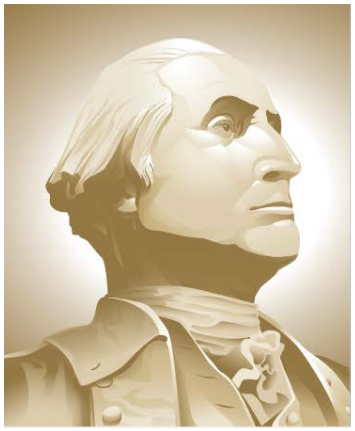
VTRA 2015 –RECALLIBRATION TO ACCIDENT DATA BY TANK FV's AND CARGO FV'



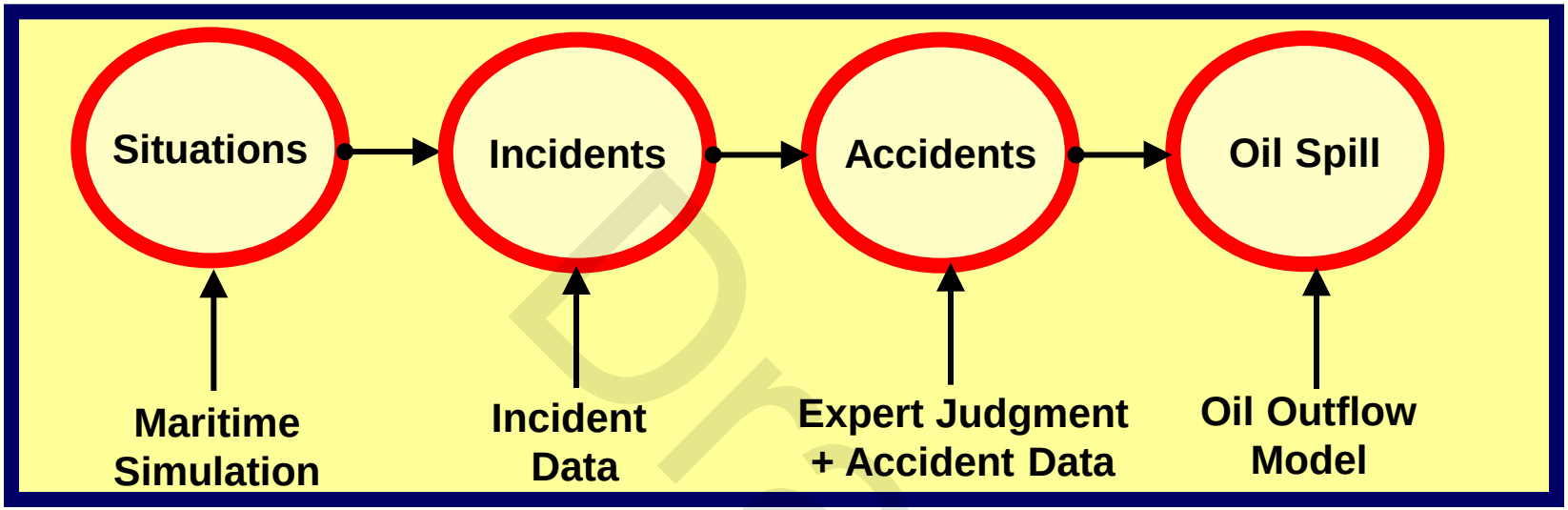
THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

VCU

Jason R.W. Merrick (VCU) and Rene van Dorp (GW)

Mar 2nd, 2016

An Oil Spill is a series of cascading events referred to as a Causal Chain



$$R = \{< s_i, l_i, x_i >\}_c$$

Complete Set

Scenario i

Likelihood i

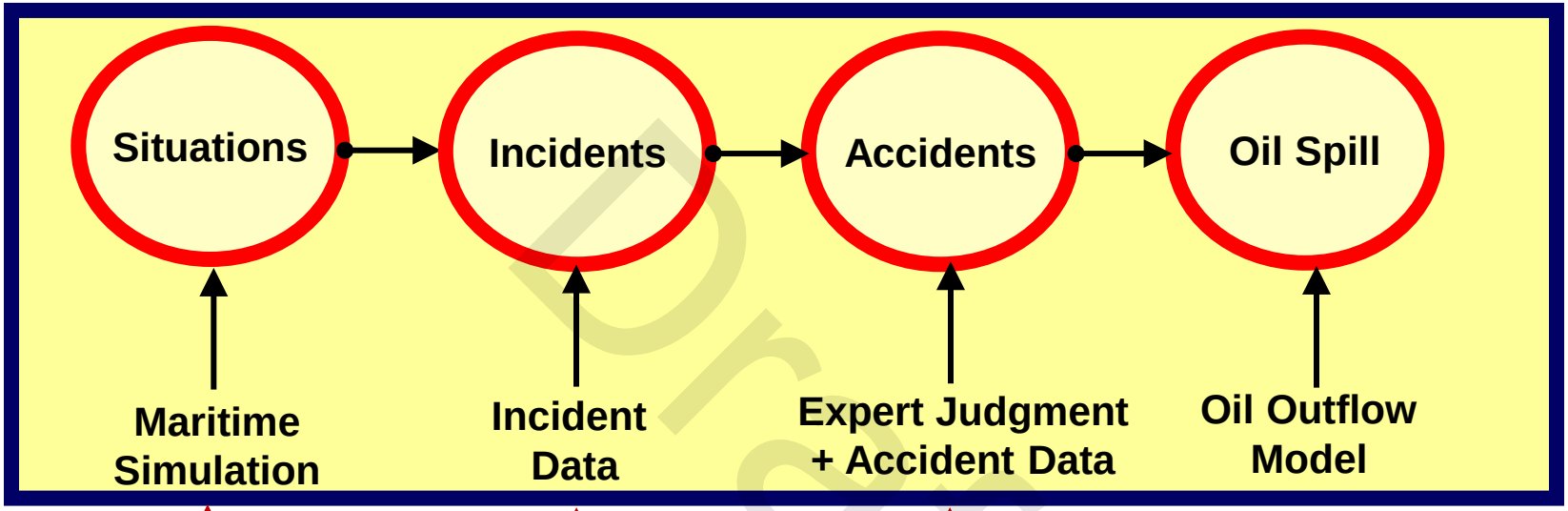
Consequence i

Use Kaplan's (1997) definition of system risk in:
"The Words of Risk Analysis", Risk Analysis 17 (4), 407-417

VTRA 2005

FV Traffic About 1% of Total Traffic

VTRA 2005 CALLIBRATION STEPS



VTOSS 2005 DATA

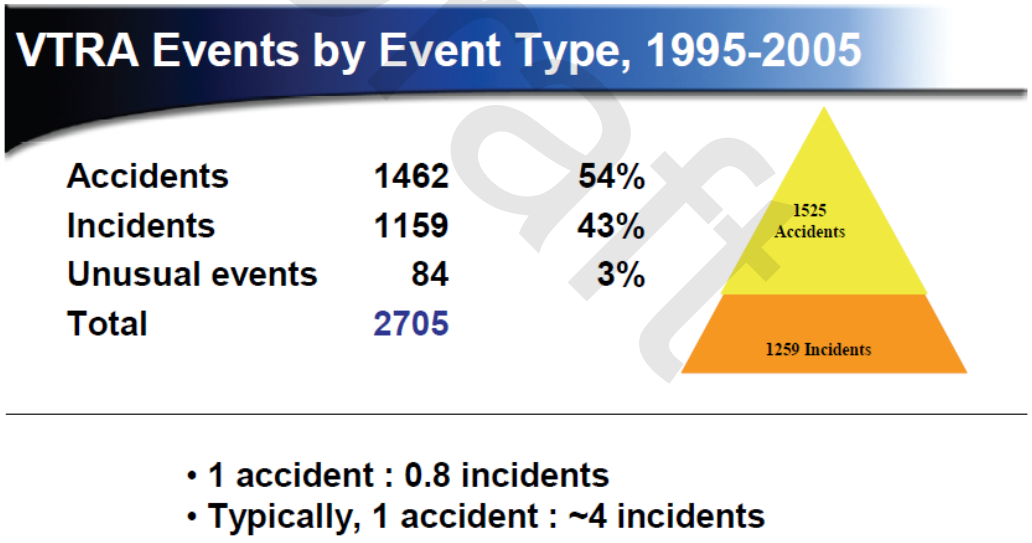
BP TANKER + ATB/ITB INCIDENT DATA
31 Incidents
1995 - 2005

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

No Accident Calibration at Oil Spill Level

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

The proportional difference in the 1995-2005 VTRA database is attributed to a lack of available incident data, and the predominance of public, rather than proprietary, data in the database. In contrast, the 1988-1998 Washington State Ferries accident-incident database contained a great deal of proprietary machinery history data. No machinery history data and very little proprietary data were available for inclusion in the VTRA Accident-Incident database, which resulted in the accident-incident proportion illustrated in Figure A-2.

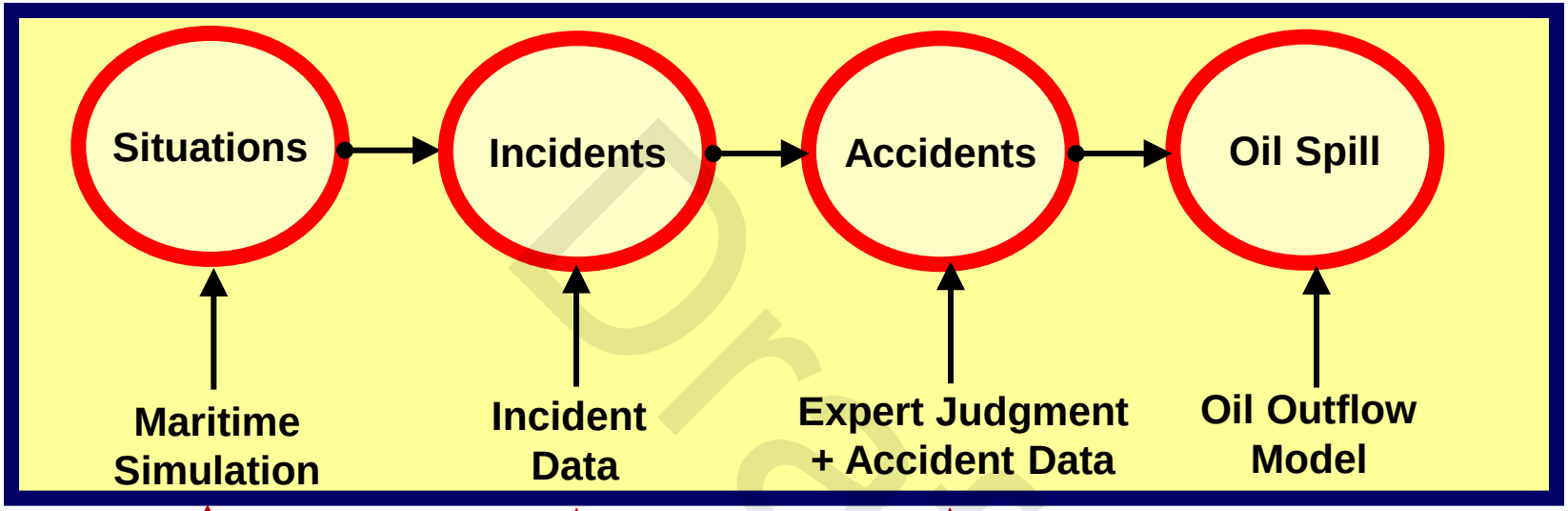


Snap Shot taken from A – 23 of VTRA 2005 Final Report

VTRA 2010

FV Traffic About 25% of Total Traffic

VTRA 2010 CALLIBRATION STEPS



VTOSS 2010 DATA

BP TANKER + ATB/ITB INCIDENT DATA
31 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).

POTENTIAL INCIDENT RATE:

The average number of incidents per year as modeled by the VTRA 2010.

These are not historical incident rates!

Incidents considered: Propulsion, Steering, Navigational Aid Failures and Human Errors

VTRA 2010 Modeling approach:

Historical yearly average numbers of incidents per year for BP Calling Tankers, and ATB/ITBS were first converted to

Incident Rates per moving hour

Using Their

Total Yearly Time on the Water (in #hours)

VTRA 2010 Modeling approach:

These incident rates per moving hour were converted to

Incidents per Year for

TANK FV (Tankers, Chem. Carrier, Oil Barges) and

CARGO FV (Bulk Carrier, Container Vessels and Other Cargo)

by multiplying these incident rates per hour by their yearly time on the water (in # hours)

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

Potential Incident Rate
per Moving Hour By Focus Vessel

Moving Hours per Year
By Focus Vessel

Potential Number of Incidents
per Year By Focus Vessel

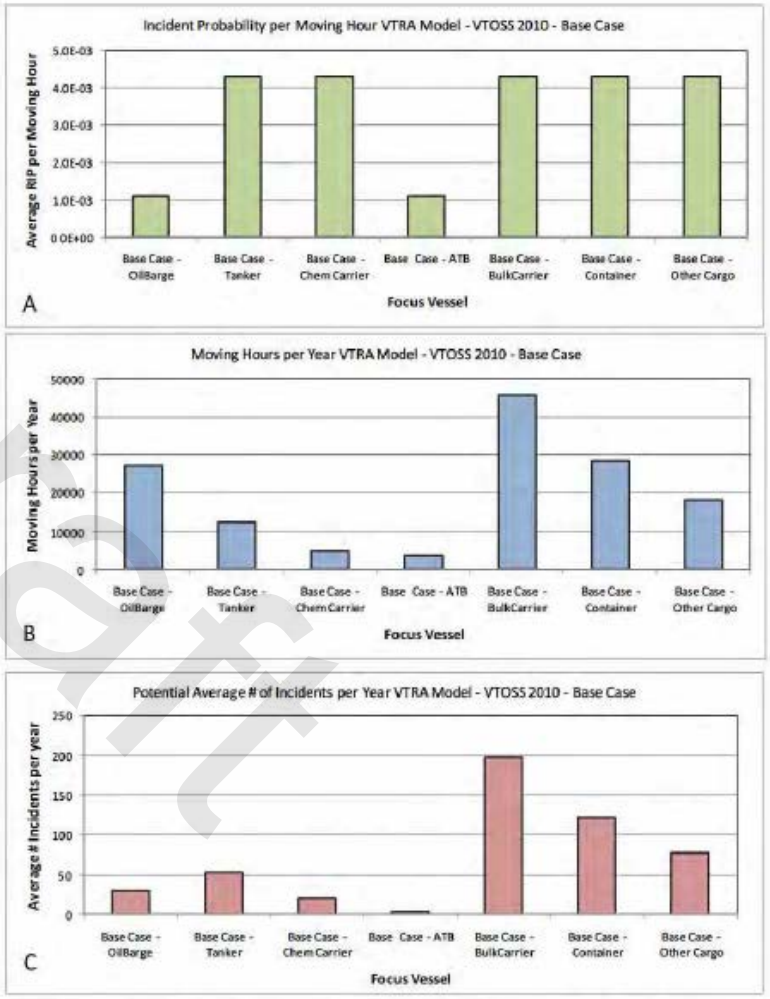
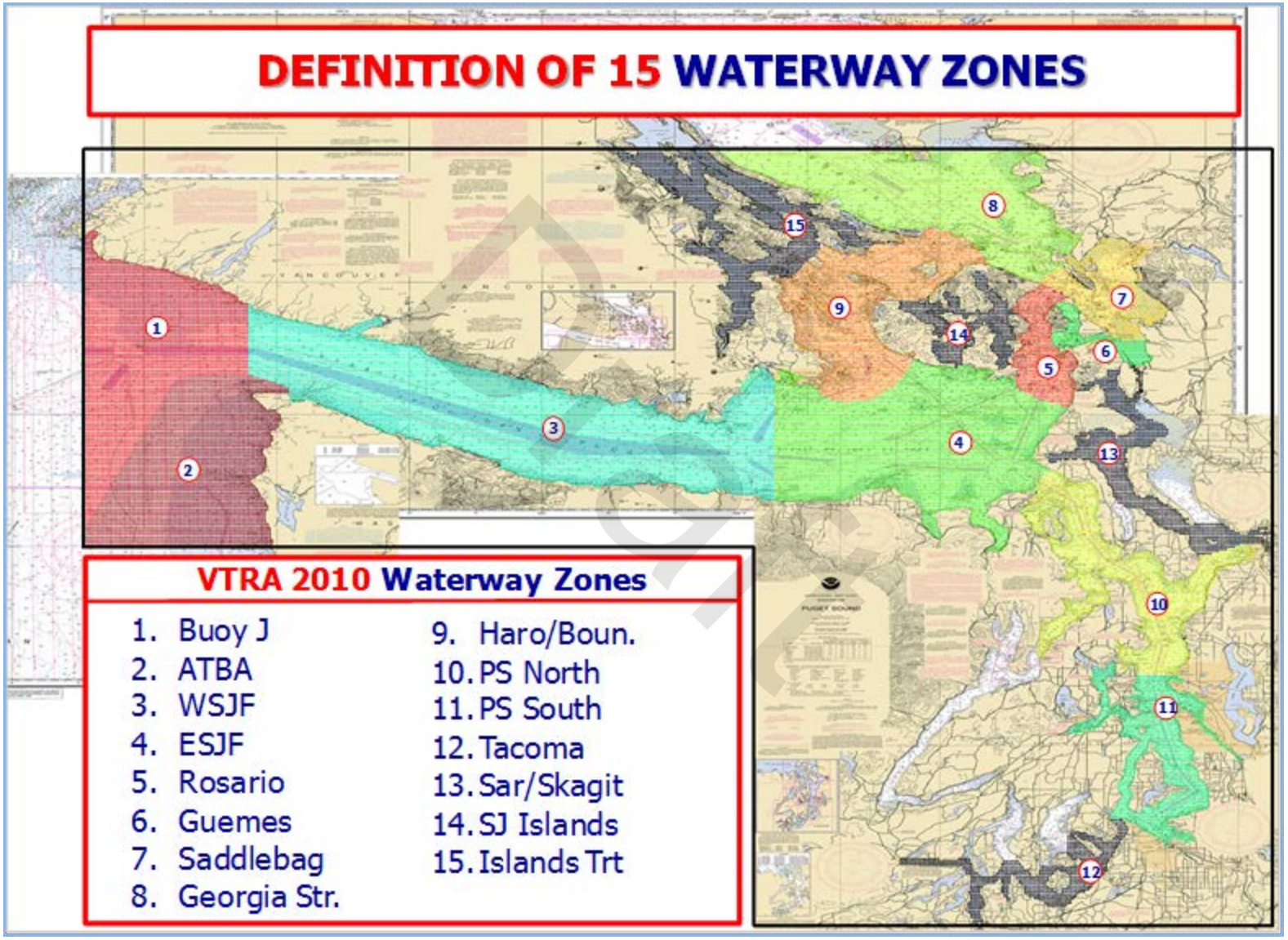


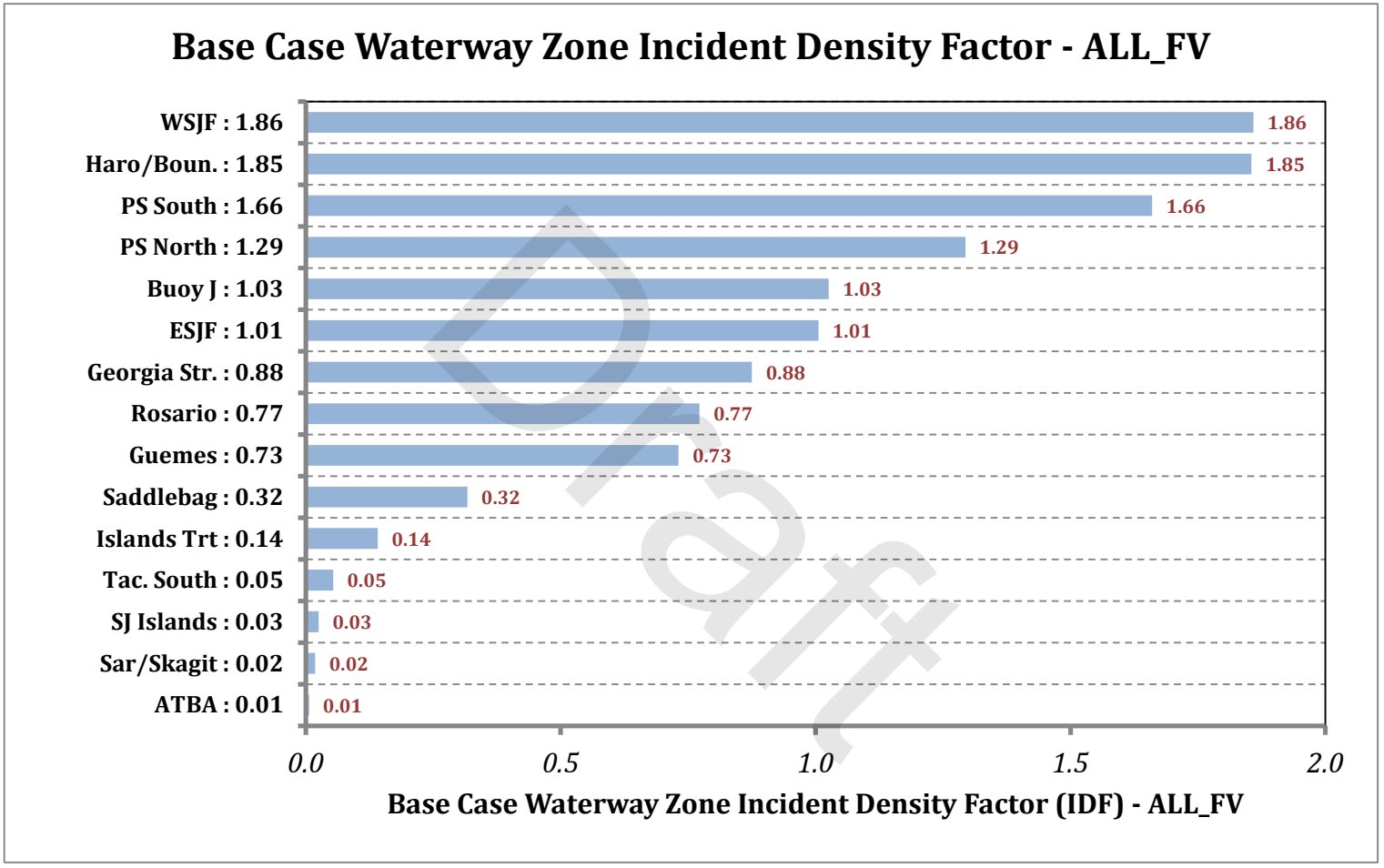
Figure 35. A: Incident rate per moving hour by focus vessel; B: Moving hours in VTRA 2010 model by focus vessel; C: Potential number incidents per year by focus vessel

Page 62 from VTRA 2010 Final Report

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

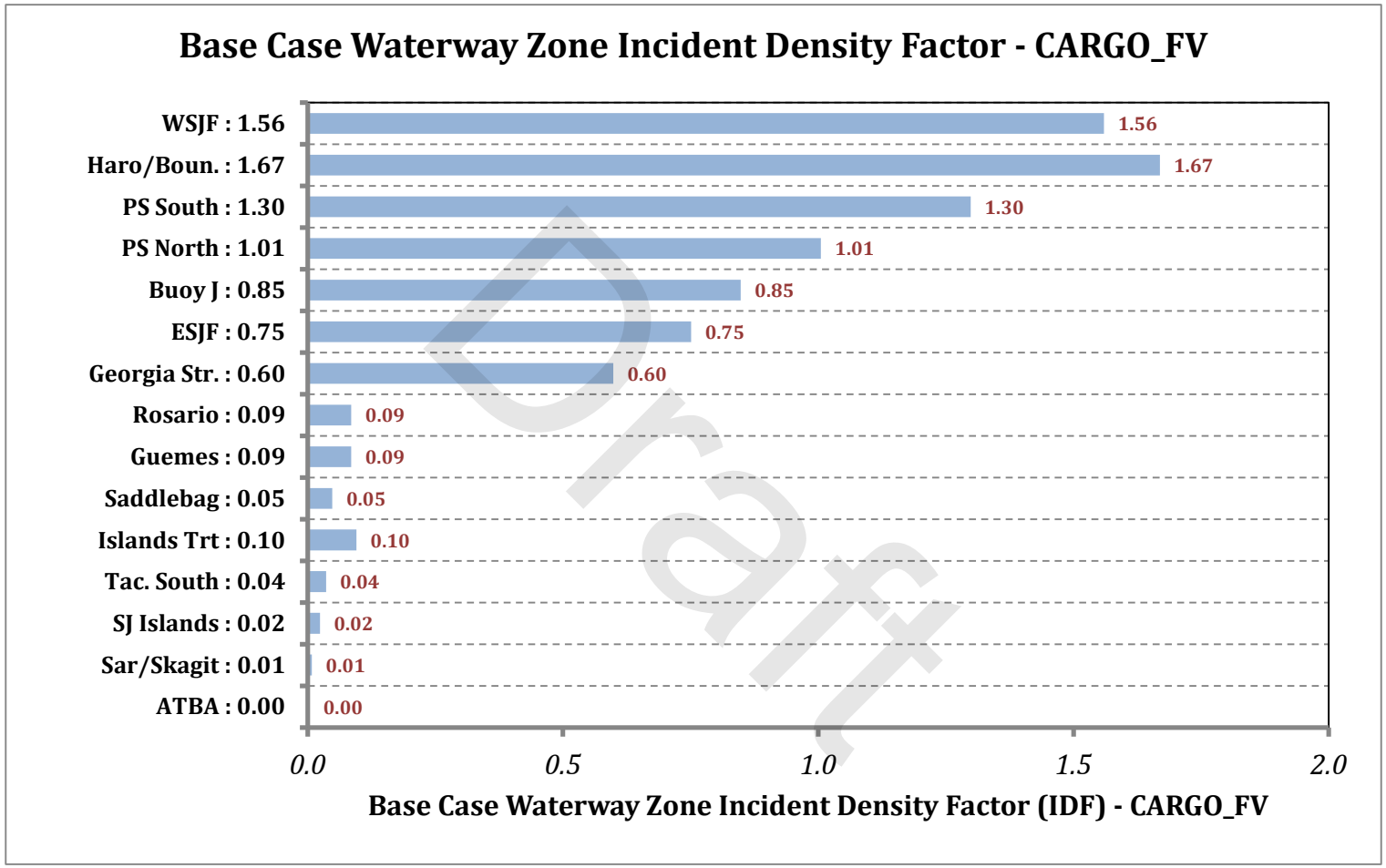


VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015



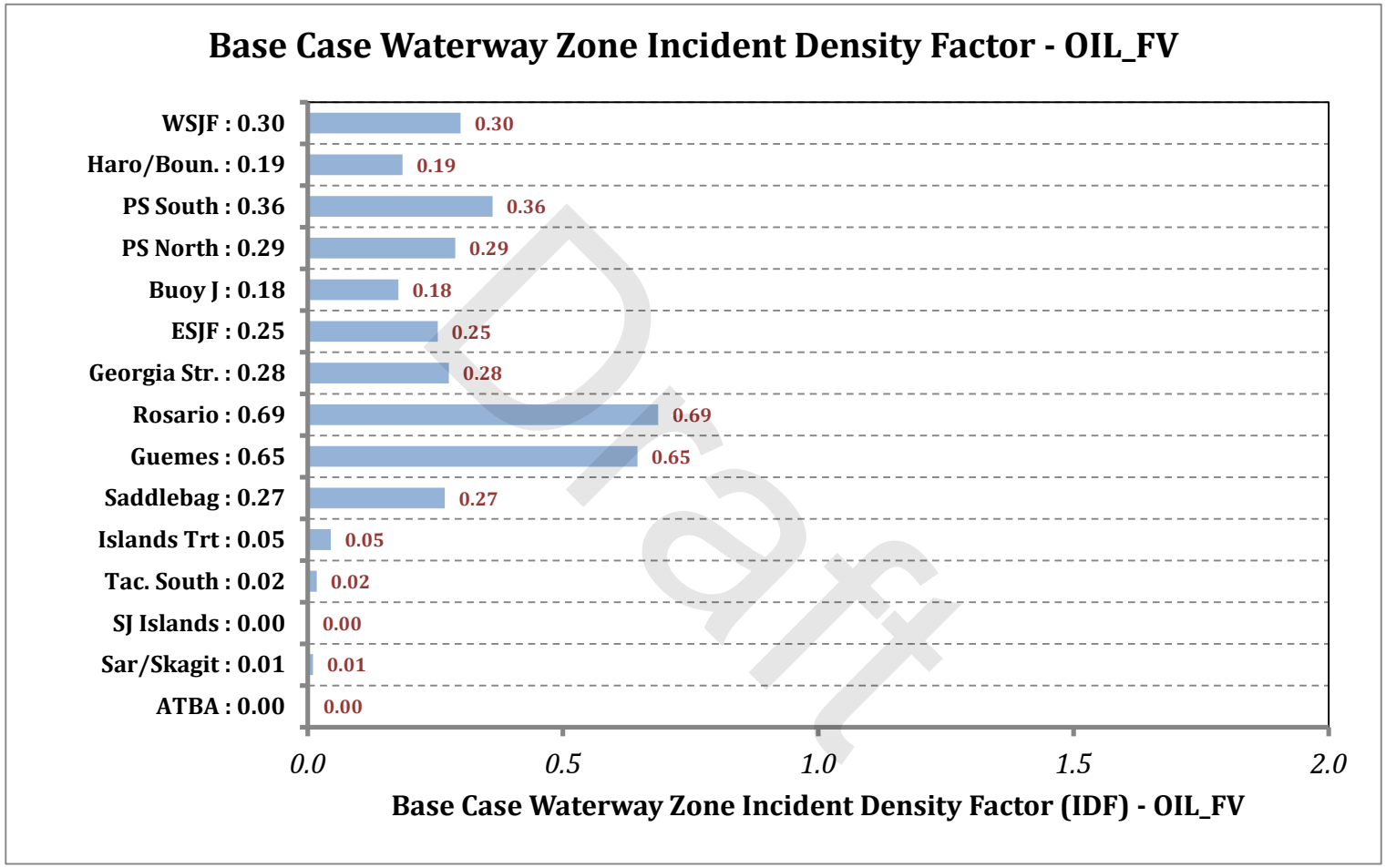
INCIDENT DENSITY FACTOR (IDF): IDF =1.00 when incident rate per year per square mile equals the average for the entire VTRA Study AREA <u>including all FV</u>

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015



INCIDENT DENSITY FACTOR (IDF): IDF - C =1.00 when incident rate per year per square mile equals the average for the entire VTRA Study AREA <u>including all FV</u>

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

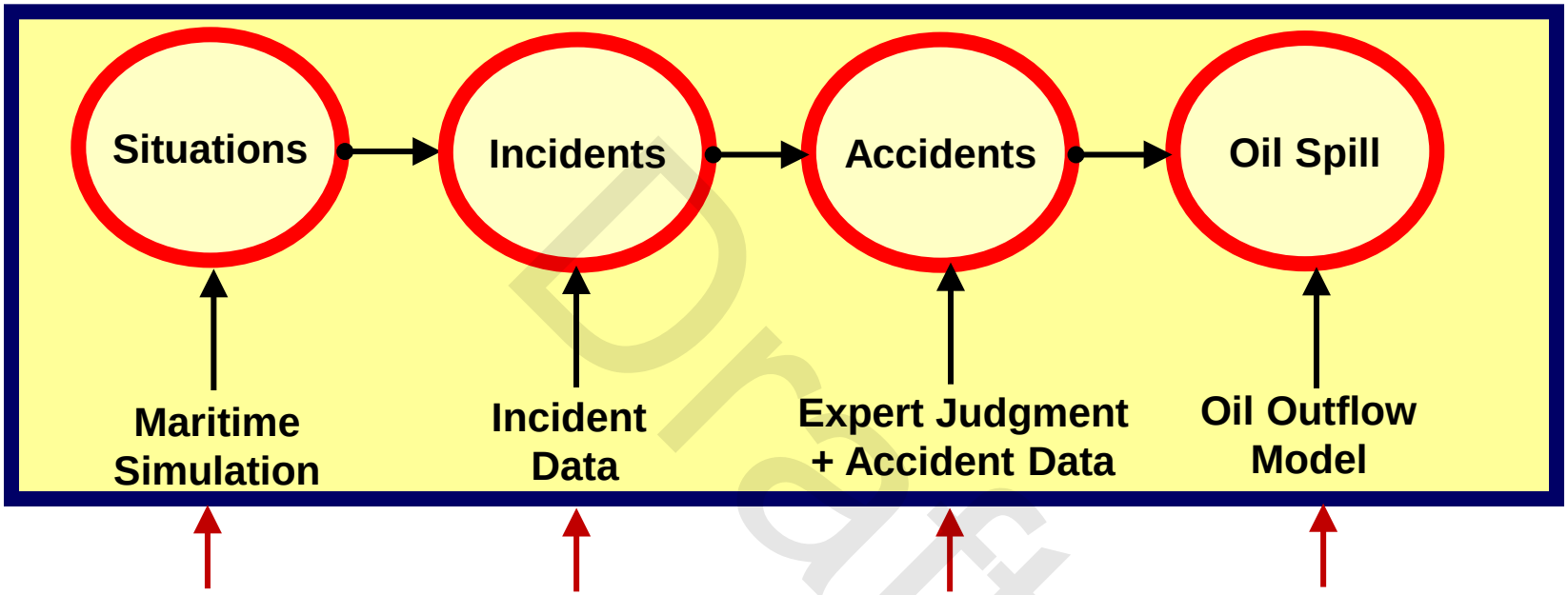


INCIDENT DENSITY FACTOR (IDF): IDF =1.00 when incident rate per year per square mile equals the average for the entire VTRA Study AREA <u>including all FV</u>

VTRA 2015

FV Traffic About
25% of Total Traffic

VTRA 2015 CALLIBRATION



VTOSS 2010 DATA + AIS 2015 COUNT LINE DATA

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

TANK FV + CARGO FV ACCIDENT DATA
13 TANK FV Accidents
52 CARGO FV Accidents
(1995 – 2005)

ALL FV ACCIDENT DATA WITH SPILLS
2 FV Accidents
(1990 – 2015)

Extrapolate to TANK FV →

Extrapolate to CARGO FV →

Rather than extrapolation from TANK FV to CARGO FV, we can for VTRA 2015 **Separately calibrate by # TANK FV accidents and # CARGO FV Accidents** using the 1995 – 2005 database developed during the VTRA 2005.

$$\Pr(Accident) = \sum \Pr(Accident|Incident) \times \Pr(Incident)$$

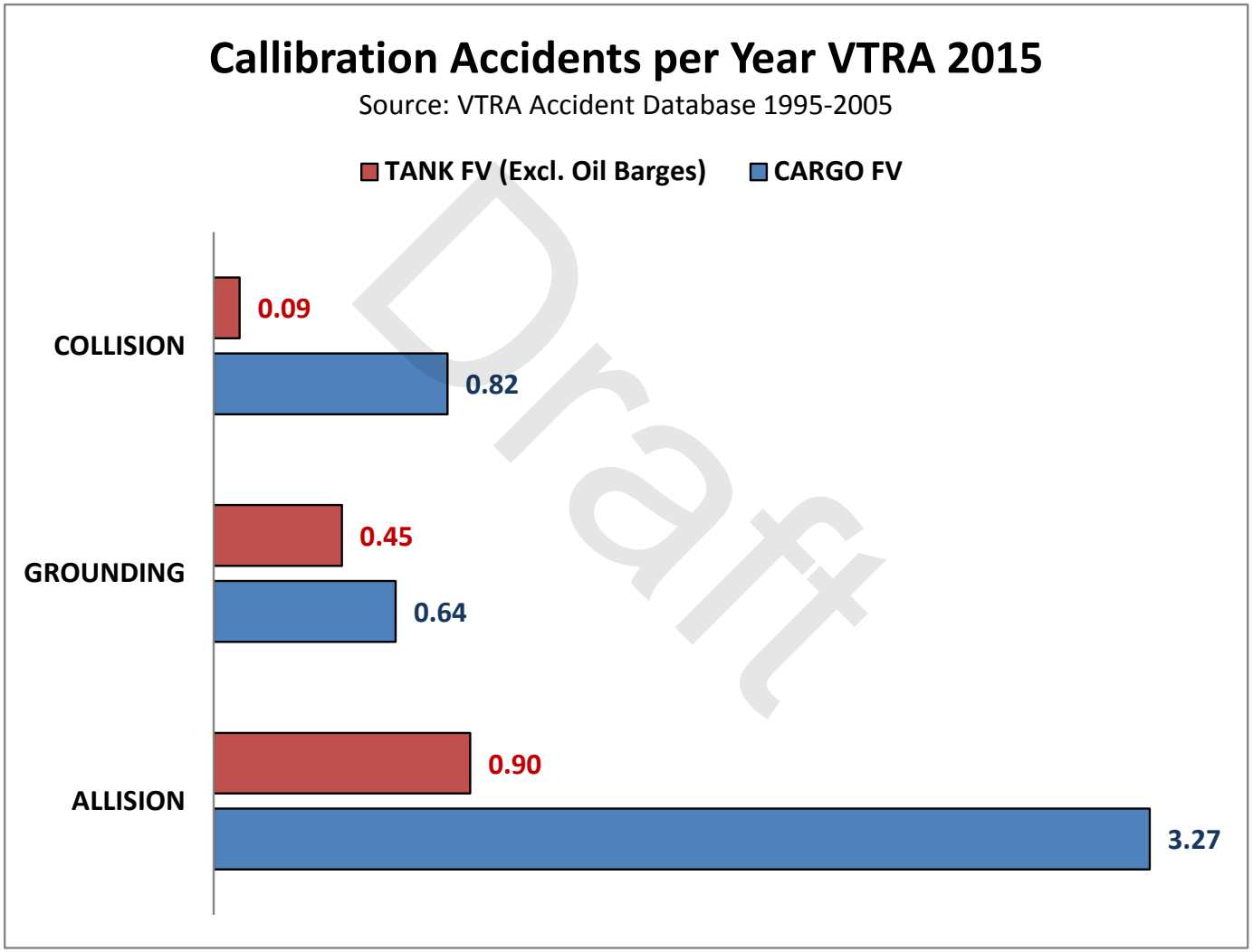
$$= \sum \text{Rel.}\Pr(Accident|Incident) \times \xi \times \Pr(Incident)$$

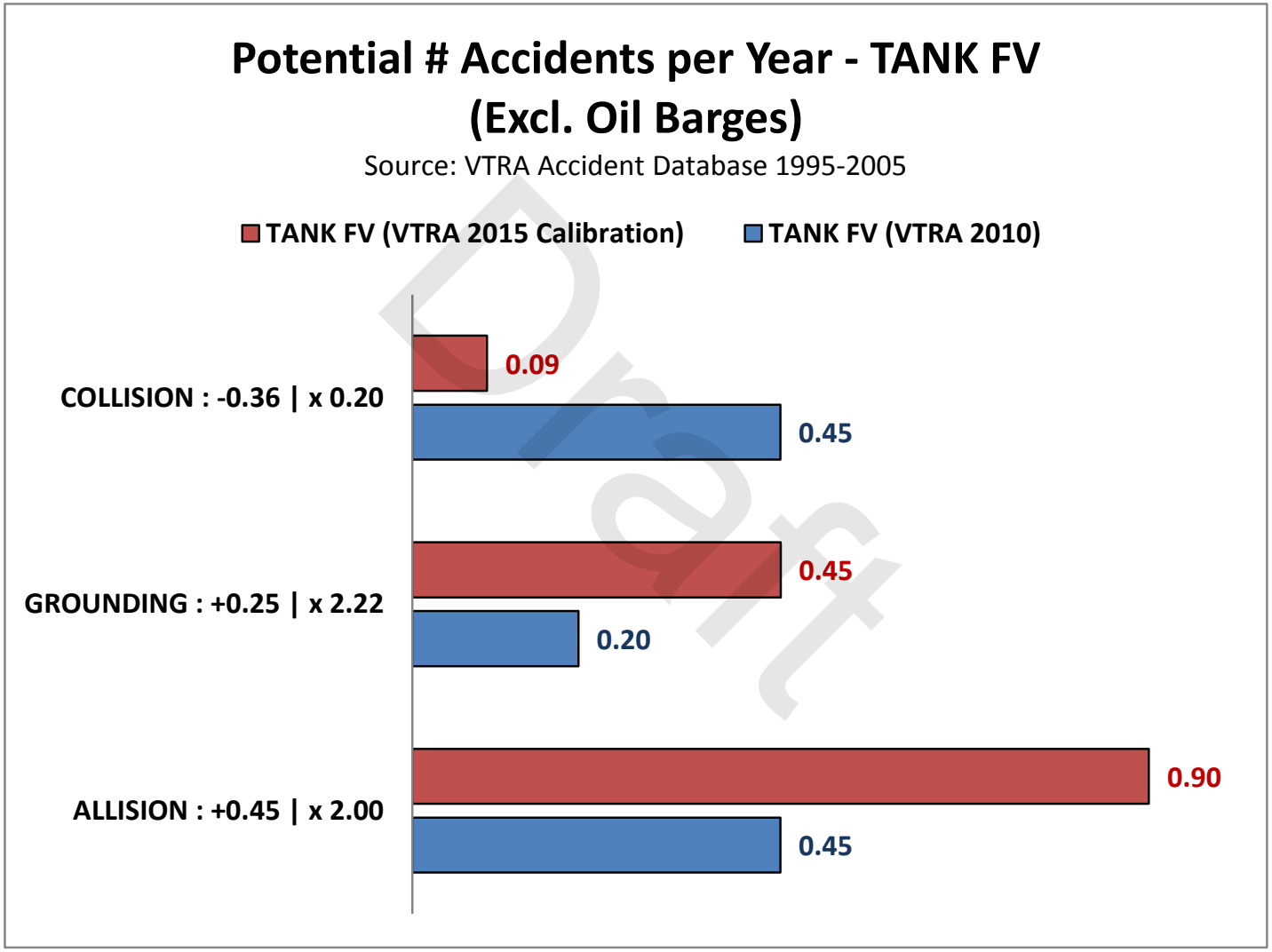
VTRA 2005 Expert Judgement Model

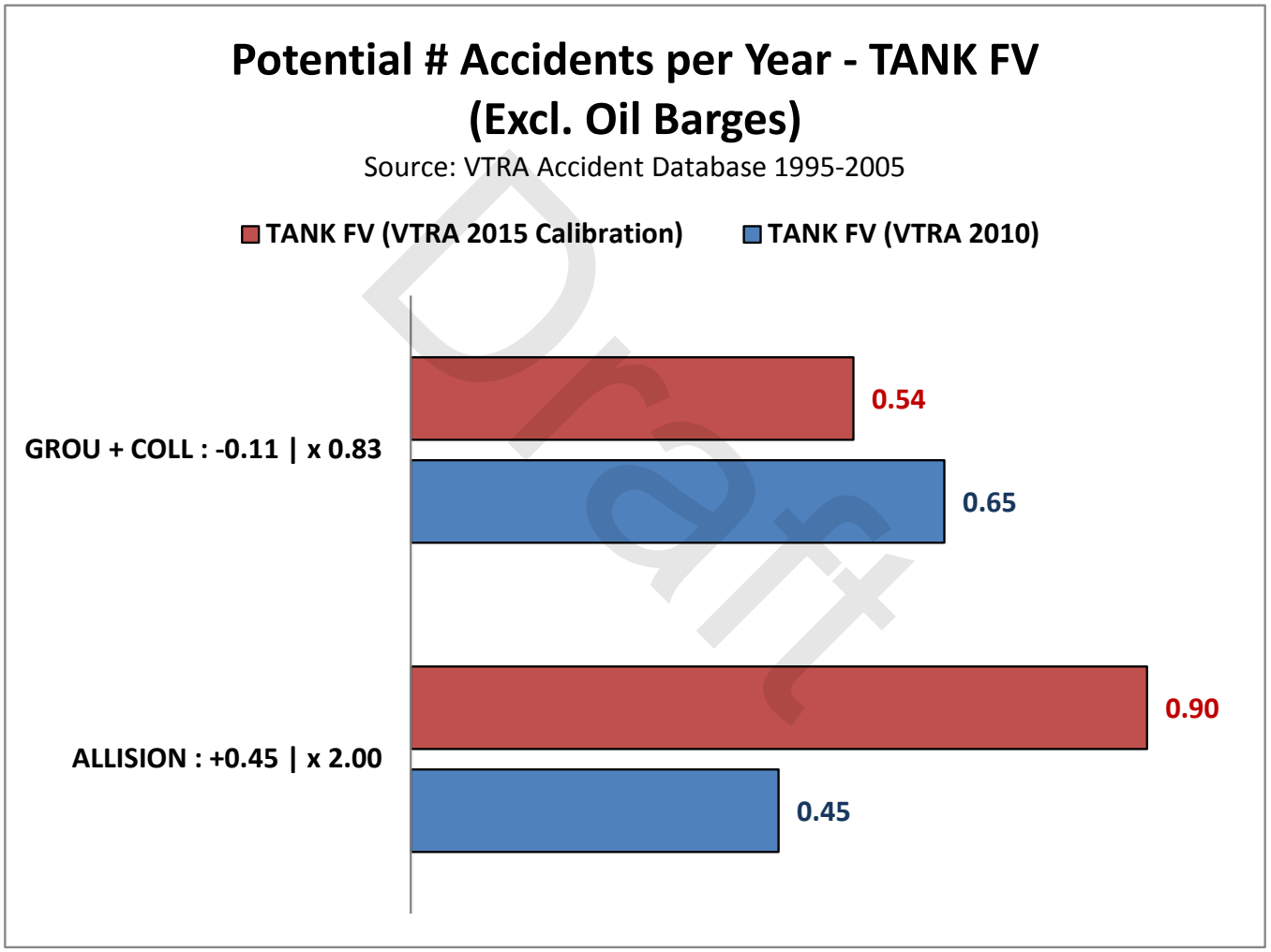
Accident Calibration Constant

VTRA 2010 Incident Model

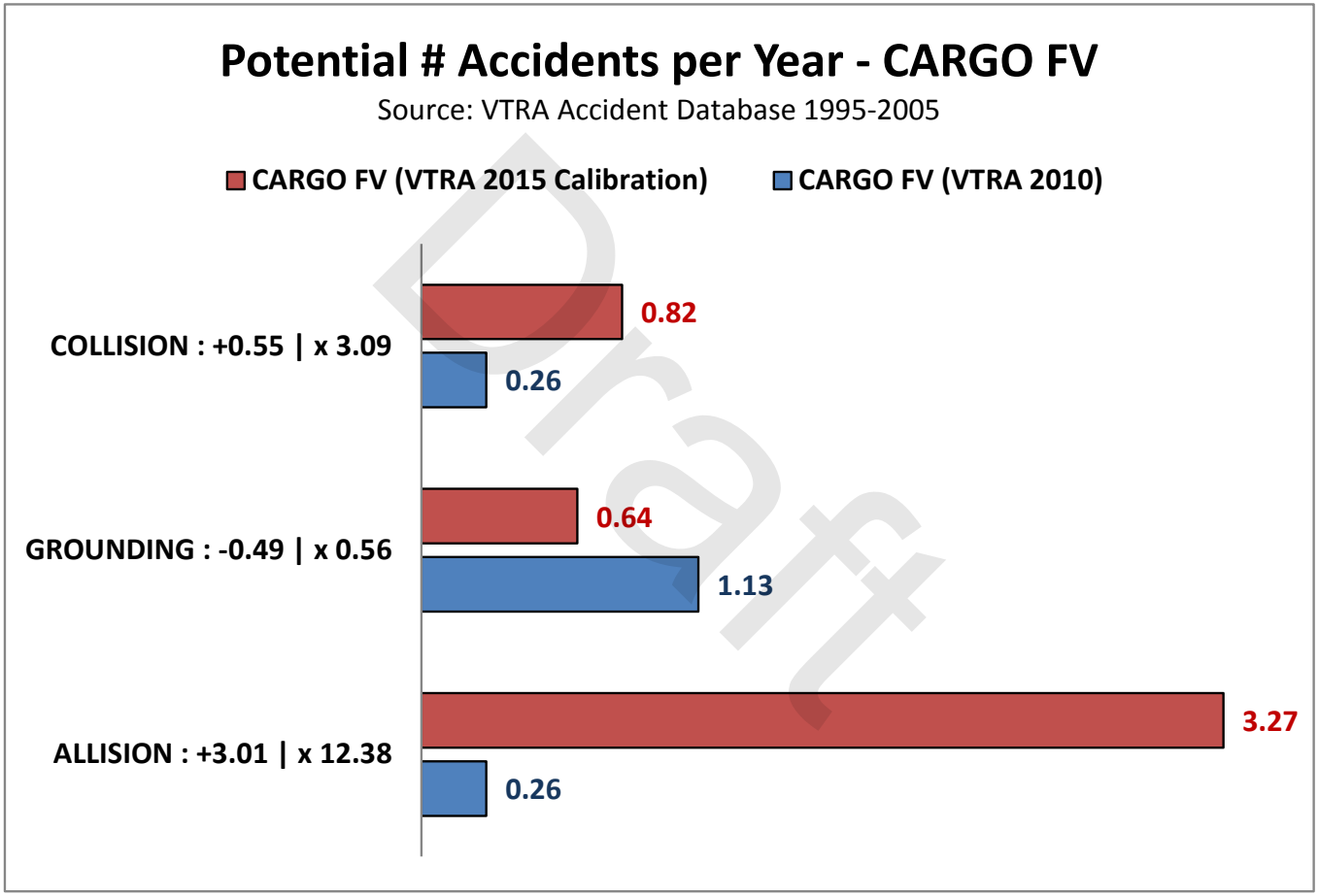
VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015



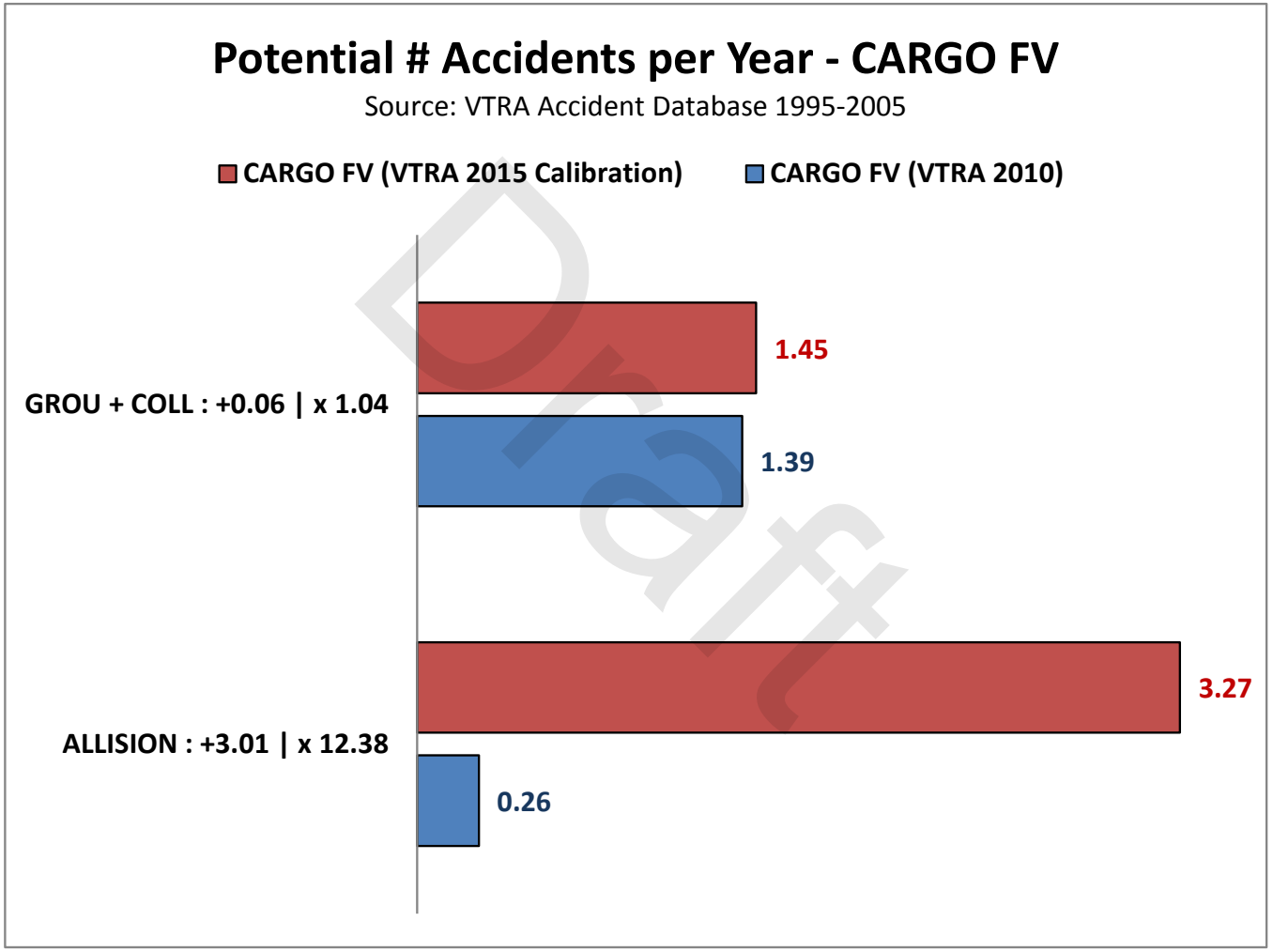

Potential # Accidents per Year - TANK FV
(Excl. Oil Barges)
Source: VTRA Accident Database 1995-2005
TANK FV (VTRA 2015 Calibration)
TANK FV (VTRA 2010)
COLLISION : -0.36 | x 0.20
0.09
0.45
GROUNDING : +0.25 | x 2.22
0.45
0.20
ALLISION : +0.45 | x 2.00
0.90
0.45
Draft


Potential # Accidents per Year - TANK FV
(Excl. Oil Barges)
Source: VTRA Accident Database 1995-2005
TANK FV (VTRA 2015 Calibration)
TANK FV (VTRA 2010)
GROU + COLL : -0.11 | x 0.83
0.54
0.65
ALLISION : +0.45 | x 2.00
0.90
0.45
Draft

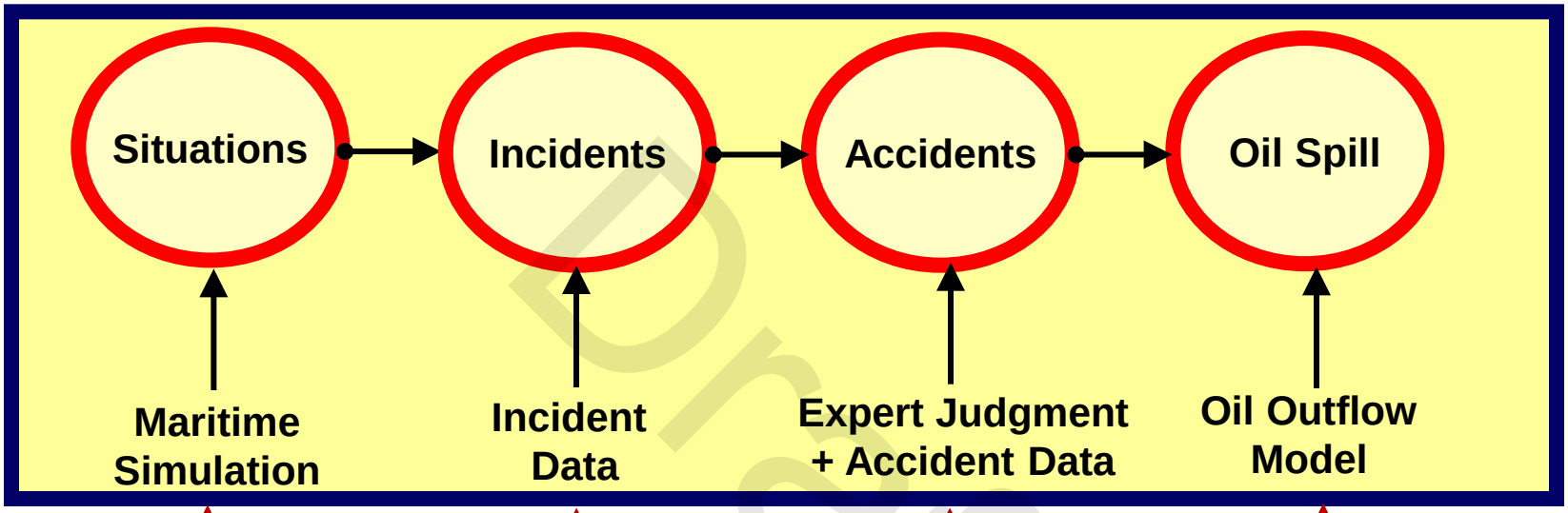
VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015



VTRA 2015 CALLIBRATION



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13 TANK FV Accidents

52 CARGO FV Accidents

(1995 – 2005)

ALL FV ACCIDENT DATA WITH SPILLS

2 FV Accidents

(1990 – 2015)

Extrapolate to TANK FV →

Extrapolate to CARGO FV →

ALL FV ACCIDENT (COLL + GROUNDING) DATA WITH SPILLS 1990 - 2015

SOURCES:

Sightline INSTITUTE

FIFTY YEARS OF OIL SPILLS IN WASHINGTON'S WATERS
What can the past tell us about the future?

U. S. COAST GUARD
OFFICE OF INVESTIGATION AND ANALYSIS (CG-545)

NOTABLE OIL SPILLS IN U.S. WATERS, 1989 – 2011

Cape Flattery (July 1991)

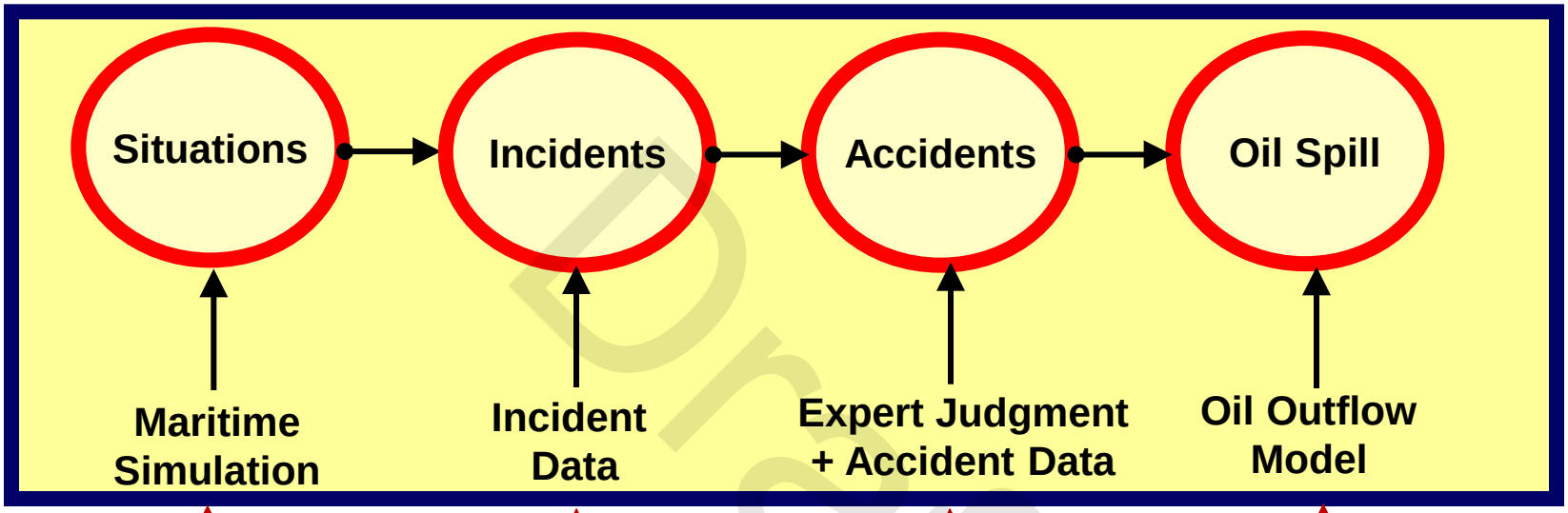
A Japanese-fish processing vessel *Tenyo Maru* and a Chinese freighter *Tuo Hai* collided about 25 miles northwest of Cape Flattery. The *Tenyo Maru* sank within minutes. One crew member drowned, and its fuel tanks, carrying 475,000 gallons of fuel oil, began leaking.

Oil washed ashore for several days after the sinking at points along the Washington coast, including Shi Shi beach, Cape Flattery, and the area between Tatoosh Island and Rialto Beach. Shorelines in the Makah Reservation and Olympic National Park were the hardest hit. The wreck continued to leak a large volume of oil, approximately 361,000 gallons in total, for more than a month before a remote control submersible's operators managed to safely pump the remaining fuel out of the vessel. In

Padilla Bay (December 1994)

The Crowley Marine Services' *Barge 101* leaked an estimated 26,936 gallons of diesel oil into Rosario Strait and the waters north of Anacortes before the tug boat crew towing the barge noticed the spill. It took several more hours before they managed to halt the flow of oil leaking from a four foot gash in one of the barge's cargo tanks. The Office of Marine Safety determined that the barge ruptured after running aground somewhere on Clements Reef, north of Sucia Island.

PROPOSED VTRA 2015 CALLIBRATION



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ALL FV ACCIDENT DATA WITH SPILLS

2 FV Accidents
(1990 – 2015)

Extrapolate to TANK FV

Extrapolate to CARGO FV

Include FV Accident Data 2006 – 2015?

YES

Compiled CARGO AND TANK FV Accident Data 2006 – 2015

#	Year	FV Class	Vessel Class	Accident Type	Latitude	Longitude	COUNTRY
1	2006	CARGO FV	Heavy Load Carrier	Allision	47.2685	-122.5506	US
2	2006	CARGO FV	Container Ship	Allision	47.2897	-122.4515	US
3	2007	CARGO FV	Bulk Carrier	Allision	47.7900	-122.4217	US
4	2009	CARGO FV	General Dry Cargo Ship	Collision	47.5000	-122.4333	US
5	2009	CARGO FV	Bulk Carrier	Grounding	48.8214	-123.2855	CA
6	2011	CARGO FV	Bulk Carrier	Allision	47.2618	-122.3615	US
7	2011	CARGO FV	Bulk Carrier	Grounding	48.8797	-123.6286	CA
8	2011	CARGO FV	Container Ship	Collision	48.5167	-124.6333	CA
9	2012	CARGO FV	Bulk Carrier	Grounding	48.5222	-122.6078	US
10	2012	CARGO FV	Bulk Carrier	Allision	47.5510	-122.3398	US
11	2012	CARGO FV	General Cargo	Allision	48.7443	-123.6036	CA
12	2012	CARGO FV	Bulk Carrier	Allision	49.0083	-123.1533	CA
13	2013	CARGO FV	Container Ship	Allision	47.2628	-122.3900	US
14	2014	CARGO FV	Bulk Carrier	Allision	47.2846	-122.4086	US
15	2015	CARGO FV	Bulk Carrier	Allision	47.5491	-122.3406	US
16	2015	TANK FV	Tank Ship	Collision	48.8614	-122.7610	US

Source: 1. USCG Sector Seattle, Special Thanks to Commander Matt Edwards
2. Transportation Safety Board Canada:
http://www.tsb.gc.ca/eng/stats/marine/index-ff.asp

DATA SOURCE CANADIAN INCIDENT & ACCIDENT DATA:

REGARDLESS:

Execution of any of the calibrations steps on the previous slides changes/updates the VTRA 2010 Base Case to a VTRA 2015 Base Case (TASK 1 – I)

HENCE:

Relative Comparisons of VTRA 2010 What-If Case Q, R, S and T ought to be re-evaluated\updated against this update VTRA 2015 Base Case (TASK 2 - I

THIS ALSO ALLOWS FOR:

Revisiting the VTRA 2010 What-If Case Q, R, S and T definitions in terms of the number of Vessel Calls.

SUMMARIZING:

Execution of TASK 1 – I and TASK 2-1

Updates\Changes the VTRA 2010 Analysis Results

CONCLUSION:

Through Execution of TASK 1 – I and TASK 2-1

The VTRA 2010 Analysis Results become Obsolete!

Leading to updated VTRA 2015 Analysis results

which is the purpose of this study.

QUESTIONS?