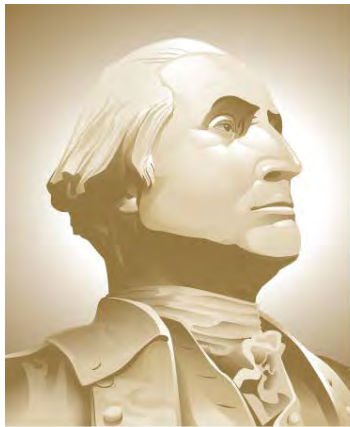


VTRA 2010 POTENTIAL GROUNDING FREQUENCY BY ALL FV, CARGO – FV, TANK- FV and WHAT-IF FV

Presentation by: J. Rene van Dorp



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CASE R: Kinder Morgan + Bunkering Operations

GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

AUGUST 30, 2013

PRELIMINARY

Table. Focus Vessel (FV) Classification for the 26 VTOSS vessel type classification used in the GW/VCU MTS simulation model.

NON – FV : Those vessels that Interacting Vessels (IV) with Focus Vessels (FV)

BASE CASE CARGO – FV : Bulk Carriers, Container Vessels, Other Cargo Vessels that travel in VTRA 2010 Base Case

BASE CASE TANK – FV : Oil Barge, Oil Tankers, Chemical Carrier, ATB 's that travel in VTRA 2010 Base Case

WHAT IF – FV : CARGO AND TANK FV'S added to VTRA 2010 Base Case to model What-If Scenario

Note: Focus Vessels (FV's) are also considered as Interacting Vessels (IV's) when interacting with another Focus Vessel.

#	VESSEL TYPE	FOCUS VESSEL?	#	VESSEL TYPE	FOCUS VESSEL?
1	BULKCARRIER	CARGO - FV	14	PASSENGERSHIP	NO
2	CHEMICALCARRIER	TANK - FV	15	REFRIGERATEDCARGO	CARGO-FV
3	CONTAINERSHIP	CARGO - FV	16	RESEARCHSHIP	NO
4	DECKSHIPCARGO	CARGO - FV	17	ROROCARGOSHIP	CARGO-FV
5	FERRY	NO	18	ROROCARGOCONTSHIP	CARGO-FV
6	FERRYNONLOCAL	NO	19	SUPPLYOFFSHORE	NO
7	FISHINGFACTORY	NO	20	TUGTOWBARGE	NO
8	FISHINGVESSEL	NO	21	UNKNOWN	NO
9	LIQGASCARRIER	TANK - FV	22	USCOASTGUARD	NO
10	NAVYVESSEL	NO	23	VEHICLECARRIER	CARGO-FV
11	OILTANKER	TANK - FV	24	YACHT	NO
12	OTHERSPECIALCARGO	CARGO - FV	25	ATB	TANK - FV
13	OTHERSPECIFICSERV	NO	26	OIL BARGE	TANK - FV

IMPORTANT:

THE OPERATIVE WORD IN PRESENTING THESE ANALYSIS RESULTS IS THE USE OF THE WORD

POTENTIAL

TO INDICATE THAT THESE ANALYSIS RESULTS DO NOT FOLLOW FROM AN HISTORICAL DATA ANALYSIS, BUT THROUGH THE USE OF AN ANALYSIS TOOL THAT EVALUATES SUCH **POTENTIAL**.

THE 2010 YEAR IS CONSIDERED **THE BASE CASE YEAR** AND A BASE CASE YEAR POTENTIAL IS EVALUATED.

NEXT, **WHAT-IF SCENARIOS** ARE DEVELOPED FROM THE BASE CASE BY ADDING ADDITIONAL HYPOTHETICAL TRAFFIC AND A WHAT-IF POTENTIAL IS EVALUATED AND COMPARED **RELATIVE TO THE BASE CASE** TO INFORM **RISK MANAGEMENT**.

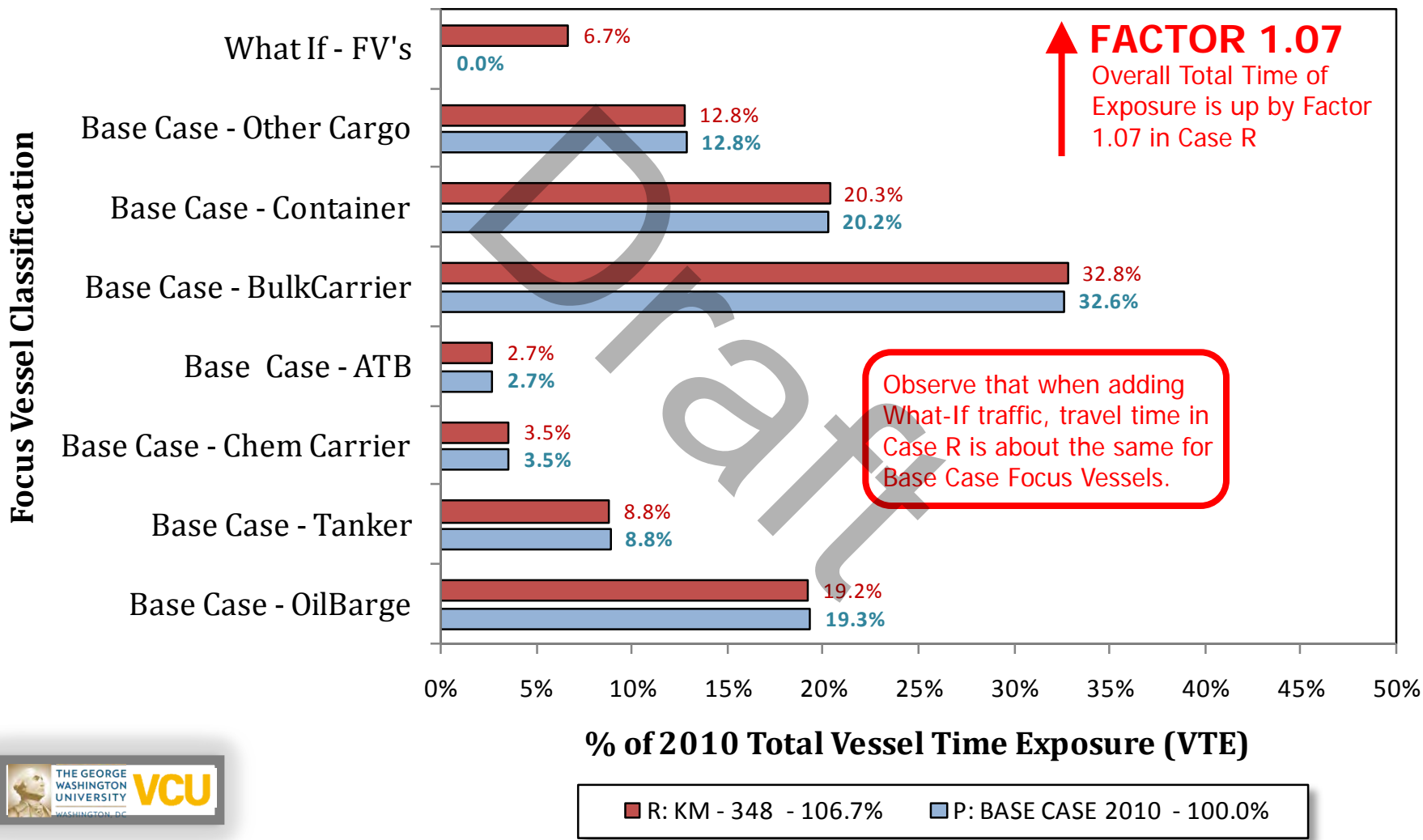
CASE R: KM 348 + Bunkering

BASE CASE 2010 TRAFFIC WITH FOLLOWING WHAT-IF FOCUS VESSELS

348 Kinder Morgan Tankers + Bunkering Barges

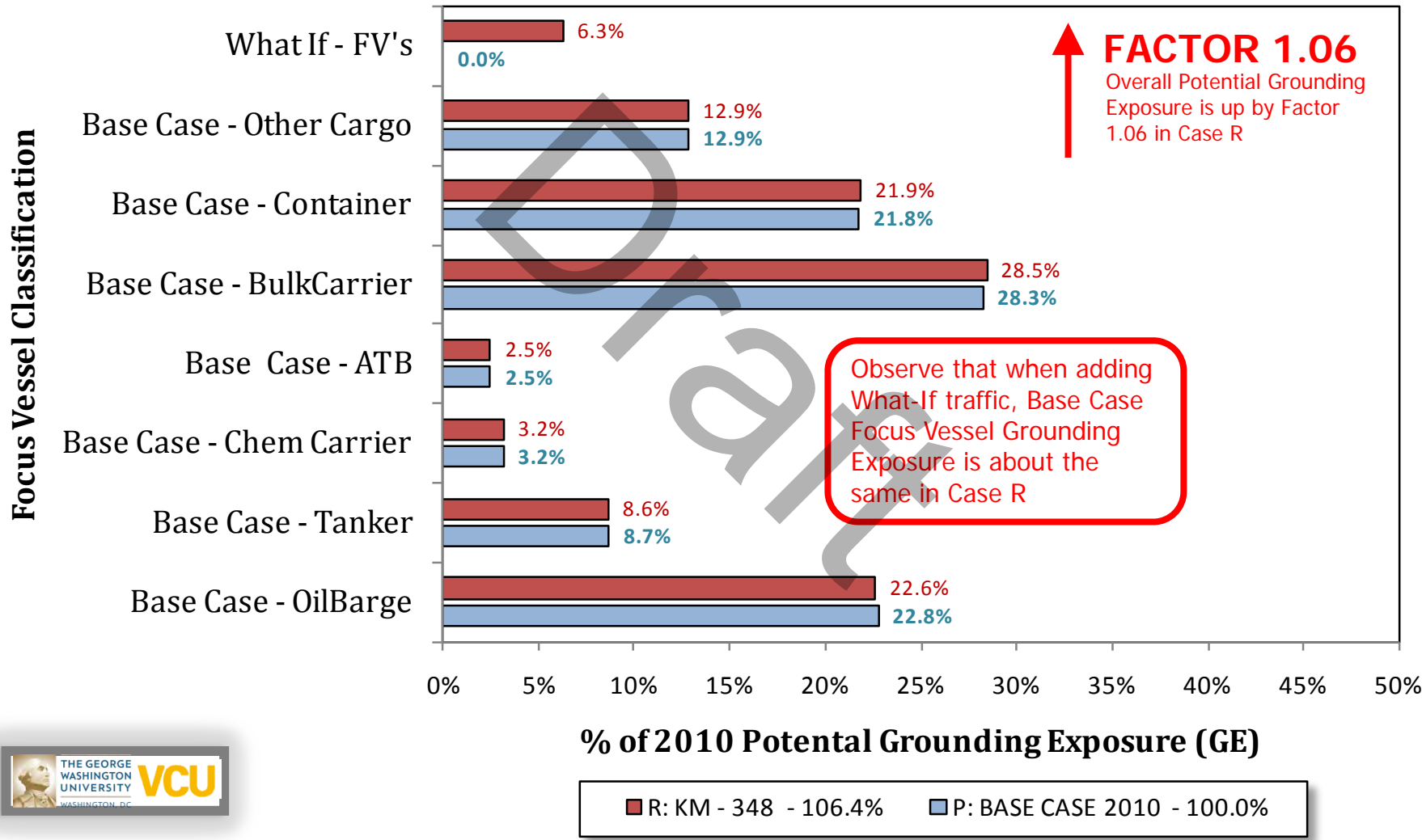
CASE R: KM 348 + BUNKERING

VTRA 2010 - Total Vessel Time of Exposure (VTE)



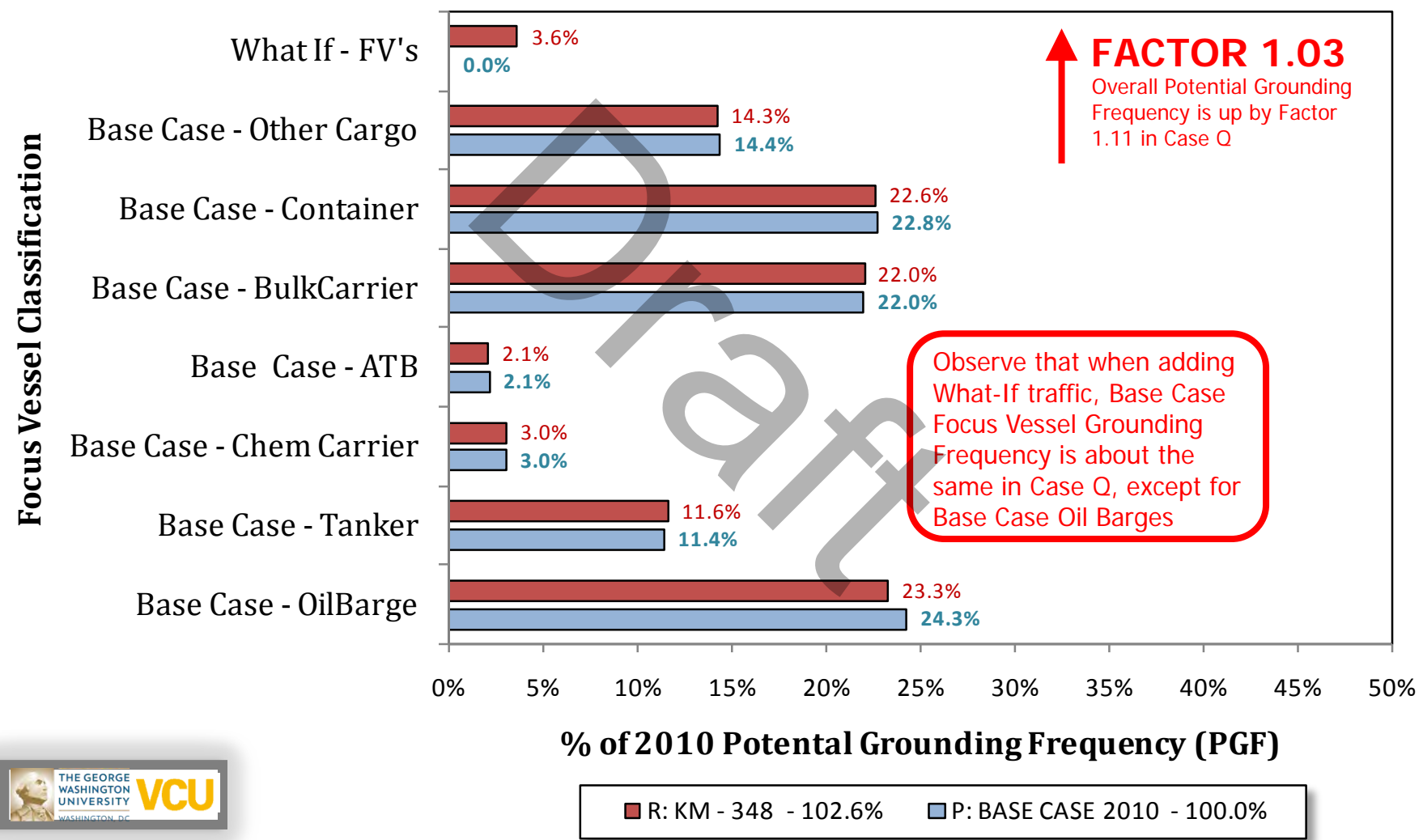
CASE R: KM 348 + BUNKERING

VTRA 2010 - GROUNDING EXPOSURE



CASE R: KM 348 + BUNKERING

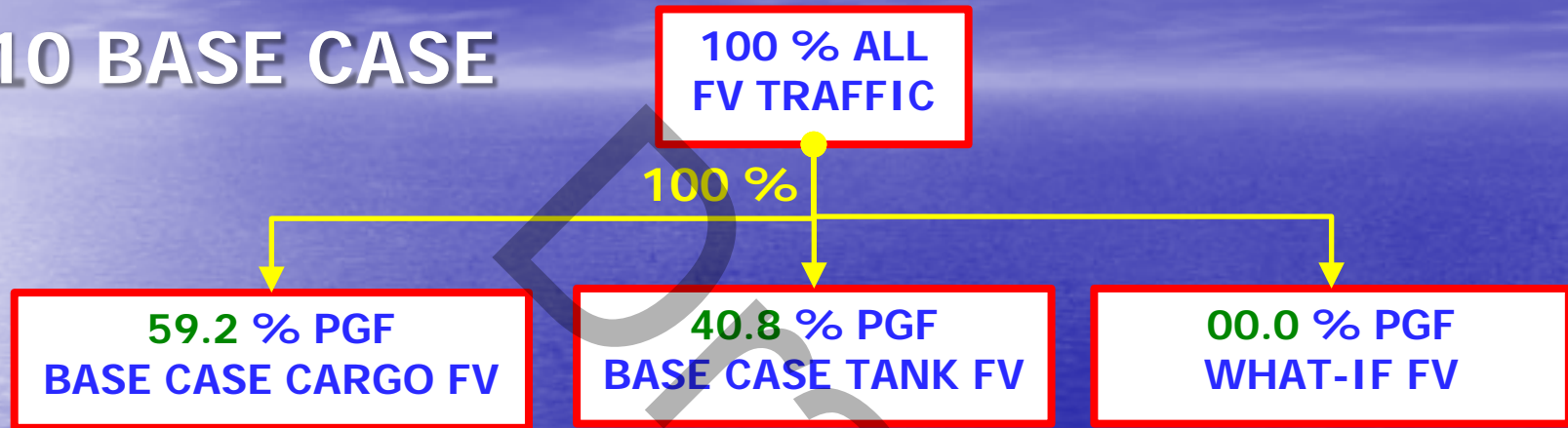
VTRA 2010 - GROUNDING FREQUENCY



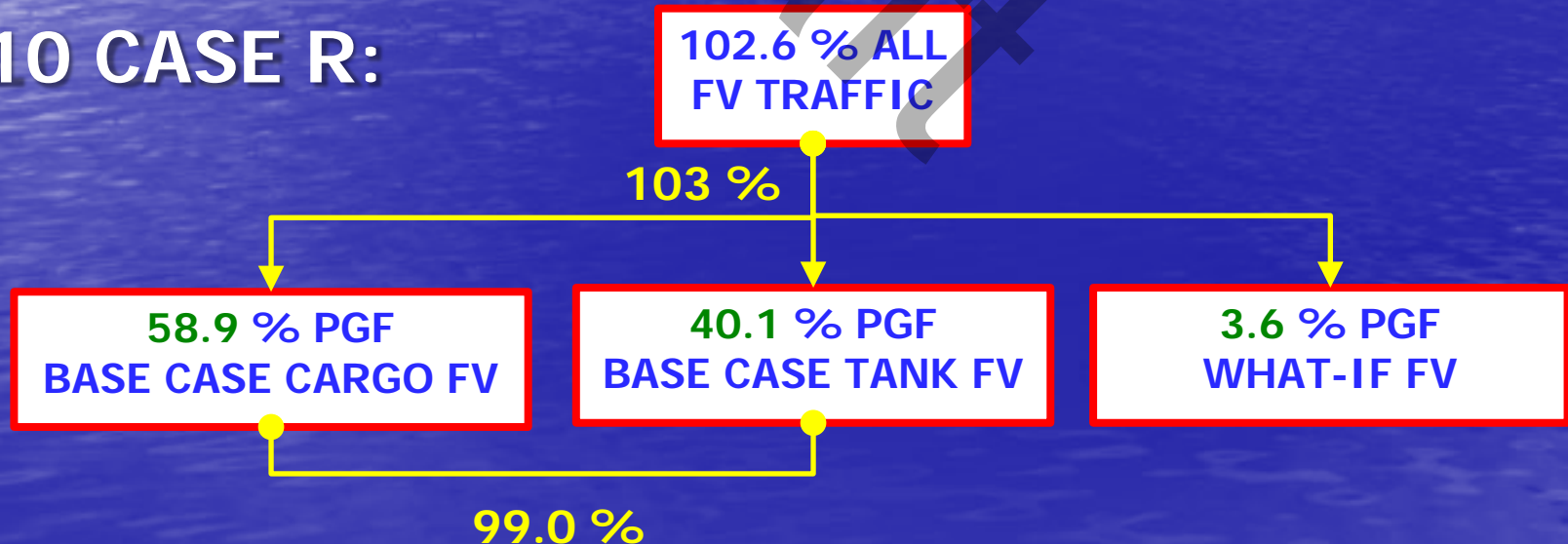
A TAXONOMY OF 2010 FOCUS VESSEL POTENTIAL ANNUAL GROUNDING FREQUENCY

PCF : POTENTIAL GROUNDING FREQUENCY - PER YEAR

2010 BASE CASE



2010 CASE R:



P: ALL FV POTENTIAL GROUNDING FREQUENCY (PGF)



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P: VTRA 2010 - BASE CASE

100%

58%

41%

Factor x Average
of Accidents

> 100.00
> 10.00
10.00
3.68
2.94
2.50
2.19
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.38
0.28
0.18
0.09
0.00

P: POTENTIAL GROUND. FREQ. (PGF)

22.0% - BULK CARGO
22.8% - CONTAINERSHIP
14.4% - OTHERCARGO
24.3% - OIL BARGE
11.4% - TANKER
03.0% - CHEMICAL CARRIER
02.1% - ATB
00.0% - WHAT-IF FV

100.0% of 2010 Base Case
ALL FV - PGF

R: ALL FV POTENTIAL GROUNDING FREQUENCY (PGF)



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R: VTRA 2010 - Kinder Morgan 348

103%

61%

43%

Factor x Average
of Accidents

> 100.00
> 10.00
10.00
3.68
2.94
2.50
2.19
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.38
0.28
0.18
0.09
0.00

R: POTENTIAL GROUND. FREQ. (PGF)

22.0% - BULK CARGO
22.6% - CONTAINERSHIP
14.3% - OTHERCARGO
23.3% - OIL BARGE
11.6% - TANKER
03.0% - CHEMICAL CARRIER
02.1% - ATB
03.6% - WHAT-IF FV

+
102.6% of 2010 Base Case
ALL FV - PGF

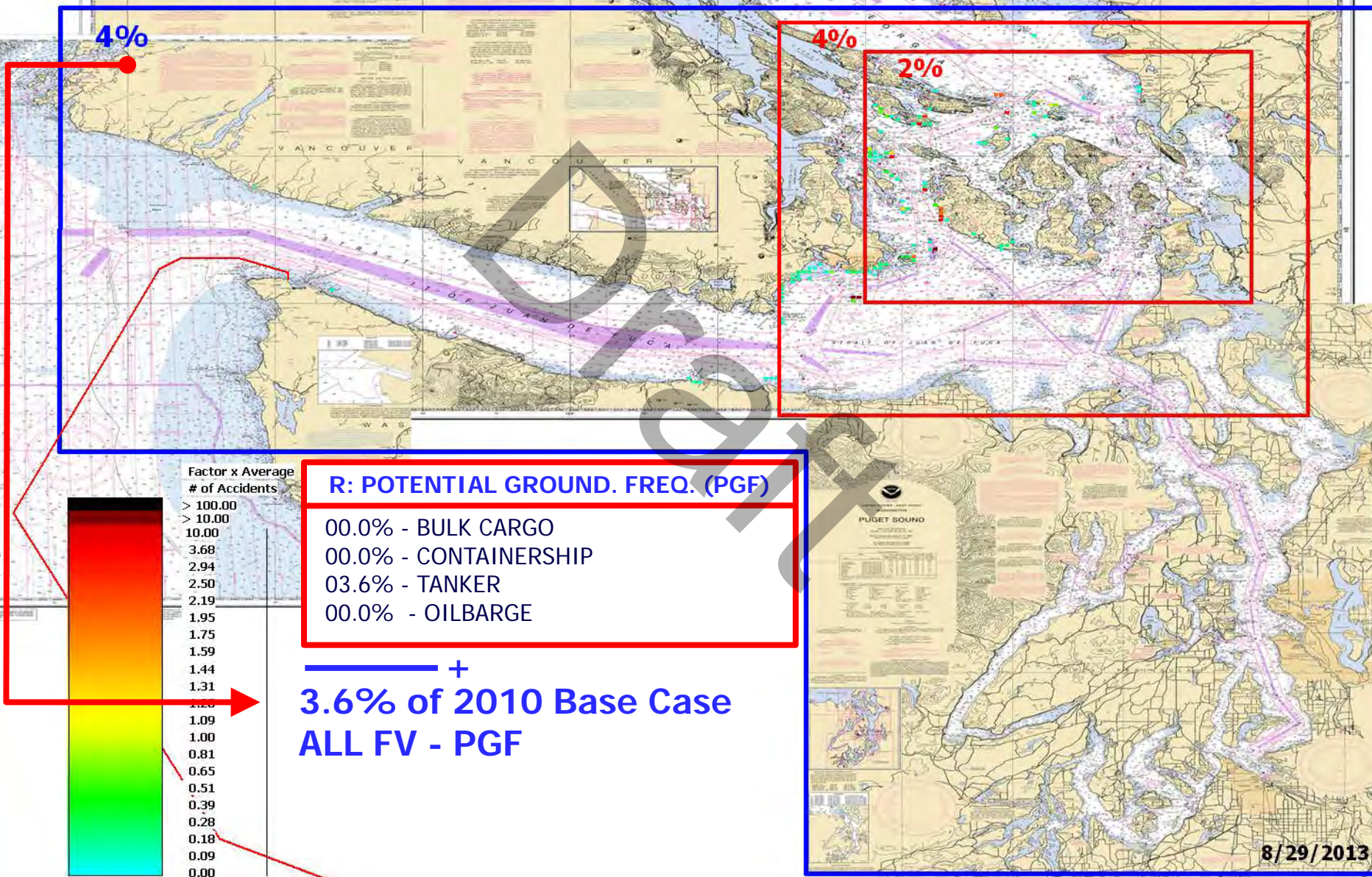
R: WHAT-IF FV POTENTIAL GROUNDING FREQUENCY (PGF)



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R: VTRA 2010 - Kinder Morgan 348



P: BASE CASE CARGO FV POTENTIAL GROUNDING FREQUENCY (PGF)



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P: VTRA 2010 - BASE CASE

59%

33%

22%

Factor x Average
of Accidents

> 100.00
> 10.00
10.00
3.68
2.94
2.50
2.19
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

CASE P: POT. GROUND. FREQ. (PGF)

22.0% - BULK CARGO
22.8% - CONTAINERSHIP
14.4% - OTHERCARGO
00.0% - WHAT-IF FV

59.2% of 2010 Base Case
ALL FV - PGF

R: BASE CASE CARGO FV POTENTIAL GROUNDING FREQUENCY (PGF)



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R: VTRA 2010 - Kinder Morgan 348

59%

32%

22%

Factor x Average
of Accidents

> 100.00
> 10.00
10.00
3.68
2.94
2.50
2.19
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

CASE R: POT. GROUND. FREQ. (PGF)

22.0% - BULK CARGO
22.6% - CONTAINERSHIP
14.3% - OTHERCARGO
00.0% - WHAT-IF FV

58.9% of 2010 Base Case
ALL FV - PGF

P: BASE CASE TANK FV POTENTIAL GROUNDING FREQUENCY (PGF)



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P: VTRA 2010 - BASE CASE

41%

26%

19%

Factor x Average
of Accidents

> 100.00
> 10.00
10.00
3.68
2.94
2.50
2.19
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

CASE P: POT. GROUND. FREQ. (PGF)

24.3% - OILBARGE
11.4% - OILTANKER
03.0% - CHEMICALCARRIER
02.1% - ATB
00.0% - WHAT-IF FV

— +
**40.8% of 2010 Base Case
ALL FV - PGF**

R: BASE CASE TANK FV POTENTIAL GROUNDING FREQUENCY (PGF)



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R: VTRA 2010 - Kinder Morgan 348

40%

25%

18%

Factor x Average
of Accidents

> 100.00
> 10.00
10.00
3.68
2.94
2.50
2.19
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

CASE R: POT. GROUND. FREQ. (PCF)

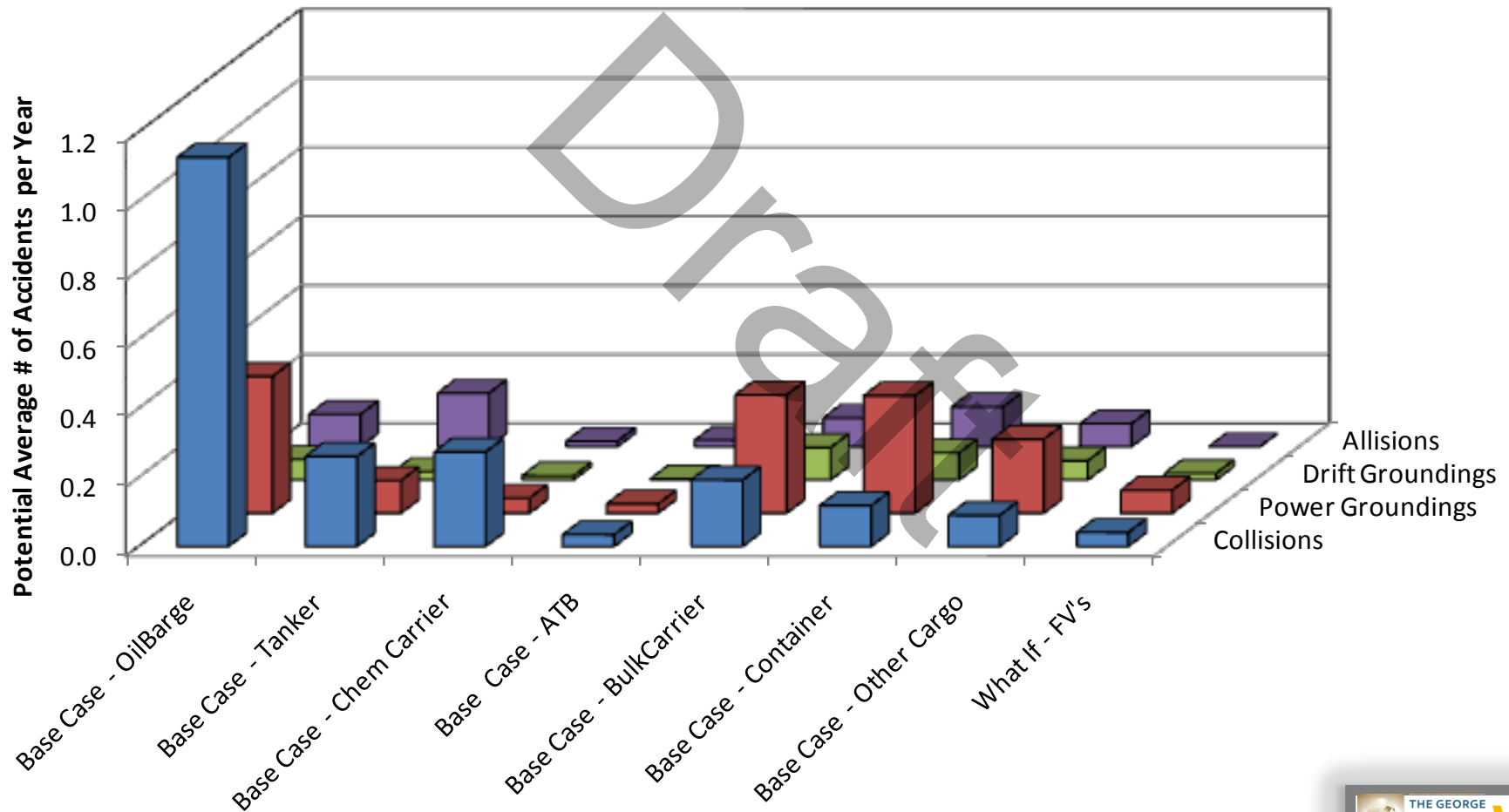
23.3% - OILBARGE
11.6% - OILTANKER
03.0% - CHEMICALCARRIER
02.1% - ATB
00.0% - WHAT-IF FV

— +
40.1% of 2010 Base Case
TANK FV - PGF

A TAXONOMY OF 2010 FOCUS VESSEL POTENTIAL ACCIDENT FREQUENCY AND ACCIDENT TYPE

CASE R: KM 348 + BUNKERING

R - VTRA 2010 : Potential Average # of Accidents per Year



R - VTRA 2010 : Potential Average # of Accidents per Year

Focus Vessel	Collisions	Power Groundings	Drift Groundings	Allisions	Total
Base Case - OilBarge	57.5%	26.8%	18.0%	17.2%	38.8%
Base Case - Tanker	13.3%	6.4%	7.4%	28.4%	12.4%
Base Case - Chem Carrier	13.9%	3.0%	3.6%	2.9%	8.0%
Base Case - ATB	1.7%	1.8%	1.0%	3.4%	1.9%
Base Case - All Tank FV's	86.4%	37.9%	30.0%	51.8%	61.1%
Base Case - BulkCarrier	9.8%	23.1%	28.5%	15.2%	16.5%
Base Case - Container	6.0%	23.0%	23.9%	21.1%	15.1%
Base Case - Other Cargo	4.6%	14.4%	16.9%	12.2%	9.9%
Base Case - All Cargo FV's	20.4%	60.5%	69.2%	48.5%	41.4%
Base Case - All FV's	106.9%	98.4%	99.2%	100.3%	102.6%
What If - FV's	2.1%	4.5%	5.9%	0.0%	2.9%
Total - Base Case + What- IF	108.9%	102.9%	105.1%	100.3%	105.5%

R - VTRA 2010 : Potential Average # of Accidents per Year

Focus Vessel	Collisions	Power Groundings	Drift Groundings	Allisions	Total
Base Case - OilBarge	1.13	0.40	0.06	0.09	1.68
Base Case - Tanker	0.26	0.09	0.02	0.15	0.53
Base Case - Chem Carrier	0.27	0.04	0.01	0.02	0.34
Base Case - ATB	0.03	0.03	0.00	0.02	0.08
Base Case - All Tank FV's	1.69	0.56	0.10	0.28	2.64
Base Case - BulkCarrier	0.19	0.34	0.09	0.08	0.71
Base Case - Container	0.12	0.34	0.08	0.12	0.65
Base Case - Other Cargo	0.09	0.21	0.06	0.07	0.43
Base Case - All Cargo FV's	0.40	0.90	0.23	0.27	1.79
Base Case - All FV's	2.09	1.46	0.33	0.55	4.43
What If - FV's	0.04	0.07	0.02	0.00	0.13
Total - Base Case + What- IF	2.14	1.52	0.35	0.55	4.55