War likelihood estimates (USG and insurance)

The post Cold War numbers on page 2 are probably more ready-to-use, so before you get too bogged down in the footnotes to this page you might want to glance at the summary paragraph on the next page too.

None of these are or ever have been classified that I know of. They are also all public. None of them are in the SNRA or its DHS sister analytic products. All of the classified estimates for nuclear attacks (and other CBRN attacks too) in the SNRA are only for terrorist attacks, not nation-states. (Although they aren't the focus of this document, authoritative unclassified estimates exist for terrorist attacks as well.[1, 2])

Cold War estimates

Public U.S. Government (USG) estimates of the probability of nuclear war during the Cold War range from 10% a year at the very beginning,[3] to 0.5% - 2% per year[4, 5] during the 1960s and 1970s, and 0.1% a year in the 1980s.[6]

Relative to Cold War

USG implicit judgements of relative risk [relative to Cold War levels] have oscillated between five and twenty percent since 1992.[7]

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[1] The President publishes his unclassified probability estimate of a catastrophic (50,000+ fatality) terrorist attack in the homeland every year in his annual Budget, as part of his cost estimates for the Terrorism Risk Insurance Program (TRIP). This estimate has varied from 1.3% / year in 2008-09, 0.5-0.6% / year from 2010-16, and 0.25-0.4% / year since, and is currently (CY 2022) 0.3% / year (rounded from 0.29%).

The calculation with current (CY 2020-27) program parameters is *Likelihood* = (0.4 t + s) / (1.12 y × [$100 billion - $\bar{I}$]), where t and s = ten year projected TRIP outlays and spending; y = years remaining in current program; and $\bar{I}$ = the insurance marketplace aggregate retention amount (IMARA) ($42.7 billion in CY 2022, https://www.govinfo.gov/content/pkg/FR-2021-12-23/pdf/2021-27795.pdf), projected for future years proportional to current dollar GDP, and averaged over those remaining years. Additional detail, https://web.archive.org/web/20220919224053/https://5usc2302.github.io/risk/References/Other%20cited/Unclassified_terrorism_probabilities_from_the_Budget.pdf.

[2] The 2015 SNRA includes unclassified likelihood and impact estimates for conventional (non-CBRN) terrorist attacks, and unclassified qualitative analysis of cyber threats from both non-state and state actors.

[3] Hirshleifer [RAND] (1953, May). War damage insurance, p. 150. *Review of Economics and Statistics* 35(2) 144-153. PDF at https://5usc2302.github.io/risk/References/Hirshleifer_1953_War_damage_insurance.pdf.

[4] 1.05% per year, President Kennedy's one-third to one-half probability estimate in Cuban Missile Crisis (Scouras [2021] pp. 11-12. Note that the author whom I'm citing questions using this estimate uncritically in the way that I'm doing here), annualized over entire Cold War, as a lower bound on the total probability in the Cold War as a whole. 33% probability over (1953-1991) 38 years, average frequency per year f from modeling as a Poisson [random] process $f_1 = 1/70 \times f_{70}$, $f_{70} = -\ln(1 - P_{70})$. f_1 frequency in one year; f_{70}, P_{70} = frequency and probability in seventy years. (The probability of occurrence in a single week in a longer time period sets the lower bound probability of occurrence in the period as a whole).

--Scouras, James, (2021). Framing the questions. Chapter 1, Scouras [editor] 2021, pp. 11-12. Scouras, James, editor (2021). On assessing the risk of nuclear war. Johns Hopkins Applied Physics Laboratory. At https://www.jhuapl.edu/Content/documents/OnAssessingRiskNuclearWar.pdf.

[5] 0.5% per year, median estimate Joint Chiefs 1970 [PONAST II]. 1% per year, mean estimate Joint Chiefs 1970; consensus estimate RAND early 1960s; median estimate Office of Civil Defense, 1970. 2% per year, mean estimate Office of Civil Defense, 1970. Greene (1972) pp. 95-99. Greene, Jack C. (1972). The case for civil defense (as developed through systems analysis). Office of Civil Defense, Department of the Army, research report no. 16. PDF at https://web.archive.org/web/20220116230119/https://bd02.github.io/staging/Public%20sources/Adversarial/Other/N/Greene%201972%20The%20case%20for%20civil%20defense%20(full%20document).pdf.

[6] 1 / 1,000 per year or less, FEMA (1983) CPG 1-101 (https://hsdl.org/?view&did=481215), pp. 37-39, definitions p. 14. An order of magnitude band (0.03% - 0.3%) around 1 / 1,000, Defense Science Board (2007) (https://dsb.cto.mil/reports/2000s/ADA471566.pdf) pp. 12-13 (10 to 100 times smaller than the referenced 2005 nuclear-terrorism estimate of 30% in 10 years).

[7] U.S. strategic forces spending relative to Cold War. Spending relative to total defense budget, https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF pp. I-II, V-VI, 6, p. 52 figure 3; relative to GDP, 12.2% (TOA 1 spending / GDP = 0.662% FY 1970 v. 0.0807% FY 2022, https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2022/FY22_Green_Book.pdf tables 6.4 and 7.3). U.S. strategic arsenal. Total warheads, 14.4% (3,750 in 2020 / 26,008 in 1970), https://www.state.gov/transparency-in-the-u-s-nuclear-weapons-stockpile/. Total yield (total megatons), 8.9% (859 MT [B2A load 50-50 B-61 & B83]) or 10.4% (1,008 MT [all B83]), sum from https://doi.org/10.1080/00963402.2022.2062943 table 1; v. 9,695 MT 1970 (https://nuke.fas.org/norris/nuc_01009701a_181.pdf table 11). Defense industrial base. U.S. radiation-hardened semiconductor chip foundries relative to 1985 (metric from https://apps.dtic.mil/sti/pdfs/ADA523661.pdf page 68 figure C-1): 11% (two foundries in 2009 vs. 18 in 1985, Sutton (2009) dissertation page 1, https://smartech.gatech.edu/bitstream/handle/1853/29778/sutton_akil_k_200908_phd.pdf) or 17% (three foundries in 2020 v. 1985, Gouker et al poster 2020, https://eri-summit.darpa.mil/docs/ERIsummit2020/posters/112%20DARPA_ERI_MTO-Poster_RHBP_Gouker_MITLL_MINSEC_final%20(Distro%20A).pdf). Plutonium pits per year (ppy) production requirement, 8.0% (requirement of 80 ppy by 2030 vs. 1,000 ppy in Cold War, https://www.energy.gov/sites/default/files/2022-08/Plutonium%20Pit%20Production%200722_0.pdf).

Post Cold War estimates[8]

Public USG *direct* estimates of the present-day probability of nuclear war include 0.24%[9] or 1%[10, 11] for steady-state conditions, and 10% in years of heightened risk.[12, 13, 14] Lloyd's estimate is 0.11% per year.[15]

There has been a lot of scholarship on quantifying this risk (the Scouras (2021) volume of note 11 is a good starting point). I'm intentionally listing only U.S. Government (USG), former USG, and insurance industry estimates here, because 1) they don't require me to make any analytic judgements myself in choosing them over others; and 2) most of them are not as well known, even though they've been public for years or decades.

750 kT airburst, blast and fire effects.
State of Michigan (2020)

[8] Image: State of Michigan (2020, November). Nuclear attack. Michigan 2020 Hazard Analysis pp. 123-128, image page 125. At https://www.michigan.gov/-/media/Project/Websites/msp/EMHSD/pdfs/pub_103_mha_2020_supplemental.pdf.

[9] National Maritime Strategic Risk Assessment (NMSRA) 2006 and 2008, annual probability of a nation-state attack. Nation-state attack annual risk 1,647 RIN [the Coast Guard's Risk Index Number], WMD transfer annual risk 34,220 RIN, same consequence bin (so that risk / risk = likelihood / likelihood), DHS (2011) slides 16-17. Annual probability of WMD transfer 5%, 2008 NMSRA, Cutts p. 37. Nation-state attack annual probability, (1,647 / 34,220) × 5% = 0.24% per year.

-- DHS/USCG (2011, March 17). United States Coast Guard risk management overview, slides 16-17. At https://web.archive.org/web/20210624202023/https://www.orau.gov/DHSsummit/presentations/March17/plenary/Cooper_Mar17.pdf. Cutts, Matthew E. (2009, June). Improving the Coast Guard Ports, Waterways, and Coastal Security Outcome Measure. Thesis, Naval Postgraduate School: at https://web.archive.org/web/20220811192250/https://apps.dtic.mil/dtic/tr/fulltext/u2/a527037.pdf. --The chart in the deck is labeled 2006 and Cutts' numbers are from 2008, but the anchoring assumption (likelihood and impact of the WMD transfer scenario) is the same in both (34,220 RIN in deck slide 16, 33,897 RIN in Cutts p. 50 figure 7).

[10] Stavridis, James, December 2017, referencing one year prior in contrast with then-current elevated-probability estimate. At https://asia.nikkei.com/Editor-s-Picks/Looking-ahead-2018/Will-there-be-a-war-on-the-Korean-Peninsula-in-2018.

[11] Perry, William (2021) (order of magnitude of 1%, i.e. ~0.3% - 3%). Hellman, Martin E. (2021). Probabilistic risk assessment. Chapter 4, pp. 85-116, Scouras (ed.) (2021). Note 41 pp. 97, 118. Also Kennedy's 50% crisis estimate averaged over seventy years (1953-2022) if used as a direct estimate, i.e. if the average probability from the Cold War to the present were assumed to be constant in the entire period.

-- Scouras, James, editor (2021). On assessing the risk of nuclear war. Johns Hopkins Applied Physics Laboratory. At https://www.jhuapl.edu/Content/documents/OnAssessingRiskNuclearWar.pdf.

[12] Stavridis, James, September and December 2017. At https://www.vox.com/2017/9/28/16375158/north-korea-nuclear-war-trump-kim-jong-un and https://asia.nikkei.com/Editor-s-Picks/Looking-ahead-2018/Will-there-be-a-war-on-the-Korean-Peninsula-in-2018. Note that Admiral Stavridis does not appear to believe that the present (June 2022) is such a period, https://www.businessinsider.com/nato-commander-stavridis-ukraine-russia-war-frozen-korean-war-putin-2022-5.

[13] Anonymous prior-Administration official c. 2021, cited in Hellman note 42 p. 118. Hellman, James (2021), note 42 p. 118, in Scouras (2021).

[14] RAND's early Cold War estimate of 10% (note 3 above) was based on similar assumptions, e.g. https://bd02.github.io/staging/Public%20sources/Adversarial/Other/N/Insurance%20estimates/Hirshleifer%202002%20War%20damage%20insurance%20revisited.pdf.

[15] Lloyd's (2018) City Risk platform (https://cityriskindex.lloyds.com/explore/). This site is no longer up, but pdf prints of the Level III interstate conflict (simulaneous aerial bombardment and economic destruction of every principal city in the United States, Russia, and China, probability 1 in 910 years) risk and consequence estimates (likelihood = risk / scenario cost) for each city are at https://web.archive.org/web/20220811202056/https://bd02.github.io/staging/Public%20sources/Adversarial/Other/N/Insurance%20estimates/ (folder) and https://web.archive.org/web/20220811201403/https://bd02.github.io/staging/Public%20sources/Adversarial/Other/N/Insurance%20estimates/Lloyd%27s%20estimates,%20source%20prints.zip (single file).

Somewhere on one of the associated pages which has unfortunately also disappeared into time, the syndicate noted that World War III is not one of the risks which it insures: it was only providing its risk estimates as a public service.