43	6/3/2003	ALLISION	47.57	-122.35	TANK BARGE	OIL BARGE	US	BARGE 255
4	1/12/1997	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	ETERNAL MARINER	44	10/11/2003	COLLISION	48.32	-125.03	TANK BARGE	OIL BARGE	US	DOTTIE
5	3/27/1997	GROUNDING	NULL	NULL	BULK CARRIER	CARGO FV	US	SEA TRIDENT	45	11/20/2003	ALLISION	47.58	122.36	CONTAINER	CARGO FV	US	CAP REINGA
6	3/30/1997	GROUNDING	NULL	NULL	FREIGHTER	CARGO FV	US	SKAUGRAN	46	12/18/2003	ALLISION	47.57	-122.35	TANK BARGE	OIL BARGE	US	NORTON
7	5/30/1997	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	VERNAL STAR	47	12/28/2003	COLLISION	48.22	-123.50	FREIGHTER	CARGO FV	US	NORSUL VITORIA
8	8/26/1997	GROUNDING	NULL	NULL	FREIGHTER	CARGO FV	US	KRASKINO	48	5/13/2004	ALLISION	47.98	122.22	FREIGHTER	CARGO FV	US	CAPE CAVO
9	10/23/1997	ALLISION	N47360	W122190	BULK CARRIER	CARGO FV	US	THALASSINI NIKI	49	9/16/2004	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	WADI ALRAYAN
10	10/30/1997	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	NORTHERN LIGHTS	50	11/12/2004	ALLISION	48.86	122.76	TANKER	TANK FV	US	GULF SCANDIC
11	1/24/1998	ALLISION	NULL	NULL	TANKER	TANK FV	US	OVERSEAS ARCTIC	51	11/22/2004	ALLISION	48.22	-123.53	FREIGHTER	CARGO FV	US	WILLI SALAMON
12	6/14/1998	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	SEA HAPPINESS	52	11/25/2004	ALLISION	48.43	-123.43	BULK CARRIER	CARGO FV	CA	THRASYVOULOS V.
13	7/7/1998	ALLISION	N47325	W122200	BULK CARRIER	CARGO FV	US	FIVI	53	2/14/2005	COLLISION	48.92	-122.92	TANK BARGE	OIL BARGE	US	PB 20
14	9/5/1998	GROUNDING	47.16	-122.73	FREIGHTER	CARGO FV	US	MONCHEGORSK	54	5/9/2005	ALLISION	N 48° 06' 00.00"	W 122° 46' 30.00"	FREIGHTER	CARGO FV	US	ROSE
15	10/26/1998	ALLISION	N48070	W122450	FREIGHTER	CARGO FV	US	GLENDYNE	55	9/10/2005	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	APL ENGLAND
16	8/17/1999	GROUNDING	N47304	W122249	FREIGHTER	CARGO FV	US	COASTAL SEA	56	9/25/2005	ALLISION	NULL	NULL	BULK CARRIER	CARGO FV	US	OAK HARBOUR
17	12/5/1999	GROUNDING	W122344	38947.00	ITB	TANK FV	US	ITB NEW YORK	57	4/13/2006	GROUNDING	28.75	114.00	FREIGHTER	CARGO FV	US	
18	12/23/1999	ALLISION	N47590	W122130	FREIGHTER	CARGO FV	US	SEA AMELITA	58	6/23/2006	ALLISION	47.27	-122.55	FREIGHTER	CARGO FV	US	SWAN
19	1/14/2000	ALLISION	48.26	123.56	BULK CARRIER	CARGO FV	US	CYNTHIA HARMONY	59	6/27/2006	ALLISION	47.29	-122.45	FREIGHTER	CARGO FV	US	APHRODITE
20	6/7/2000	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	HYUNDAI LIBERTY	60	3/2/2007	COLLISION	48.52	-122.59	TANK BARGE	OIL BARGE	US	SHAUNA KAY
21	7/29/2000	ALLISION	N48124	W123277	FREIGHTER	CARGO FV	US	MERKER RIVER	61	4/14/2007	ALLISION	48.52	-122.62	TANK BARGE	OIL BARGE	US	BARGE 255
22	9/6/2000	COLLISION	N48274	W125418	FREIGHTER	CARGO FV	US	SELENDANG KASA	62	10/18/2007	ALLISION	47.79	-122.42	FREIGHTER	CARGO FV	US	NURTEN ANA
23	1/23/2001	ALLISION	N47342	W122211	FREIGHTER	CARGO FV	US	NORTON	63	12/18/2007	GROUNDING	47.63	122.39	TANK BARGE	OIL BARGE	US	
24	2/11/2001	COLLISION	47:16:45	122:26:00	FREIGHTER	CARGO FV	US	GLYFADA	64	7/29/2009	COLLISION	49.29	-123.09	TANK BARGE	OIL BARGE	US	
25	2/11/2001	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	HYUNDAI LIBERTY	65	11/10/2009	COLLISION	47.50	-122.43	FREIGHTER	CARGO FV	US	HORIZON ANCHORAGE
26	4/29/2001	ALLISION	NULL	NULL	CONTAINER	CARGO FV	US	MARUBA TRADER	66	11/18/2009	GROUNDING	48.82	-123.29	BULK CARRIER	CARGO FV	CA	HEBEI LION
27	6/2/2001	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	T.L.I. ATSAH	67	12/16/2009	COLLISION	49.12	-123.20	TANK BARGE	OIL BARGE	US	
28	7/6/2001	COLLISION	48.27	-125.06	FREIGHTER	CARGO FV	US	HORIZON NAVIGATOR	68	3/9/2011	COLLISION	47.59	-122.37	TANK BARGE	OIL BARGE	US	DAVID 120
29	8/6/2001	ALLISION	48.17	124.90	CONTAINER	CARGO FV	US	CSX NAVIGATOR	69	4/16/2011	GROUNDING	48.88	-123.63	BULK CARRIER	CARGO FV	CA	SELANDIA
30	12/14/2001	ALLISION	48.83	122.72	TANKER	TANK FV	US	LEYTE SPIRIT	70	8/19/2011	COLLISION	48.52	-124.63	CONTAINER	CARGO FV	CA	COSCO SHENZEN
31	1/11/2002	ALLISION	N 47° 39' 12.00"	W 122° 22' 42.00"	FREIGHTER	CARGO FV	US	COASTAL NOMAD	71	10/4/2011	ALLISION	47.26	-122.36	FREIGHTER	CARGO FV	US	
32	1/19/2002	COLLISION	48.41	122.78	TANKER	TANK FV	US	ALLEGIANCE	72	1/25/2012	ALLISION	33.73	-118.17	TANKER	TANK FV	US	
33	2/11/2002	ALLISION	N 48° 07' 50.00"	W 123° 27' 12.00"	TANKER	TANK FV	US	BLUE RIDGE	73	7/26/2012	ALLISION	47.55	-122.34	FREIGHTER	CARGO FV	US	
34	5/4/2002	COLLISION	47:27	122:24	FREIGHTER	CARGO FV	US	MEDEA	74	12/7/2012	ALLISION	49.01	-123.15	CONTAINER	CARGO FV	CA	CAPE APRICOT
35	6/23/2002	ALLISION	47.54	-122.33	TANK BARGE	OIL BARGE	US	NATHAN 114	75	11/2/2013	ALLISION	47.26	-122.39	FREIGHTER	CARGO FV	US	
36	7/17/2002	ALLISION	47.27	-122.40	TANK BARGE	OIL BARGE	US	FOSS 185 P2	76	8/29/2014	ALLISION	47.28	-122.41	FREIGHTER	CARGO FV	US	
37	12/6/2002	ALLISION	48.86	122.76	BULK CARRIER	CARGO FV	US	ALMA	77	6/22/2015	GROUNDING	48.75	-123.08	BULK CARRIER	CARGO FV	CA	ANDROMEDA
38	2/27/2003	ALLISION	47.59	-122.34	TANK BARGE	OIL BARGE	US	FOSS 248 P2	78	9/1/2015	ALLISION	47.55	-122.34	FREIGHTER	CARGO FV	US	
39	4/5/2003	COLLISION	N 47° 19' 24.00"	W 122° 27' 27.00"	FREIGHTER	CARGO FV	US	MEDEA	79	11/26/2015	GROUNDING	48.75	-123.09	FREIGHTER	CARGO FV	CA	STAR LYGRA
40	4/17/2003	ALLISION	NULL	NULL	FREIGHTER	CARGO FV	US	TEAL ARROW									

4 VTRA 2005/2010 Accident Calibration Records in 0 - 1 m3

+ 75 Additional VTRA 2015 Accident Calibration Records in 0 - 1 m3

+ 1991 Tenyo Maru Collision in > 1 m3 Spill Category

+ 1994 Barge 101 Grounding in > 1 m3 Spill Category

# QUESTIONS?

# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

## VTRA 2015 Model Accident Calibration of the 0 m<sup>3</sup> - 1 m<sup>3</sup> Spill Category

Source: VTRA Data from 2005 - 2015

US	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup>			CA	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup>		
	ALLISION	GROUNDING	COLLISION		ALLISION	GROUNDING	COLLISION
CARGO FV	11	1	1	CARGO FV	1	4	1
TANK FV (Excl. Oil Barge)	1	0	0	TANK FV (Excl. Oil Barge)	0	0	0
OIL BARGE	1	1	5	OIL BARGE	0	0	0

US	NUMBER OF DATABASE YEARS			CA	NUMBER OF DATABASE YEARS		
	ALLISION	GROUNDING	COLLISION		ALLISION	GROUNDING	COLLISION
CARGO FV	11	11	11	CARGO FV	11	11	11
TANK FV (Excl. Oil Barge)	11	11	11	TANK FV (Excl. Oil Barge)	11	11	11
OIL BARGE	11	11	11	OIL BARGE	11	11	11

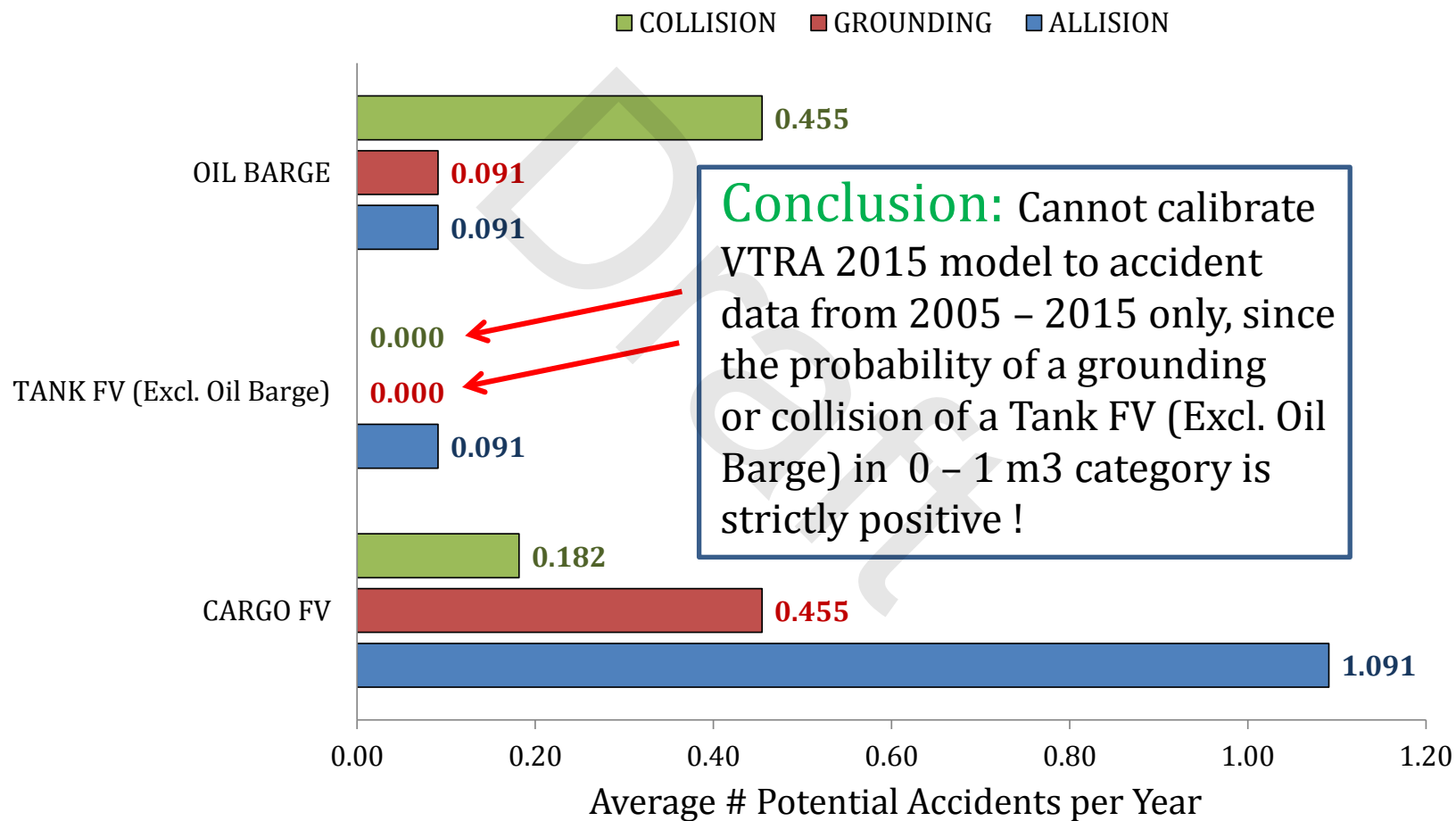
US	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup> PER YEAR			CA	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup> PER YEAR		
	ALLISION	GROUNDING	COLLISION		ALLISION	GROUNDING	COLLISION
CARGO FV	1.000	0.091	0.091	CARGO FV	0.091	0.364	0.091
TANK FV (Excl. Oil Barge)	0.091	0.000	0.000	TANK FV (Excl. Oil Barge)	0.000	0.000	0.000
OIL BARGE	0.091	0.091	0.455	OIL BARGE	0.000	0.000	0.000

additive

US + CA	NUMBER OF ACCIDENTS IN 0 - 1 m <sup>3</sup> PER YEAR			TOTAL
	ALLISION	GROUNDING	COLLISION	
CARGO FV	1.091	0.455	0.182	1.727
TANK FV (Excl. Oil Barge)	0.091	0.000	0.000	0.091
OIL BARGE	0.091	0.091	0.455	0.636
TOTAL	1.273	0.545	0.636	2.455

additive

Average # Accidents per Year in 0 - 1 m<sup>3</sup> Spill Category in VTRA 2015 Study Area: **Source: VTRA Accident Data 2005 - 2015**



# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

## VTRA 2015 Model Accident Calibration of the 0 m<sup>3</sup> - 1 m<sup>3</sup> Spill and the 1 m<sup>3</sup> or more Spill Category

Source: VTRA Data from 1990 - 2015

US + CA	NUMBER OF ACCIDENTS		TOTAL
	0 - 1 m <sup>3</sup>	1 m <sup>3</sup> or More	
ALL FOCUS VESSELS	111.94	0	111.94

US + CA	NUMBER OF DATABASE YEARS		TOTAL
	0 - 1 m <sup>3</sup>	1 m <sup>3</sup> or More	
ALL FOCUS VESSELS	26	26	26

US + CA	NUMBER OF ACCIDENT PER YEAR		TOTAL
	0 - 1 m <sup>3</sup>	1 m <sup>3</sup> or More	
ALL FOCUS VESSELS	4.31	0.00	4.31

US + CA	% OF # OF ACCIDENT PER YEAR		TOTAL
	0 - 1 m <sup>3</sup>	1 m <sup>3</sup> or More	
ALL FOCUS VESSELS	100.0%	0.0%	100%

??? Why not 79

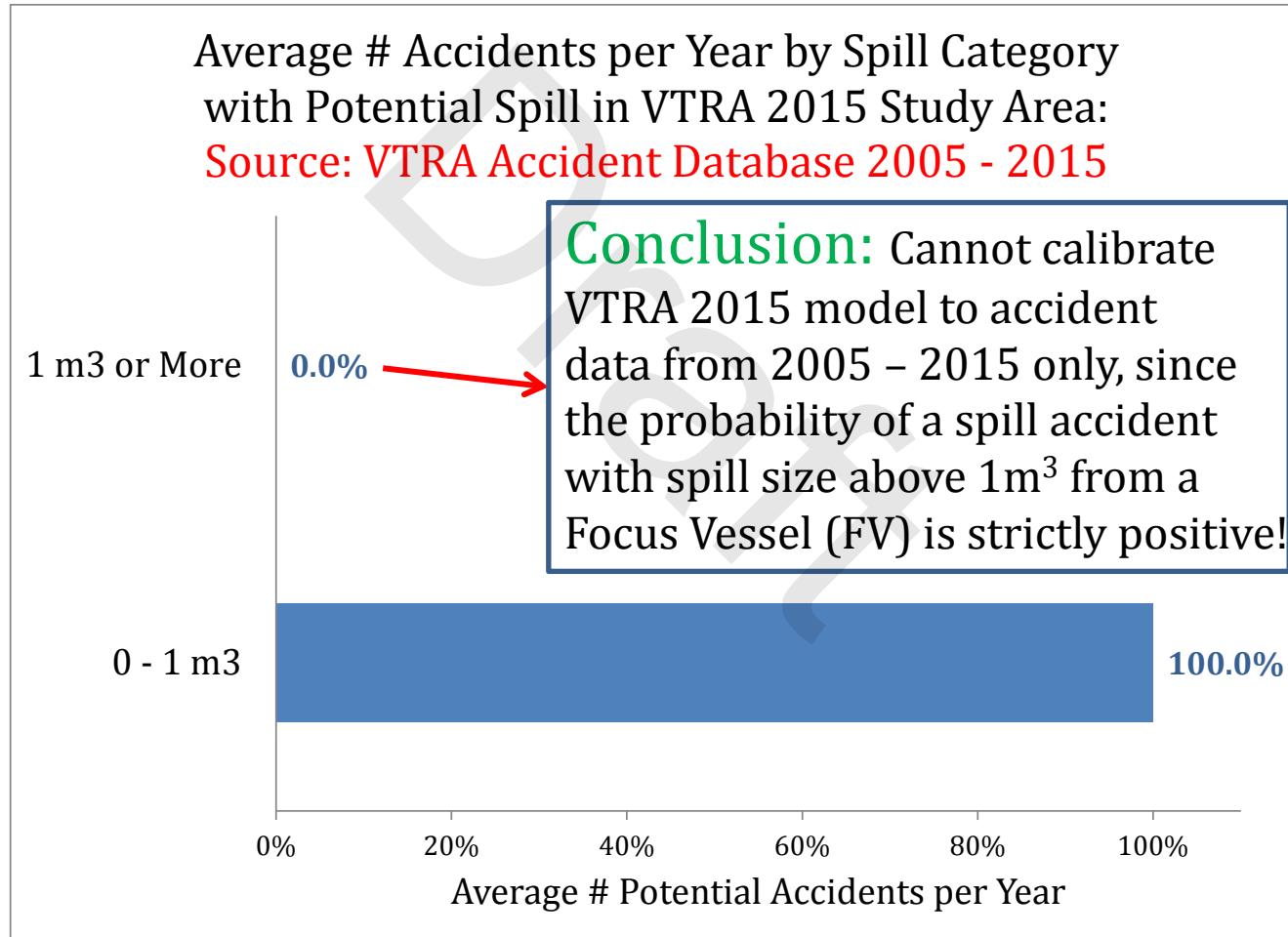
1. Recall 4.306 Per Year in 0 - 1 m<sup>3</sup> Cat.
2. and 4.306 x 26 years = 111.94

## VTRA 2015 Model Accident Calibration of the 0 m<sup>3</sup> - 1 m<sup>3</sup> Spill and the 1 m<sup>3</sup> or more Spill Category

Source: VTRA Data from 2005 - 2015

Average # Accidents per Year by Spill Category with Potential Spill in VTRA 2015 Study Area:

Source: VTRA Accident Database 2005 - 2015



# MORE QUESTIONS?