

VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

CARGO FV and TANK FV Accident Calibration and Uncertainty in # Accidents per Year

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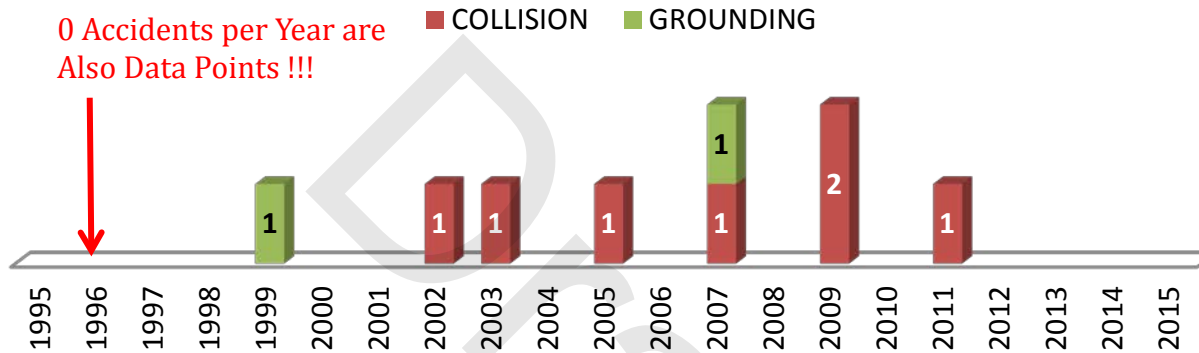


OUTLINE

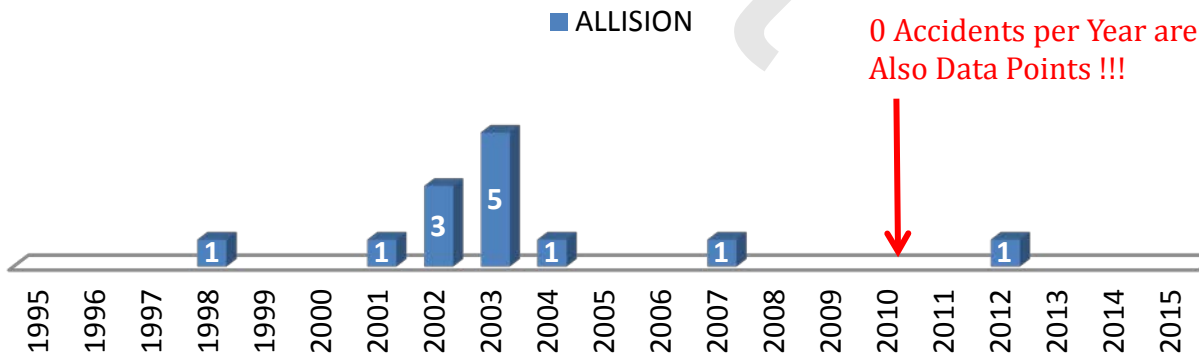
1. **Uncertainty in Average # Accidents per Year**
2. VTRA 2015 Accident Data Calibration
3. Summary Accident Data Reconciliation

VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

TANK FV Coll. + Grou. by YEAR - VTRA 2015 Callibration Accidents - 9 Total

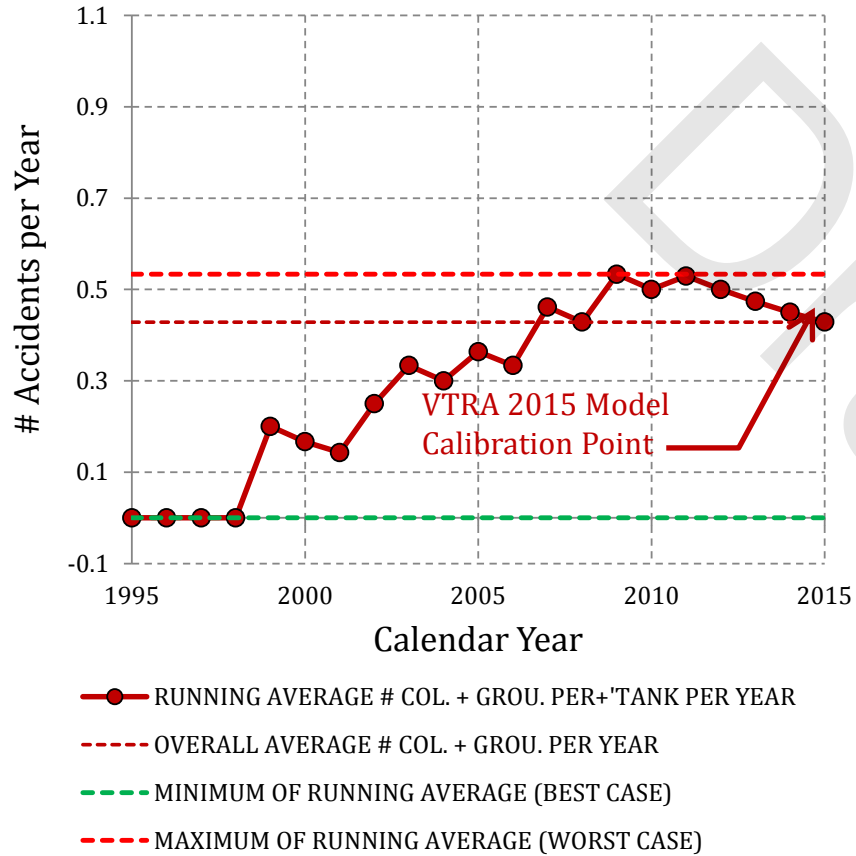


TANK FV Allisions by YEAR - VTRA 2015 Callibration Accidents - 13 Total

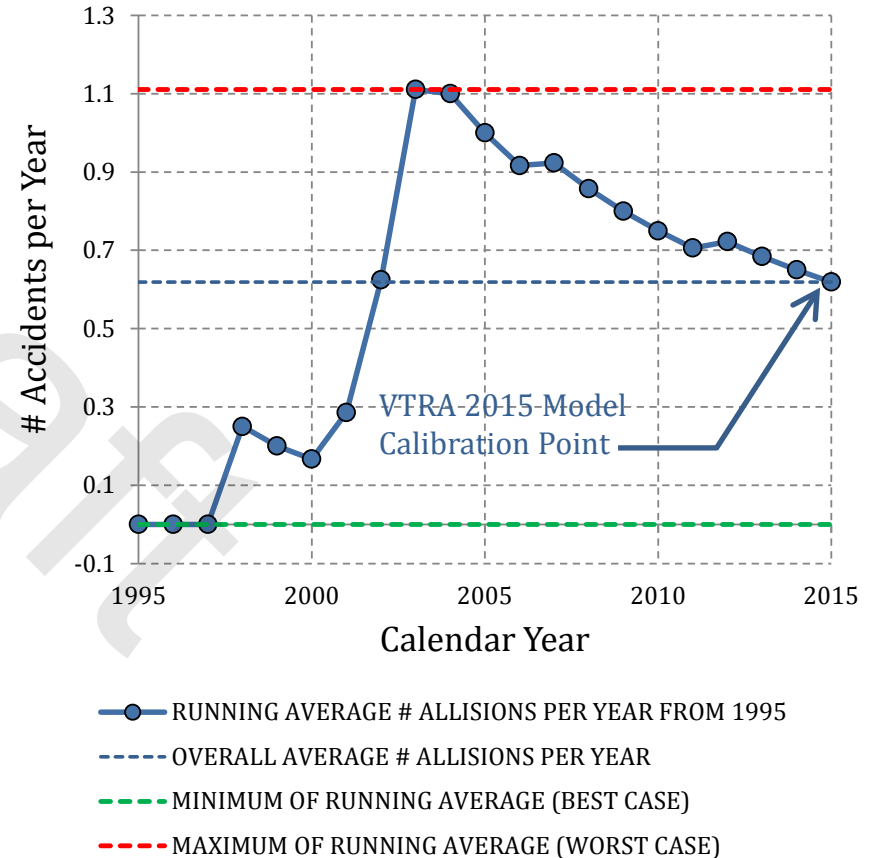


VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

TANK FV VTRA 2015 Accident Calibration:
Uncertainty in Average # Col. + Grou. per Year

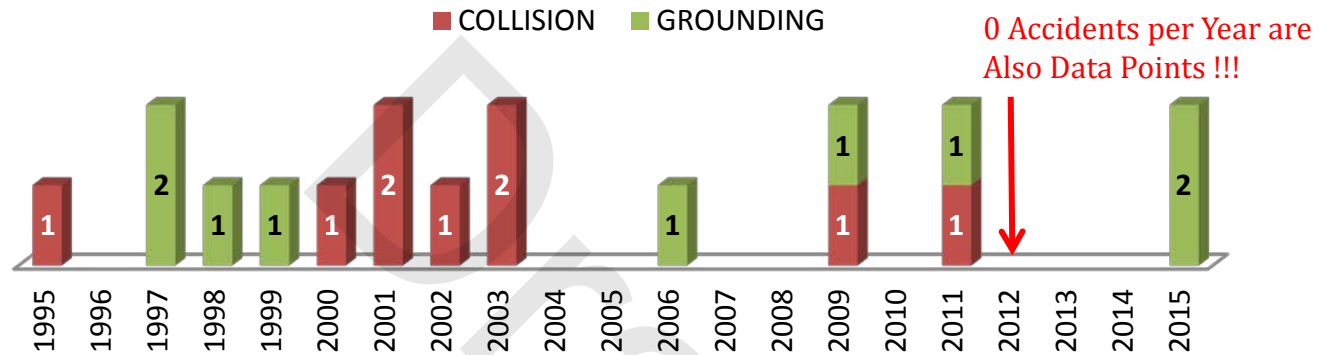


TANK FV VTRA 2015 Accident Calibration:
Uncertainty in Average # Allisions per Year

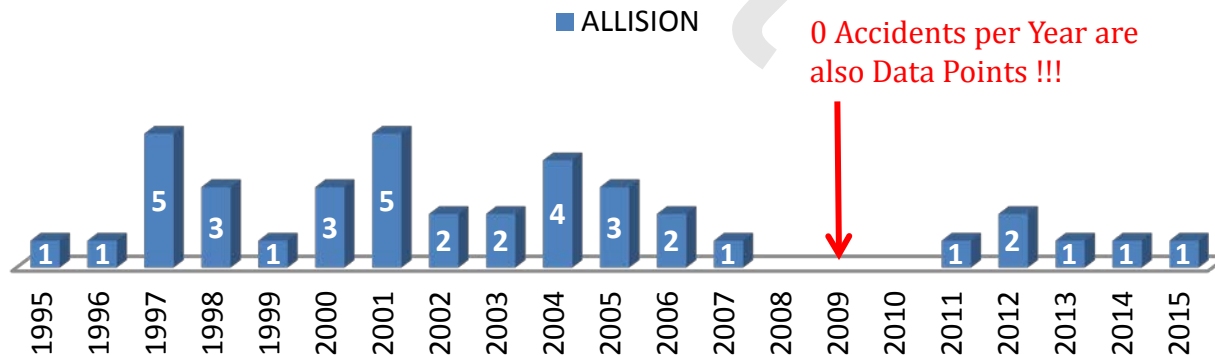


VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

CARGO FV Coll. + Grou. by YEAR - VTRA 2015 Callibration Accidents - 18 Total

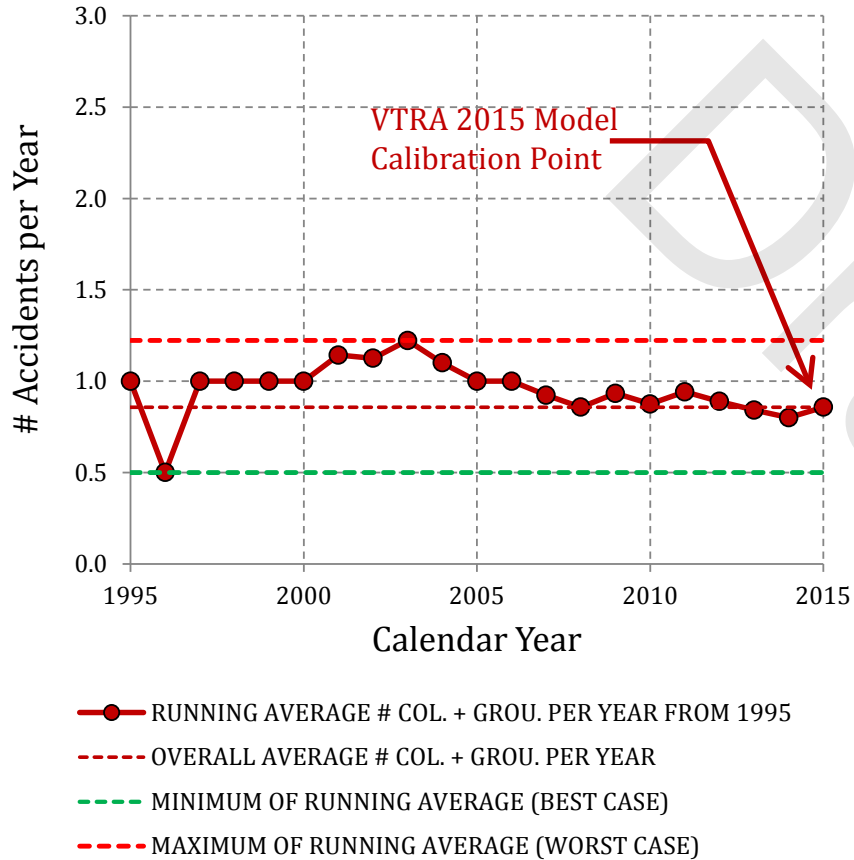


Cargo FV Allisions by YEAR - VTRA 2015 Callibration Accidents - 39 Total

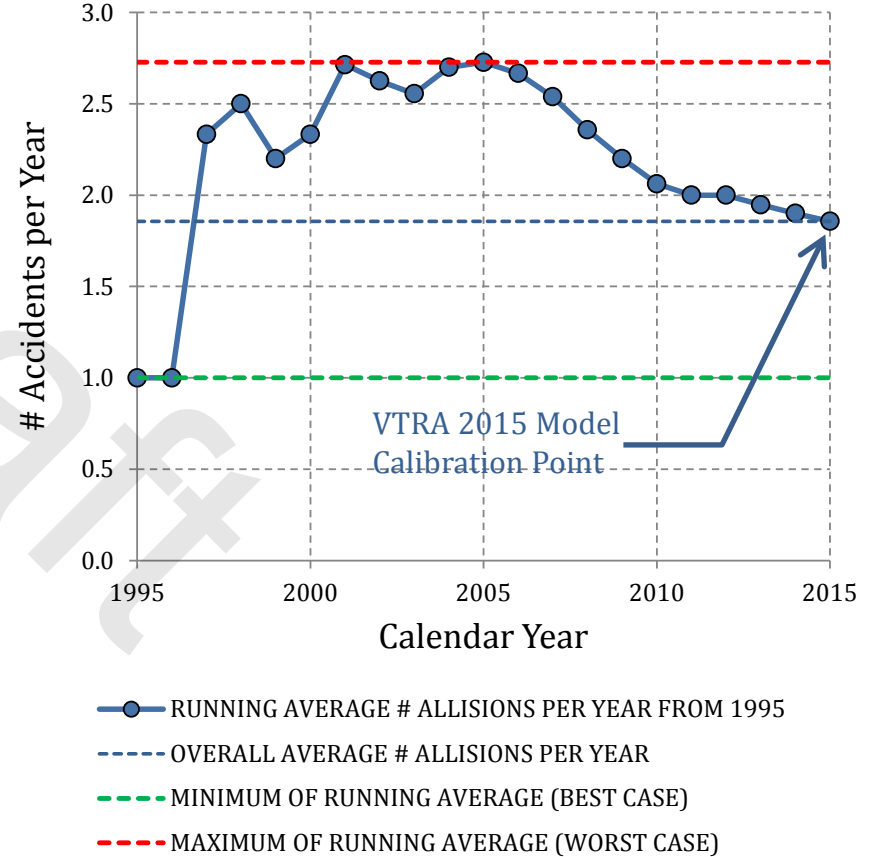


VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

CARGO FV VTRA 2015 Accident Calibration: Uncertainty in Average # Col. + Grou. per Year

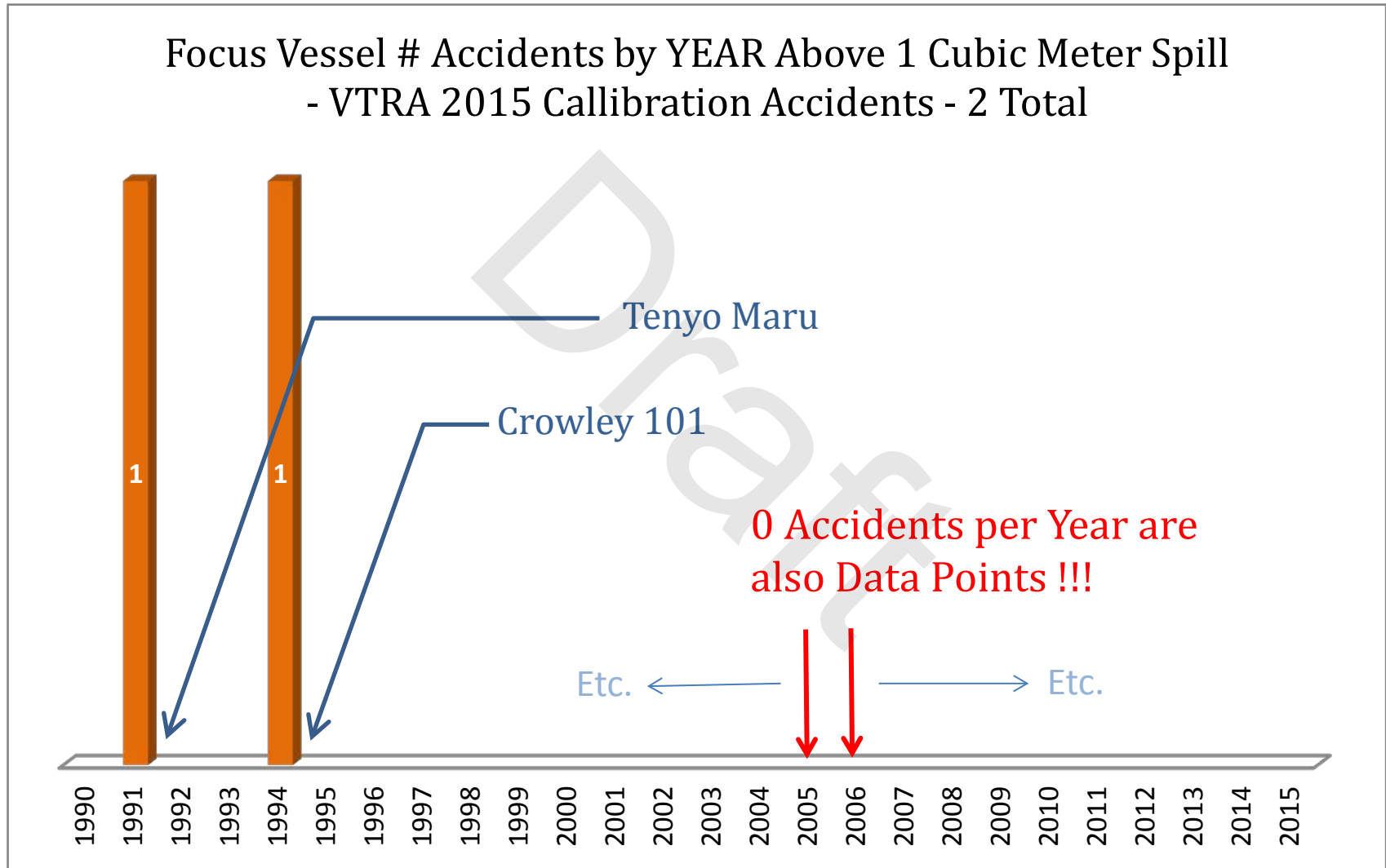


CARGO FV VTRA 2015 Accident Calibration: Uncertainty in Average # Allisions per Year

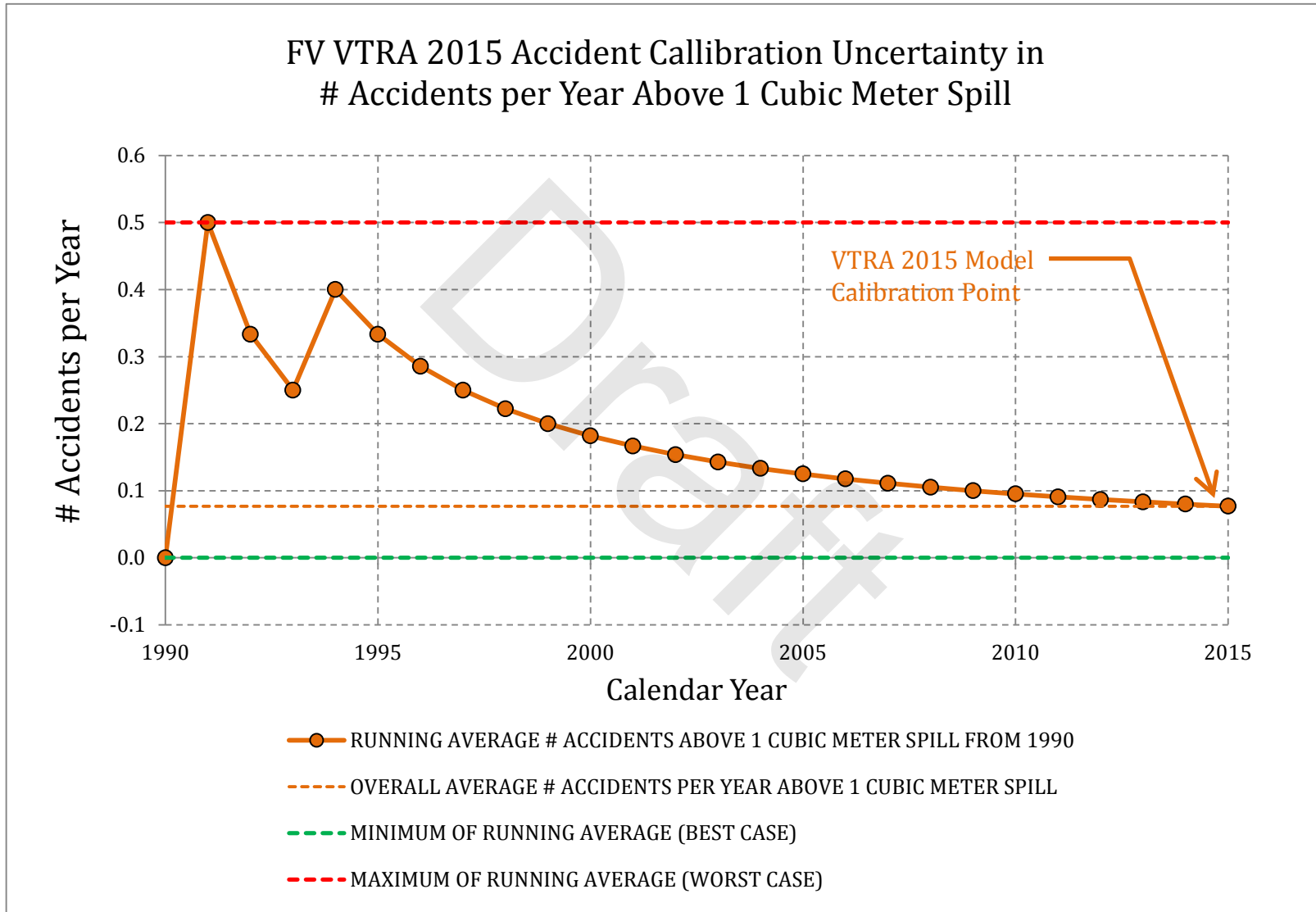


VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)

Focus Vessel # Accidents by YEAR Above 1 Cubic Meter Spill
- VTRA 2015 Calibration Accidents - 2 Total



VESSEL TRAFFIC RISK ASSESSMENT (VTRA 2015)



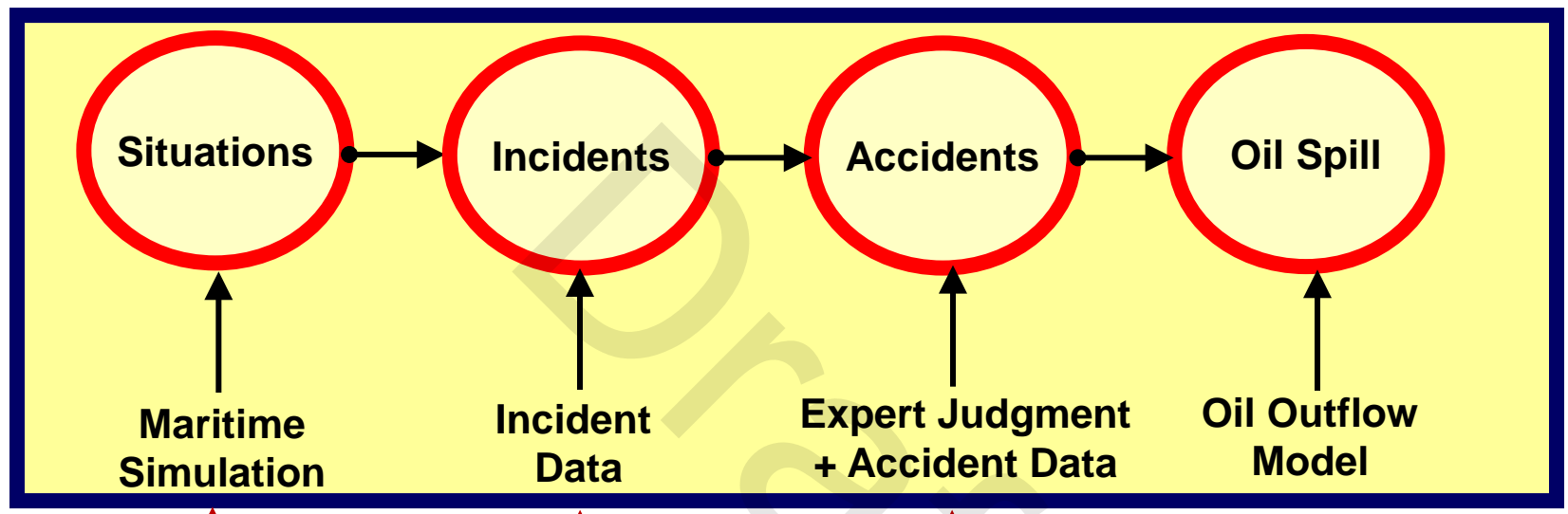
Conclusions

1. The Number of Accidents per Year is Uncertain and Varies from Year to Year.
1. 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!

OUTLINE

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

RECALL - VTRA 2010 CALLIBRATION STEPS



↑
VTOSS 2010 DATA

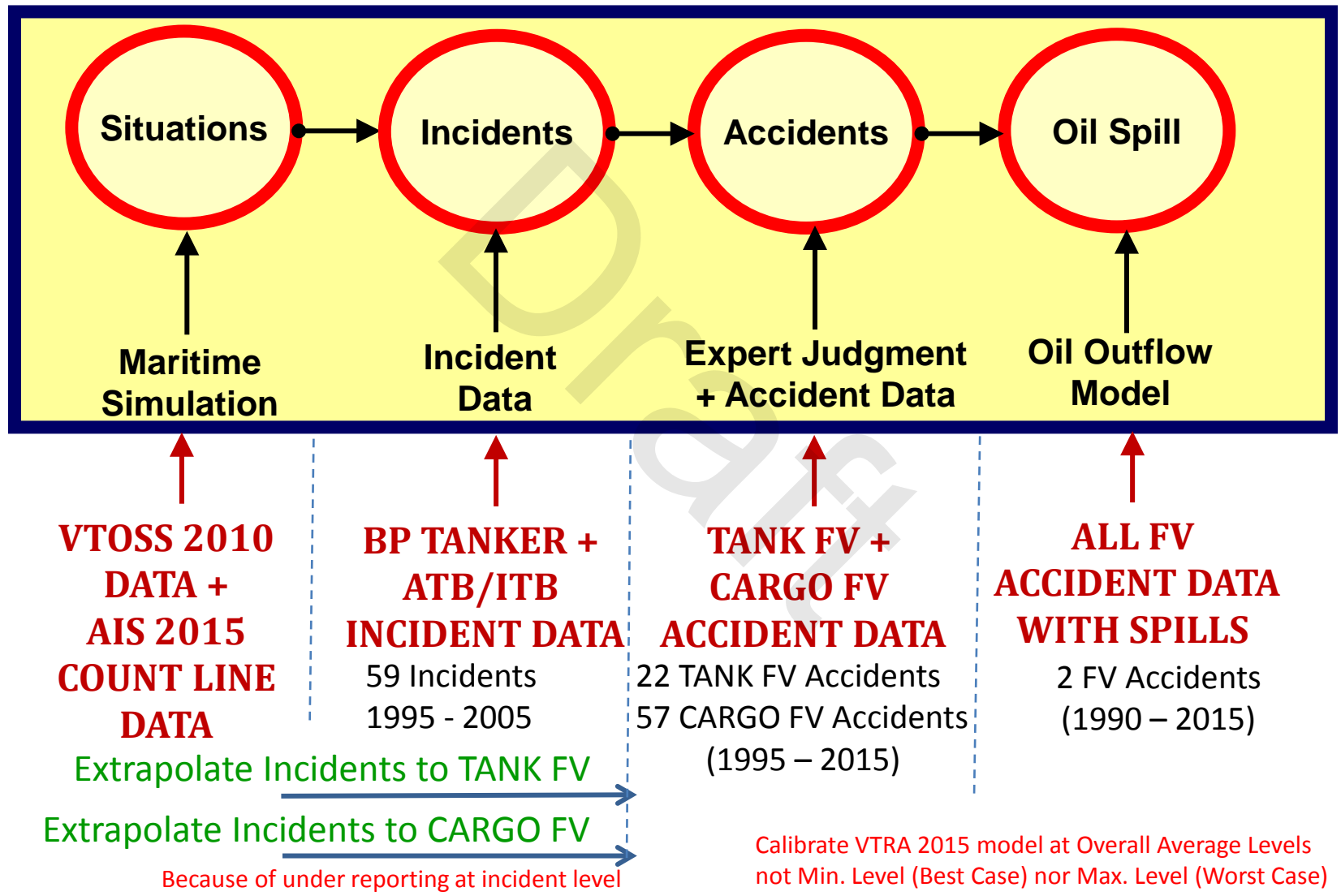
↑
BP TANKER + ATB/ITB INCIDENT DATA
59 Incidents
1995 - 2005

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

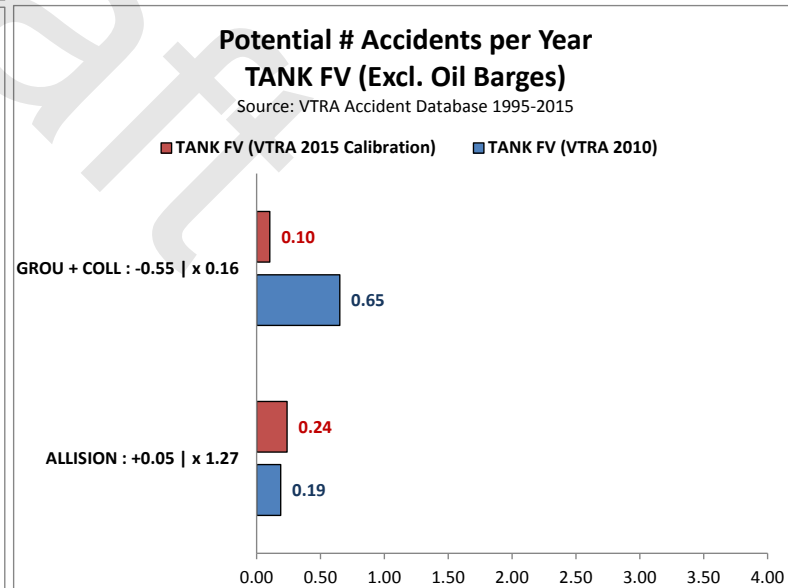
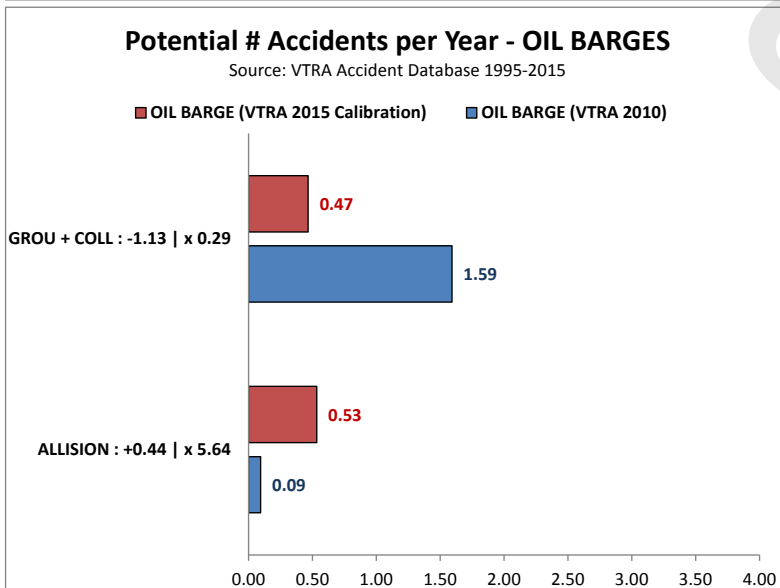
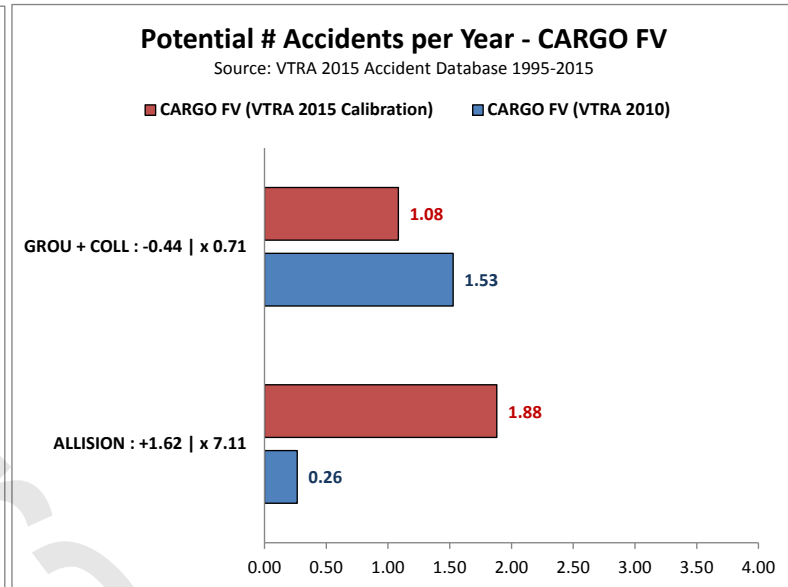
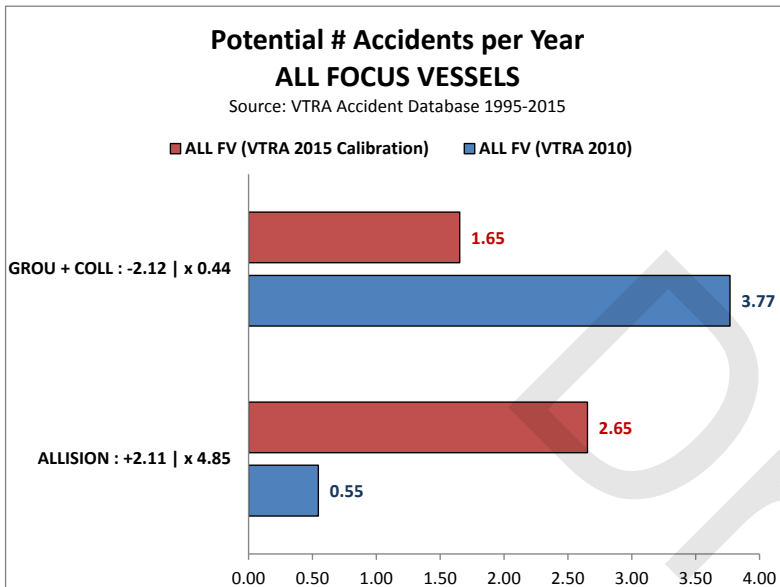
→
No Accident Calibration at Oil Spill Level

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

VTRA 2015 CALLIBRATION STEPS



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010



OUTLINE

1. Uncertainty in Average # Accidents per Year
2. VTRA 2015 Accident Data Calibration
3. 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 13 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)

Accident Level Callibration Data



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	MONCHGORSK	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 2010 Accident Calibration Records

+ 75 Additional VTRA 2015 Accident Calibration Records