

The Fallout Story

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The Fallout Story – Chapter 1 - Synopsis

- Chapter 1 – Motive – This chapter discusses my background, starting in 1955 when I observed the western sky light up early (while dark) in the morning while milking cows with my Dad in LaVerkin, Utah. It tracks my various “interventions” that took me to the NTS as a USPHS employee. Then my subsequent return to College at the U of U working on a fallout project, sampling milk for Cs-137. From Utah I went to CSU for a Masters degree in Radiological Health. From CSU I went to the NRDS as Health Physicist for Pan Am World Airways. After that project was canceled, I became employed by the AEC. This led to a promotion in 1973 as Chief of the Radiological Branch. In the last half of the 1970s, and because my office held all the past historical radiological documents, I traveled frequently to Wash. D.C. to support Congressional hearings on radiation exposure to “downwinders” and military veterans all of whom claimed their various maladies (typically cancer) was caused from the purported exposure to “fallout” and “shine”. As I became intimately acquainted with the actual data from downwind/NTS monitoring and having many interactions with the public I knew that the real story of “Fallout” needed to be told!
- The main thing I came to realize was the radiation exposures to the veterans and the public was not even close to being high enough to cause cancer and other claimed maladies.
- (17 pages)

The Fallout Story – Chapter 2 - Synopsis

- Chapter 2 – Understanding the Units of Radiation Measurements
- This chapter discusses the fundamental units necessary to understand what ionizing radiation is all about. It starts with the definition of what ionization is and goes on to the definition of a roentgen and other units that explain what and why various units are used. A comparable table follows that compare historical units with the modern.

- Table 2-1 Units & Measures of Radioactivity, Exposure and Dose

Activity – (new) $1\text{Bq} = 1\text{ decay/sec}$ ($1\text{ Ci} = 3.7 \times 10^{10}\text{ Bq}$)

(old) $1\text{ pCi} = 2.2\text{ decays/sec} = 37\text{ mBq}$

Exposure (X or γ rays)– coulomb/kilogram (C/kg)

Roentgen – In SI units (R) $= 2.58 \times 10^{-4}\text{ C/kg}$; $0.001\text{ R} = 1\text{mR}$

Dose Equivalency:

Rem (old), $0.001\text{ rem} = 1\text{ mrem}$

Sv (new), $1\text{ Sv} = 100\text{ rem}$, $10\text{ mSv} = 1\text{ rem} = 1000\text{ mrem}$

Absorbed Dose:

rad (old) – 100 ergs/g ; $0.001\text{ rad} = 1\text{ mrad}$

Gray (new), $1\text{ Gy} = 1\text{J/kg} = 100\text{ rad}$, $10\text{ mGy} = 1\text{ rad}$

The roentgen shall be the quantity of X or gamma radiation such that the associated corpuscular emission per 0.001293 grams of air produces, in air, ions carrying 1 electrostatic unit (esu) of quantity of either sign.

The dose equivalent in rem is equal to the absorbed dose in rad (radiation absorbed dose) multiplied by a quality factor. A Quality Factor (Q) is a numerical factor assigned to describe the average effectiveness of a particular kind (and sometimes energy) of radiation in producing biological effects in the human. The factor used to derive equivalent dose from absorbed dose. X- and gamma rays, electrons, and beta particles have been assigned Q's of 1.

(7 Pages)

The Fallout Story – Chapter 3 - Synopsis

- Chapter 3 – Radiation Protection Criteria for Members of the Public
- Radiation protection criteria began developing in the 1920s & 30s as scientists gained experience with the discovery of radiation; that is the emissions of X & Gamma rays from natural materials and radiation producing machines.
- This chapter is intended to educate the reader about the evolution of radiation protection criteria, specifically for the public. Before WW II, the concern was primarily for practitioners. With the nuclear age concern shifted to members of the public and workers who may be exposed to new radionuclides as internal emitters. After WW II the U.S. Advisory Committee on X-ray and Radium Protection was reorganized and expanded to include six cabinet offices.
- It also discusses the evolution of the various committees (i.e. ICRP & later the NCRP) up to the forming of the Federal Radiation Council (FRC-1960) who issued many reports as guidance. This Council was disbanded by President Carter, who then established the Federal Radiation Policy Council, and the Interagency Radiation Research Committee. These two organizations were abolished by the Reorganization Plan of 1970 and all functions transferred to the EPA.
- According to Senator John Glenn cited that the above situation created anarchy existing with respect to setting of radiation standards. The Reagen white house requested that the Director of OSTP create an organization to deal with the problem. And in 1984 CIRRPC was established to address the need. CIRRPC was to address national and international issues involving ionizing and nonionizing radiation. It was served by a Policy Committee made up of representatives from 18 Federal agencies, a Science Panel and a 6-member Executive Committee. (26 Pages)

The Fallout Story - Chapter 3 – Synopsis Continued

- When weapons testing began at the Nevada Proving Ground (NPG) in 1951 the guidance recommended by the aforementioned groups was all the guidance that was available, (detail in appendix 1). The bottom line was that the guidance largely employed by the test community was 0.3 R/week and/or 3.9 R/13 weeks and 10.0 R per lifetime for the offsite public.
- The FRC published the following in the Federal Register under the President's Signature 18May60.
- The following Radiation Protection Guides be adopted for normal peacetime operations: (Part of the printed table for populations follows)

Type of Exposure	Condition	Dose ¹ (rem)
Individual ²	Year	0.5 (whole-body)
Average ²	30 years	5 (gonads)

² Eight different clarifications follow to explain what is meant by the FRC's Guide. For example: "it is our basic recommendation that the yearly radiation exposure to the whole body of individuals in the general population (exclusive of Natural background and the deliberate exposure of patients by practitioners of the healing arts) should not exceed 0.5 rem."

"The FRC suggests the use of the arbitrary assumption that the majority of individuals do not vary from the average by a factor greater than three. Thus, we recommend the use of 0.17 rem for yearly whole-body exposure of average population groups."

The FRC published in FRC Report No. 3 the estimated Radiation Doses in the US from Fallout. "We conclude that nuclear testing through 1961 has increased by small amounts the normal risks of adverse health effects."

They concluded in their No. 4 report "Although absolute fallout levels in the U.S. in 1963 will probably be substantially increased over 1962 if rainfall is normal, they will still be in relative terms far short of figures which would cause concern or justify counter-measures. Cumulative whole-body radiation doses from all past tests are estimated to be 110 millirems in 30 years, which is about one-thirtieth the exposure from natural sources such as soil, rocks, and building materials."

Studies of stratospheric fallout in the United States from past testing were reported in FRC Report Nos. 4 and 6. On the basis of this information, the Council concluded that the health risk from radioactivity in food over the next several years would be too small to justify protective actions to limit the intake of radionuclides either by diet modifications or by altering the normal distribution and use

The Fallout Story – Chapter 4 - Synopsis

- Chapter 4 – Early Monitoring History

- Monitoring for fallout began at the very first nuclear test “Trinity-1945” at Alamogordo, New Mexico. Monitoring was also done for the pacific tests beginning with Shot Able at Bikini Atoll in 1946 and continued throughout the pacific test period. There was offsite monitoring for Trinity and a fallout pattern was created. The ORERP (see Chapter 9) project reviewed the historical monitoring data and the recreated fallout patterns can be seen in Chapter 11. However, much of the early monitoring was related to radiological safety for test personnel. When testing moved to the continent and the public was near the test area, a more organized approach to monitoring downwind of the operations area became more formal and evolved with time.

- For Operation Ranger, the first test series at the “Nevada Proving Grounds” in the winter of 1951, a program of off-site monitoring was organized as part of the rad-safe program directed by Los Alamos Scientific Laboratory (LASL). Because all the Ranger events were air drops, very minimal ground level contamination was found outside the controlled area. Air borne radioactive material was collected by air sampling equipment at distances 10-100 miles from ground zero for 3 of the 5 events. The first Radioactivity from the Nevada series offsite and away from the controlled area was found in snow in Rochester, New York, in February of 1951, in the northeastern part of the U.S. and was investigated by the New York Operations Office (NYOO) of the AEC. Because of this experience the NYOO began making plans for measurements of fallout at long distances.

- Operation Buster (fall 1951) included a more extensive ground monitoring program and small air sampling program.

- For operation Jangle, an elaborate air-sampling program was planned. Off-site ground monitoring teams measured surface radioactivity levels out to 300 miles.

- UpShot-Knothole, spring 1953 combined the air sampling and ground monitoring programs to improve utilization of personnel. Plans for the Public Health Service (PHS) participation had begun in the fall of 1952. The PHS involvement continued throughout the test era via a MOU executed in 1954.

- A brief review of each test series continues in the chapter.

- The exposure data recorded by the monitoring teams for the various series was reviewed and tabulated by the Test Manager’s Committee to Establish Fallout Doses (TMCEFD) and is presented in **Appendix 4!**

- (9 Pages)

The Fallout Story – Chapter 5 - Synopsis

- Chapter 5 – Nature and Behavior of Fallout

- WHAT IS RADIOACTIVE FALLOUT?

- At detonation, a fireball forms and has extreme temperatures (comparable to the interior temperature of the Sun at 1.0×10^8 °C) vaporizes the nuclear material the plutonium and or uranium that escaped fission, the bomb or device casement materials, water vapor and some of the dirt that has been sucked into the fireball. Depending on the height of the burst and the terrain below, the updraft created can cause varying amounts of additional dirt and debris to be sucked up from the earth's surface into the radioactive cloud. This rising mass of very small particles will eventually reach a height, approaching that of the troposphere, depending upon the yield, and the atmospheric conditions. Then the contaminated particles and droplets gradually descend to the earth. This phenomenon is referred to as fallout!

- The factors mentioned below influences the behavior, the amount of fallout produced and where it will land.

- 1-Yield, 2-Design of the nuclear weapon/device, 3-Height of the Explosion or height of Burst (HOB), 4- Surface beneath the point of burst, 5-Meteorological Conditions.

- Fallout is heavily influenced by all aspects of the weather. Weather events enhance the deposition of the fallout. See Chapter 11 as it explains how event Harry (1953) became so important to the amount of fallout in St. George, UT. See Chapter 12 for the discussion of fallout occurring in the northeast in 1951.

- The chapter portrays the fallout atmospheric transport model from UNSCEAR, depicting how the transfer of various air masses between the stratosphere and the troposphere and the length of time for the fallout to be transferred to the earth's surface. For example, those materials 12-18 miles in altitude take a few years for half of it to be removed or fall to the earth.

- The chapter shows the distribution of the 2975 isotopes created by the fission of Pu or U and their distribution by their mass number. The vast majority of them have very short half-lives and have completely decayed within minutes and hours. Which emphasizes why climatic factors such as wind speed, direction and distance are so important in reducing offsite fallout.

- (5 pages)

The Fallout Story – Chapter 6 - Synopsis

- CHAPTER 6 – Atmospheric Radiological Source Term
- Nuclear tests detonated in the atmosphere has contributed to worldwide fallout since the very first tests and combat use. The debris clouds of the tests that penetrated the stratosphere created a radioactive source term and the radioactive particles that make up the source term take a long time to fall to the earth's surface.
- In 1955 the United Nations established the United Nations Scientific Committee on the Effects of Atomic Radiation (www.UNSCEAR.org). This Committee has compiled a large variety of data and information on the topic of radioactivity in the environment, including fallout, its distribution, dose, and potential harm to the public. They report regularly to the United Nations General Assembly and in the early history reported annually. Much of their reported information can be viewed on the UNSCEAR web site.

Worldwide Nuclear Testing Totals by Country

Country	Tests	Devices fired	Yield Range (Kt)	Total Yield (Kt)
USA	1032	1132	0-15,000	196,514
USSR	727	981	0-50,000	296,837
UK	88	88	0-3,000	9,282
France	217	217	0-2,600	13,567
China	47	48	0-4,000	24,409
India	3	6	0-60	70
Pakistan	2	6	1-32	51
North Korea	6	6	1-250	197.8
Total	2,121	2,476	0-50,000	540,849

Sources: NV-209 rev. 16, 2015, Wikipedia 2020; Worldwide Nuclear Explosions, Yang et.al, 2000

- Figures in Chapter 6 also indicate where in the world nuclear tests have taken place. Also contains a table indicating the number of US nuclear tests by type, e.g., air drops, tower tests, underground etc. (7 Pages)

The Fallout Story – Chapter 7 - Synopsis

- Chapter 7 – Types of tests (e.g., airdrop, tower, balloon, underground, rocket, etc.)

•The early series, Ranger (1/27/51-2/6/51), and Buster/Jangle (10/22/51-11/29/51) were mostly airdrops from aircraft. Of the 12 events in the two series 9 were air drops (air drops had Height of Burst (HOB) over 1000 feet and higher). Buster had 1 small yield (0.1kt) 100 ft. tower shot. Jangle had 1 surface event (HOB 4 ft.), 1.2 kt, and 1 crater event at (HOB - 17 ft.), 1.2 kt.

•The radioactivity on the ground immediately under the fireball results from neutron activation of the soil. The instrument readings are from neutron activation of sodium, manganese, and aluminum. Note that the radioactivity readings are a series of concentric circles. This is because of the geometry of the neutron flux that is directed downward towards the ground from the explosion

•“For Nevada soil, the sodium and manganese composition generally vary by a factor of 1.4 to 2 and the aluminum composition varies by a factor of 3 to 7 within and between test areas. A general neutron-induced decay curve for Nevada soil was used to extrapolate the observed dose rates back to H+1 hour. Sodium 24 decay is used for a few patterns” (DNA -1251 May 1979). The half-life for ^{24}Na is 14.96 minutes. Which means the induced radioactivity in the soil under an air drop burst, e.g., >1000 ft. would be down to background in hours!

•The Buster/Jangle/Dog event – 1/11/51, 21 kt, airburst, HOB 1,417 ft. – This event is about the same yield and HOB as the Hiroshima bomb. One observes the dust cloud, and the residual radioactivity a result of neutron activation of the soil.

•This is somewhat counter to the recent discussions about black rain from Hiroshima. Recent publications discuss that perhaps radioactive soot became entrained in the cloud and when raining out downwind of Hiroshima, caused significant radiation exposures. BJ Dog data seems to be counter intuitive of this assumption.

•Table 7-1 includes test parameters for selected Atmospheric Tests. Such as type, Yield, HOB, Cloud top and Height of the Tropopause.

•(9 Pages)

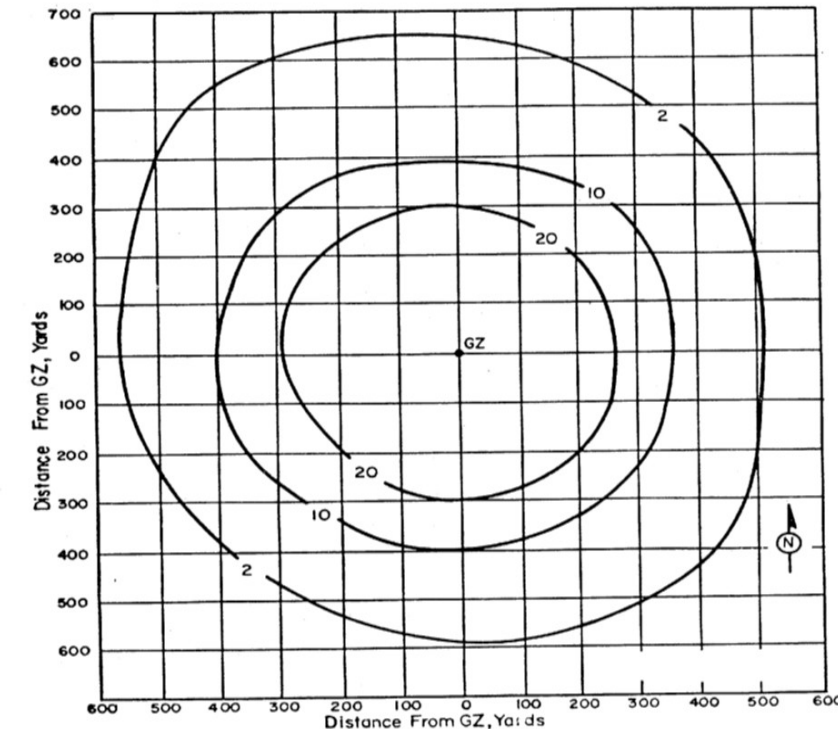


Figure 26. Operation BUSTER-JANGLE - Dog. On-site dose rate contours in r/hr at H+1 hour.

The Fallout Story – Chapter 8 - Synopsis

• Chapter 8 – Understanding the Importance and Role of Meteorology

• Understanding the meteorology approaching detonation day (D-day) was extremely important. Understanding the weather, particularly the wind patterns was paramount. To ensure that fallout missed population centers the wind direction was critical, not only the direction, but wind speed as well. Weather balloons equipped with radiosondes were sent aloft, in the forecasted downwind area, at time intervals to measure altitude, pressure, temperature, relative humidity, wind speed and direction.

• The unexpected exposure at St. George, UT, is an example of a forecast going wrong. (The wind speed aloft ~10K ft. and the wind shear over the Grand Canyon was missed.) Many events were postponed until the weather became more suitable.

• Once the mushroom cloud raises above the troposphere and enters the stratosphere the radioactive particles are now influenced by the dynamics of the stratosphere, the particles are transported farther and settle out more slowly.

• The model in figure 8-1 depicts the transfer of various air masses between the stratosphere and the troposphere and the length of time for material e.g., fallout to transfer from the stratosphere via the troposphere to the earth's surface. For example, for those materials 20-30 km (~12-18 miles) in altitude it takes a few years for half of it to be removed or fall to the earth.

• (3 Pages)

FALLOUT ATMOSPHERIC TRANSPORT MODEL

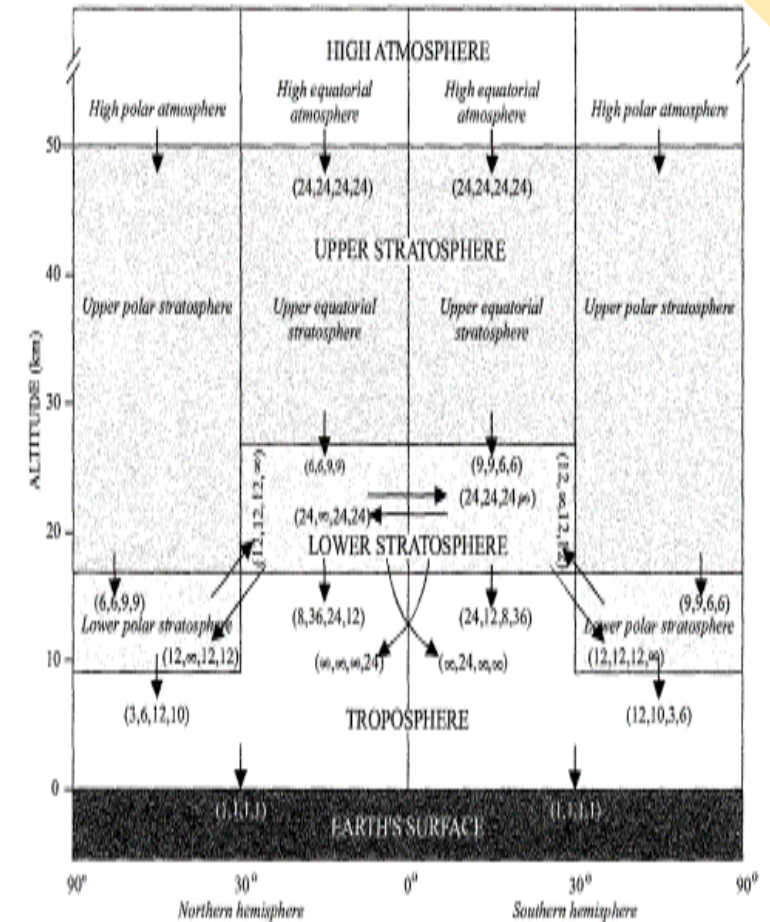


Figure III. Schematic diagram of transfers between atmospheric regions and the earth's surface considered in the empirical atmospheric model [B1].

The numbers in parentheses are the removal half-times (in months) for the yearly quarters in the following order:

The Fallout Story – Chapter 9 - Synopsis

- Chapter 9 –
 - Public concern began to surface in 1953 following the Upshot-Knothole test series. Numerous sheep died during the spring of 1953 following the winter feeding in Nevada northeast of the NTS. Congressional Hearings were held to evaluate the impact on the public.
 - It was not appreciated until the late 1950s that ingestion of the iodine family of isotopes consumed through the environmental pathway could deliver an organ dose substantially larger than the measured external exposure.
 - The number of claims for radiation damages began mounting in the 1977-78-time frame, and with expected lawsuits to follow, it was decided to establish a project to review all the historical radiological measurement records and establish to the best technical ability what the internal organ doses might have been. To this end the ORERP was established and was underway by June 1979. The objectives of the project were to examine from first principals what the external exposure were, find and examine all the historical data, develop appropriate calculational methods to estimate the internal doses and build a collection of the historical documents and data and make them accessible to investigators and members of the public.
 - The Project was divided into various components that were assigned to specific task groups. The dose reconstruction work was divided into two phases. Phase I, was performed at locations within approximately 300 km of the NTS, where ground-monitoring personnel made gamma exposure-rate measurements following the nuclear tests. On April 2, 1959, a special committee was formed to review all the monitoring data accumulated from 1951-1958 (the completion of the Hardtack test series). The Committee's data is compiled in Appendix 4.
 - The fallout pattern reanalysis task used this data base along with meteorological data to reanalyze 12 fallout patterns of particular significance. These 12 patterns were found to be in general agreement with their historical counterparts. This general agreement provided confidence that historical patterns can be used to provide the normalized gamma exposure rates required for dose estimates. Following this work the Town Data Base with 1,950 records involving 74 events at 352 locations was constructed. The Town Data Base provides the fundamental input data on fallout levels used in Phase I dose reconstruction.
 - The science developed by EML scientists and described in detail in EML 400 (Krey1981) and Science (Beck1983), for estimating the net fallout from the NTS was a major breakthrough for independent radiation dose verification.

The Fallout Story – Chapter 9 Continued, slide 2

- This technique of measuring global deposited Cs-137 provided the means to determine the net residual Cs-137 and Pu-239,240 from NTS in soil samples taken in the downwind region. ORERP, along with other data, used the technique to estimate the fallout deposition from the NTS at locations beyond the range where gamma exposure-rate measurements were made by monitoring personnel . This data became known as Phase II of the project.
- The next task was to develop atmospheric transport calculations of fallout deposition for 10 NTS events that contributed significant fallout to Phase II locations. Gum-film, soil data, transport calculations, survey-meter measurements, and other data were used to develop estimates of event-specific fallout for 53 events in 129 counties. These estimates were compiled into a County Data Base for Phase II similar in format to the Town Data Base for Phase I. The County Data Base then contains the H+12 hr. exposure rates and time of fallout arrival information for Phase II that were used by the models for dose assessment.
- Another task group used these models to calculate doses received from gamma exposures resulting from external sources and the exposure due to the passage of a fallout cloud on direct deposition on skin, whole-body gamma doses and beta doses to the skin. These calculations were for 9 age/occupation categories for both the Town and County Data Bases. Results of survey questions were used to develop lifestyle and shielding parameters used in the calculations. Organ doses for 22 organs and tissues were scaled to the whole-body dose.
- A model to simulate the transport of radio nuclides deposited on plants and soil to humans was created by another task group. A survey of lifestyles, food habits and agricultural practices provided information to help develop parameters specific to the region and time of interest. Also, an extensive study of dairy practices in the milk distribution systems of the 1950s in regions that supplied milk to Nevada and Utah was performed. The output of this model was used directly as input to the internal dose model.
- The external dose, environmental pathway, and internal dose models were integrated into an individual dose-assessment model to facilitate the calculation of individual doses based on life-style information provided about the individual.
- The soil sampling work discussed here and in Appendix 7&8 was designed to be a separate and independent investigation of the fallout deposition that occurred during the above ground nuclear weapons testing at the NTS. The soils data is published in a DRI, report titled “Off-Site Radiation Exposure Review Project Phase II Soils Program (McArthur 1988). This data fed into the effort to estimate the population doses of communities in the downwind region.
- For this work to be credible the data had to meet stringent criteria:
 - The sampling site (3 sites were preferred in each community) had to be undisturbed since 1950. No plowing or grading, no addition or removal of soil.
 - No animal burrowing should have occurred.
 - Ground cover, e.g., lawns/grass to limit water and wind erosion.
 - Situated such that nearby erosion would not have added sediments to the location. Flood irrigation would add extra fallout containing sediments to the location invalidating the pristine nature of the location.
 - Preferred sites were flat, open, grassy areas 40 feet square that were not close to buildings, roads, or natural obstructions that could affect fallout deposition.

The Fallout Story – Chapter 9 Continued, slide 3

- The ORERP project created two important data bases, the Town Data Base & the County Data Base.
- The ORERP project was audited by the Dose Assessment Advisory Group (DAAG) a Federal Advisory Committee. The Federal Advisory Committee Act mandated routine open public meetings. Reports with public briefings were routinely held. The members of the DAAG are listed in Appendix 7.
- A further independent evaluation of the radiation dose to residents of Utah was performed by Dr. Ray Lloyd at the University of Utah. Dr. Lloyd and others at the U of U were engaged in performing radiation dose assessment related to their study of radiation as potential casual factor in leukemia in residents of Utah. Dr. Lloyd states:
 - “During the period from January 1985-May 1988, I worked on the Utah Fallout Project as dosimetry coordinator. *I considered my most important tasks on that project to be the refutation of the official AEC/DOE fallout exposure estimates and the establishment of correct and more defensible radiation doses to each individual subject.*”
 - “After almost 3 years of intensive study, we concluded to our astonishment – that the official AEC/DOE exposure estimates were not seriously in error and that the total external exposure at St. George was only of the order of about 4 R.” (Lloyd, 1997; Lloyd et al., 1990). Dr. Lloyd continues, “but the one that most nearly addresses the central claim in Scharnberg’s 1997 article has to do with estimation of expected number of leukemias in the absence of NTS fallout and comparison with the total number that actually occurred. Comparison of the observed number of deaths with non-CLL leukemia (CLL was excluded as it is known as not being caused by radiation) and the expected numbers without NTS fallout exposure suggests that the effect of NTS fallout was small if not entirely absent; that is, the possibility of zero induced cases is not excluded. When I initiated this analysis, I expected that I would be able to identify an unmistakable excess of leukemia in the population. My anticipation was that I could use this value with the collective dose for the county to estimate a leukemia risk coefficient for low-dose radiation exposures, but I was surprised that a clear excess did not emerge from the data.” Dr. Lloyd’s complete statement and reference is included in Chapter 17.
- Table 9-2 in the book, is an important comparison of the various data sets (TMCEFD, Beck and Krey, & the External dose assessment model) used to assess the external dose model. The comparison demonstrates the general good agreement among these various methods of exposure and dose estimation.
- It is very important to keep in mind that when ^{137}Cs is measured in a soil sample that it is for the total ^{137}Cs that has been deposited on the soil from all global sources (e.g., Soviet Union & the U.S. plus others).
- The technique to tease out from the total ^{137}Cs the NTS contribution requires the ability to use the Pu isotope ratios, which were available to the ORERP researchers by specific event.
- (14 Pages)

The Fallout Story – Chapter 10-Synopsis

- Chapter 10 – NATO/SCOPE-RADTEST (The Russian Fallout Story)
- The January 10-14, 1994, RADTEST Advanced Research Workshop on Atmospheric Nuclear Tests, held at the IAEA in Vienna, Austria, was a historic event in the study of these releases. The Workshop was very historic, in that it brought together scientists experienced with measuring deposition and radiation dose from fallout, from the United States, United Kingdom (UK/England), Russia (or FSU – Formerly the Soviet Union), China, and France. “The papers were organized into three categories: Source term studies, Dose reconstruction and ecological and health effects.” It was made possible by the ending of the cold war and made for the sharing of previously restricted work involving data, models, and information about the fate of the release of radionuclides in the environment and their possible effects on human health.
- I was somewhat familiar with the data presented by the UK representatives about the UK tests in Australia, as I served on two committees for the Australian government related too their cleanup of the UK nuclear test sites at Maralinga, AU.
- *However, this was the first time I had the opportunity to hear firsthand from Russian and Chinese scientists about their respective programs of monitoring and measuring deposition from their tests and their investigation of fallout from the US tests. I was fascinated with the presentation of the data collected by the Russian fishing trawlers that prowled our east and west coasts gathering fallout/deposition data. I had heard commentary about the trawlers being present, but only now at the symposium did I learn of the sophistication of the sampling equipment and what they were able to learn about the US testing program and other country's programs, e.g., China's.*
- *Of particular interest to me was the comments made by Russian scientists concerning two US tests. Schooner and Baneberry. Following is what Dr. Izrael wrote about his observations concerning the fallout of the two events, Schooner: “The detonation led to the release of a considerable fraction of the radioactivity into the atmosphere, which spread over the USA territory and beyond. In the week after the detonation, the radioactive products reached the Soviet territory and were detected by the Soviet Radiation Monitoring System. Baneberry: “According to FSU synoptical data, the products from this detonation were transported, for the first period, to the northeast then along the Canadian border. On 24th December, an obvious increase in the atmospheric concentrations of some radionuclides, and the appearance of short-lived radionuclides, was detected by a Soviet research vessel. The transport of radioactive products from the Baneberry explosion into the atmosphere of the North Atlantic continued until 31st December 1970.”*
- Novaya Zemlya aka Northern Test Site (NTS). “The first nuclear test at NTS was conducted underwater on September 21, 1955. As of January 1, 1992, 132 nuclear tests had been carried out at NTS; the total energy yield of those explosions was equivalent to 272 Mt of TNT [Mikhailov et al., 1992].” 87 of the total number of tests at NTS were conducted in the atmosphere (including 3 water-surface explosions), with an energy yield of about 250 Mt TNT. A major part of the radionuclides from the atmospheric tests were “injected” into the stratosphere, where they mixed and distributed globally, resulting in long-term fallout and deposition of different quantities of radionuclides on the earth's surface (global fallout). Long-lived fission products—¹³⁷Cs, ⁹⁰Sr, and ¹⁴C---were the principal dose-contributing nuclides.” ...The contribution of the atmospheric tests, which were discontinued by 1963, equaled approximately 1.8×10^{17} Bq (4.9×10^6 Ci) in terms of ¹³⁷Cs and about 1.2×10^{17} Bq (3.2 Ci) ⁹⁰Sr, i.e., around 20% of the total amount of radionuclides released to the environment from nuclear explosions. Making allowance for NTS contribution to the total energy yield of the USSR atmospheric nuclear explosions, the quantity of ¹³⁷Cs from those tests constituted 0.166×10^{18} Bq (4.5×10^6 Ci), and that of ⁹⁰Sr 0.11×10^{18} Bq (2.9×10^6 Ci). According to some estimates, about 42% of the total fission-energy releases of all atmospheric tests occurred between 1952 and 1958, and 47% in 1961-62. The NTS contribution to this distribution accounts for approximately 27% and is completely attributed to air tests [Mikhailov, 1992].”
- (Chapter 10 has 18 pages)

The Fallout Story – Chapter 10 Synopsis, Continued (Slide 2)

- “Dietary intake is one of the pathways of radionuclide intake into the human organism; in the Far North they pass through the “lichen-reindeer-man” and “water-fish-man” food chains.”
- ¹³⁷Cs peaked in the 1970-1978 years. Moss ranged from 300-550 Bq/kg; Lichens ranged from 750-1500 Bq/kg; Reindeer meat ranged from 80-370 Bq/kg; Fish from 3.0-3.7 Bq/kg; Milk 0.56 Bq/kg and Geese & Ducks ranged from 15-22 Bq/kg. An additional induced dose, above that received from natural background and medical exposure to the urban population, averages 1 mSv/y.”
- “The first underground nuclear test (UNT) was conducted at NTS on September 18, 1964. All UNT’s at NTS can be classified as follows:
 - 15 explosions (36%) with radioactive products (debris, gases) practically completely contained in the rock mass.
 - 25 explosions (60%) were accompanied by a seepage of radioactive inert gases into the atmosphere which, however, did not result in residual contamination.
 - 2 explosions (4%) were accompanied by venting of radioactive gaseous and vaporous products into the atmosphere and were characterized by the direct participants as nonstandard radiological situations.”
- “The total yield of (energy release) of underground nuclear tests at NTS did not exceed 25 Mt (TNT). None of the UNT’s at NTS had resulted in radioactive fallout beyond the boundaries of the test site. [Mikhailov et al., 1992]”
- “As mentioned above, 42 UNT’s have been conducted at NTS since 1964. They were accompanied by the escape of insignificant quantities of radioactive inert gases (0.5×10^{18} Bq total), which were confined within the NTS territory for 2-5 days.....However, this did not make a considerable contribution to the radioactive contamination of the archipelago, as compared with the existing background radiation level [Matushchenko et al., 1990; Mikhailov et al., 1992],”
- Semipalatinsk Test Site (STS)
 - “The first surface detonation of a nuclear warhead in the USSR on August 29, 1949 marked the beginning of nuclear-weapons testing at this test site. A series of further nuclear tests followed, including the H-bomb atmospheric explosion on December 5, 1953. The STS operations are characterized by two periods: during the first, from 1949 to 1962, nuclear tests were primarily conducted in the atmosphere; during the second period from 1963-1989, after the conclusion of the Moscow Treaty of 1963, only underground nuclear tests were conducted [Dubasov et al., 1993].”

The Fallout Story – Chapter 10 Synopsis, Continued (Slide 3)

- Semipalatinsk Test Site (STS) – Continued: “Atmospheric Tests: 124 explosions (8 high-altitude, 91 air, and 25 surface events) were fired between 1949 and 1962. The total yield of those explosions was 6.4 Mt TNT or about 40% of the general energy release of all atmospheric nuclear tests conducted in the former USSR. It is worth noting that the STS was a main base of surface nuclear testing (out of 26 tests conducted in the former Soviet Union, 25 events took place at the STS firing grounds). Those explosions led to radioactive contamination of the territory surrounding the test site and exposure of the proximate population (in the Beskaragaisk, Zhana-Semeysk and Abai districts of the Semipalatinsk Region).
- “Maximum radiation doses were recorded for the Altai Territory population [Logachev et al., 1993] after the first nuclear test in 1949 (as much as 60 cSv {*c=0.01 or 1/100 so 60 cSv=0.6Sv or 60,000 mrem – compared to St. George, Utah, at ~ 4,000 mrem*})
- STS Underground Nuclear Explosions: “343 underground nuclear tests (e.g., holes and/or mine openings) were conducted at STS during the second period (1963-1989) [Gorin et al., 1993]. (In addition, 5 PNE’s were fired at STS, including 4 cratering explosions with soil ejection.”
A Comparison of radioactive releases from Atmospheric Nuclear Detonations and Nuclear Reactor Accidents (Table 2, pg. 7, Shapiro 1998)

^a Decay corrected to three days after shutdown or detonation. ^b ¹³⁴Cs is produced in reactors by neutron activation. P or peta is the prefix for 10¹⁵.

Nuclide	Radioactivity Released (PBq) ^a				
	Hiroshima	Weapons Tests	Chernobyl	Kyshtym ^c	Windscale ^d
¹³⁷ Cs	0.1	1,500	89	0.01	0.044
¹³⁴ Cs ^b	-	-	48	-	0.0011
⁹⁰ Sr	0.085	1,300	7.4	1.0	0.00022
¹³³ Xe	140	2,000,000	4,400	-	14
¹³¹ I	52	780,000	1,300	-	0.59

The Fallout Story-Chapter 10 Synopsis Continued (Slide 4)

•**People's Republic of CHINA (PRC) – Test Site at Lop Nor.** Following are summary extract statements by the Chinese Scientists (*Zhi, C, Liu, U., Zhu, G. and Gu, Z.*) at the workshop: "China started atmospheric nuclear tests in 1964, and a total of 22 tests were conducted. Though the number of tests and the fission yields are relatively small, the effect of slight radioactive contamination is also reflected in our research work." "Since the end of the 1950's a survey of radioactive contamination in the environment has been conducted in China. A system of investigation and monitoring network for environmental radioactivity was organized by the Ministry of Public Health in the early 1960's and operated by the sanitary-epidemiological stations and medical institutes in every province, autonomous regions and municipalities throughout China, forming a nationwide environmental radioactivity monitoring network of 45 institutions. The Laboratory of Industrial hygiene, Ministry of Public Health acts as the technical guidance Center." "This paper is the first summary report of the monitoring data collected by this network from 1960 to 1987."

"The deposition of long-lived radionuclides represents the contamination on the earth's surface by intermediate and long-term fallout. The peak value of deposition appeared in 1963. The total amount of ^{90}Sr deposited in the Chinese territory makes up 3.8% of the Northern Hemisphere (Table 1, pg. 273, Shapiro, 1998)."

"The trend in ^{137}Cs deposition is the same as that of ^{90}Sr deposition."

"The average daily intake of ^{90}Sr for the Chinese population from 1961 to 1987 was estimated on the basis of Chinese diet components. The data from ^{90}Sr intake in China have been consistently higher than those in New York (about three-fold) and in USSR (about two-fold) because of different diet components. Maximum levels of ^{90}Sr in the diet were recorded in 1963 following the period of most active nuclear tests between September 1961 and late 1962."

The dose commitment from ^{90}Sr fallout is shown in Table 2 (pg. 274, Shapiro, 1998). The average values are about 1500 μGy for red bone marrow and about 3200 μGy for bone lining cells.

Table 1. Comparison of ^{90}Sr total deposition in China and in the World

	Deposition PBq	Area: 1×10^{-4} km
Northern Hemisphere	460	25,500
China	12.3 – 17.1	960
China/Northern Hemisphere	2.1 – 3.0	3.8

The Fallout Story-Chapter 10 Synopsis Continued (Slide 5)

•**Following summarizes what the Russian presentation had to say about the Chinese Tests:** “The PRC started its nuclear testing program in 1964 and conducted mainly atmospheric explosions, whose individual energy yields reached 3 Mt TNT. From the mid 1960’s, those tests made a major contribution to the contamination of the atmosphere in the Northern hemisphere.”

•“Each Chinese detonation (excluding very deep underground ones) was detected both by the radiation monitoring system in the USSR territory and by research vessels in the World Ocean of the Northern hemisphere. As a rule, fallouts of radioactive products from Chinese nuclear tests over the Soviet territory took place after the first circulation around the globe.”

•**United Kingdom (UK)** – Australia (Montebello Islands, Maralinga, & Emu) & South Pacific (Malden & Christmas Islands). The presentation by the UK representatives focused on the military participants and the long-term effects of those participants. The various test locations are a result of my personal knowledge.

United Kingdom's nuclear testing series summary				
Years	Tests	Yield range (kilotons)	Total yield (kilotons)	Notes
1952	1	25	25	First British nuclear test. Montebello Islands, Western Australia
1953	2	8 to 10	18	Emu Field, South Australia
1956	2	15 to 60	75	Montebello Islands
1956	4	2 to 15	30	Maralinga, South Australia
1957	3	1 to 27	34	Maralinga, South Australia
1957-1958	9	24 to 3,000	7,869	thermonuclear tests, Malden & Christmas Islands.
1961-1991	24	0 to 140	1,232	Nevada Test Site, USA (underground)
1952-1991	45	0 to 3,000	9,282	Total country yield is 1.7% of all nuclear testing.

The Fallout Story – Chapter 10 Synopsis Continued (Slide 6)

•**FRANCE** – The material furnished at the workshop about France was submitted by Russian representatives. – Following is the information presented by Yu A. Izrael of the Former Soviet Union.

•Between 1966 and 1974, France undertook 44 nuclear detonations at the Tuamotu site in the southern hemisphere. The detonation heights were generally some 100 m which explains the relatively low levels of contamination of the boundary layer of the troposphere, and the release of the main part of the radioactivity into the upper layers of the troposphere and the stratosphere.” Further from the site, Soviet research vessels detected, from time to time, the appearance of fresh products from French nuclear tests. Typically, concentrations varied from mBq/m³ to some tens of mBq/m³. Fresh radionuclides from French detonations were often used as synoptical, or meteorological, tracers by Soviet researchers (Izrael et al., 1994).

The French chose French Algeria as the optimum site after consideration of several other locations. In July 1957 the Reggane site was chosen and the first French Nuclear test, Gerboise Bleue, occurred on February 13, 1960, in the Tanezrouft desert of Algeria. It was 60-70 Kt and was a Plutonium device. From 13 February 1960 to 16 February 1966 there was 17 tests.

The French tested in French Polynesia from 2 July 1966 to 31 January 1996. These tests are listed as follows:

Total number of French nuclear Test: 1960 - 1996		
Location	No. of Tests	Dates
Algeria	17	1960-1966
French Polynesia		
Mururoa	179	1966-1996
Fangataufa	14	1966-1996
Total	210	
Atmospheric		
Algeria	4	3 tower, 1 surface
Mururoa	42	5 tower, 31 balloon 3 aircraft, 3 barge
Fangataufa	4	3 balloon, 1 barge
Subtotal	50	Feb. 1960 – Sep. 1974
Underground		
Algeria	13	tunnel
Mururoa	137	83 rim and 54 lagoon
Fangataufa	10	3 rim and 7 lagoon
Subtotal	160	Nov. 1961-Jan 1996
Total	210	
Safety Tests	12	Mururoa: 1966-1989 (atmospheric, 7 UG)

The Fallout Story – Chapter 11 Synopsis

- Chapter 11 – Tracking Fallout Deposition
- The Eastman Kodak Story - Fallout information was routinely collected by the Physics Department Research Laboratory of the Eastman Kodak Company, Rochester, NY. “Evidence of radioactive fallout was found by Eastman Kodak Company physicists in snow which had fallen at Rochester, N.Y., January 29th.” The NYOO was notified of the Kodak finding on Feb.2, 1951, by the Division of Military Applications (DMA) of the AEC who requested that the NYOO conduct an independent investigation.” The NYOO report states: “Because of its short half-life the radioactivity cannot be considered to constitute a health hazard but may be significantly deleterious to portions of the photographic industry.” This proved to be the case.
- A series of meetings (AEC & NAPM) occurred deciding that the photographic manufacturers and their suppliers of raw products would do their own monitoring but would be advised the HASL. By the spring of 1951, a network of 10 stations were set up (Ranger occurred during January 1951, Buster/Jangle occurred in the fall of 1951). The early network was expanded to 61 stations with 20 of these gummed paper, the rest were water filled trays. During the fall 1952 Pacific tests the network was expanded throughout the continental U.S., North American and overseas. A summary of this deposition data appears in Appendix 12.
- As previously mentioned, the AEC signed a memorandum of understanding with the U.S. PHS to assume the responsibility for monitoring and sampling the near offsite area in 1954. The U.S.PHS began their national sampling network in 1956 this effort continues to the present day. The 1956 Network became known as the Radiation Alert Network (RAN). This network of 68 stations became incorporated into the Environmental Radiation Ambient Monitoring Systems (ERAMS). In 2005 ERAMS became RadNet. RadNet currently has 140 radiation air monitors in 50 states and runs 24 hours a day, 7 days a week collecting near-real-time measurements of gamma radiation.
- The field monitoring performed at the NTS and vicinity (nominally 200-300 miles) used various ionization chamber type instruments such as the T1B & JUNO, Geiger Mueller type instruments, scintillation detectors and vacuum cleaner type of air samplers (pulls air through a filter). The data collected by the field monitors and tracking aircraft (with similar instruments) was used to plot the fallout patterns discussed in chapter 12. Suggest watching the following video on YouTube: YouTube.com video: “Atomic Tests in Nevada: The Story of AEC’s Continental Proving Ground (1955). Shows more of the tracking fallout story!
- (18 Pages)

The Fallout Story – Chapter 12 Synopsis

- Chapter 12 – Fallout Patterns

- The fallout patterns that deposited significant radioactive debris in Eastern Nevada, Southern Utah and Northern Arizona were reanalyzed as part of the Fallout Verification Task Group of the ORERP Project. This required the examining and analyzing the survey meter data which consisted of external gross-gamma exposure rate readings at 3 feet above the ground taken at numerous locations within the fallout field. These readings were normalized to H+12 hours, plotted on a map, and isopleths drawn connecting points of equal H+12-hour exposure rates. The data sources came from final reports of the off-site radiological-safety organizations, their data packages, consisting of copies of the original mobile monitor survey logs, radio message logs, monitors' journals, post-event survey instrument calibration sheets, air sampling logs, and radiation recorder logs.

- A comparison of the 1980(s) and 1956 patterns were made and presented in each of the reanalysis reports. (Quinn 1981). The WSNSO reexamined and wrote reports for 13 different atmospheric events and 2 cratering tests as part of ORERP

- As explained in chapter 11, fallout data was obtained both in the near and far field of the NTS. The following figures illustrates the type of patterns generated from the monitoring data analysis.

Sedan Fallout Trajectories July 6, 1962

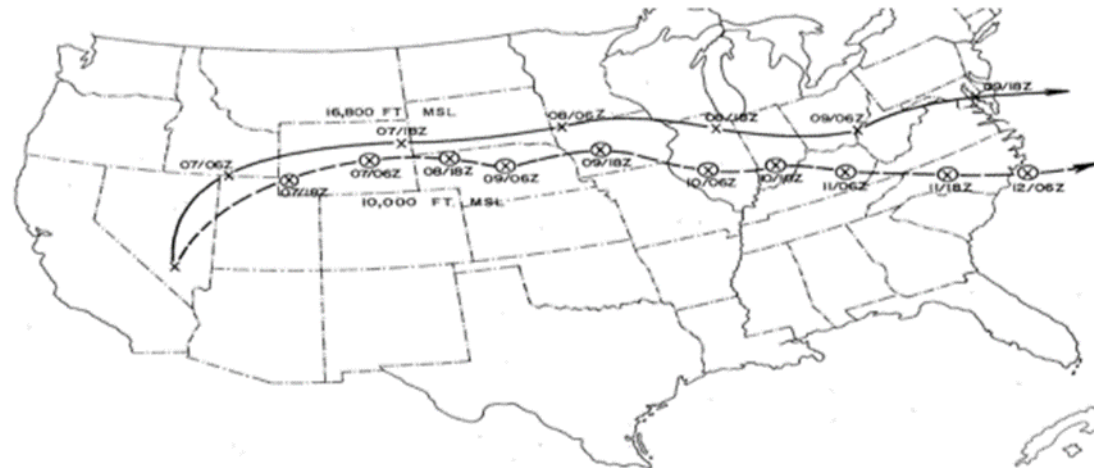


FIGURE 2.6 METEOROLOGICAL TRAJECTORIES – SEDAN – DETONATED JULY 6, 1962 AT 1700Z, DAY / TIME (GCT)

The Fallout Story – Chapter 12 Synopsis – Continued to Illustrate fallout patterns for Smoky and Trinity

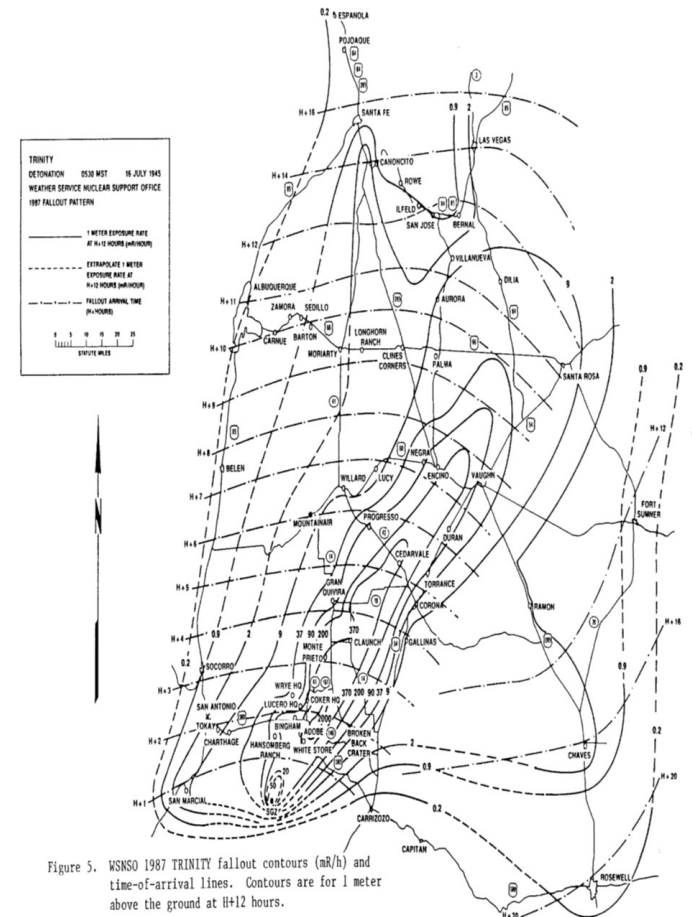
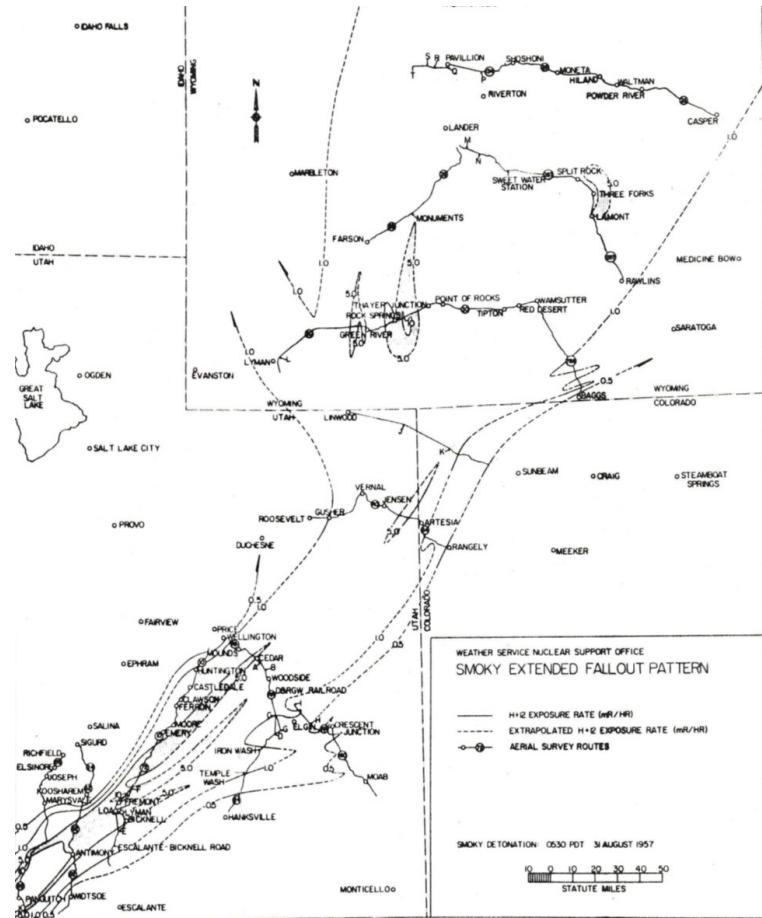


Figure 5. WNSO 1987 TRINITY fallout contours (mR/h) and time-of-arrival lines. Contours are for 1 meter above the ground at H+12 hours.

The Fallout Story – Chapter 13 Synopsis

- Chapter 13 – Radiation Health Effects

- In radiation biology we are interested in the amount of insult or dose to the cell that can cause survivable mutations. At high dose rates radiation can kill not only cells, but whole organisms. Data from various sources tells us how high the dose rate needs to be for this cell/organism death to happen. . Radiation can be fatal by destroying the ability for the cell to undergo mitoses (cell death), and if too many cells are killed in this way the whole organism may be at risk from “Acute Radiation Syndrome.” This process cannot cause cancer and takes place on the time scale of the cell cycle, generally a few weeks. “There is some difference between a dose given to the whole body and one applied only locally, but most organs fail due to the local dose when their own cells die independently of the fate of other organs.” This type of cell death is commonly referred to as a deterministic process.

- “Most cells with damaged DNA, mutations or chromosome aberrations are either repaired correctly by enzymes within hours or are repaired with errors such that they are not viable and fail to be reproduced in the cell cycle and die. However, a few of those that suffer DNA double strand breaks are incorrectly repaired and yet survive. These mutations may persist in abnormal chromosomes whose behavior is kept in check by the immune system. Failure of the immune system and other protective systems in the body may result in runaway cell growth that hijacks the resources of the organism; this is the malignancy that we know as cancer.....With advancing age the immune system becomes less vigilant, and errors may escape detection. The process is similar whether the error was initiated by radiation or another source of chemical oxidation. The probability that cancer develops is small and therefore apparently rather random, so it is sometimes called a stochastic process. The evidence shows that carcinogenic development is related more to the failure of the immune system and other protective systems in the body than to the presence of an increased number of damaged DNA, mutations, or chromosomes. The period in which the development of malignancy is kept in check by the immune system is called the latency.”

- “As the dose diminishes the probability that cancer will develop also diminishes and as will be discussed later in reviewing the dose response of the Japanese survivors it appears to fade out at about the 10-15 rad level. As a result of the diminished cancer effect with dose the science of epidemiology is employed to try and determine cause and effect at low doses. And this science is used to study many cause and effect of a host of environmental insults.”

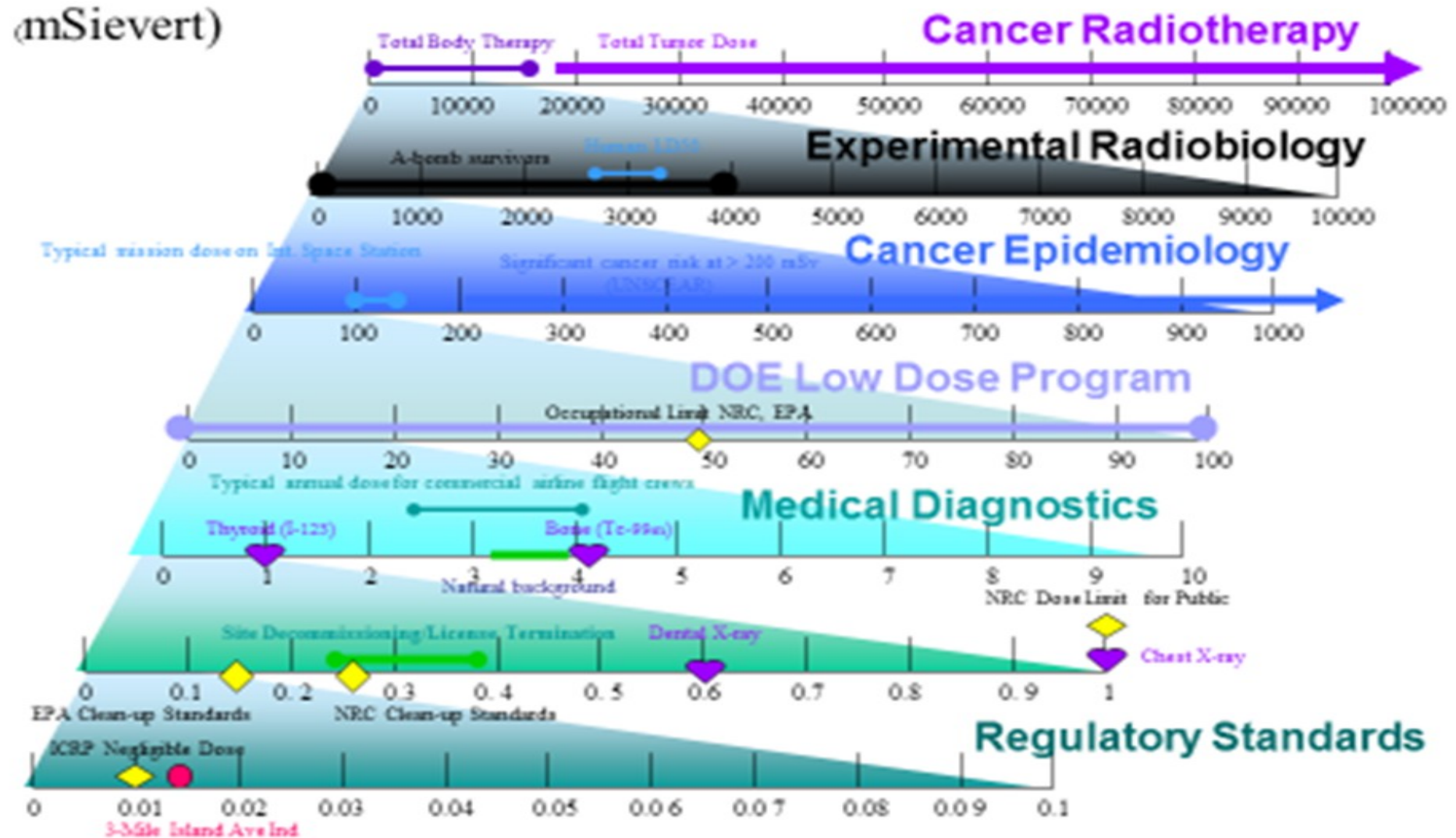
- “To further understand the difficulty of teasing out what dose may cause a measurable increase in radiation caused cancer it is important to understand the amount of radiation that exists naturally in our environment and how much of a radiation dose humans are routinely exposed to.”

- **Appendix 6** on Natural Radiation reviews the different kinds of radiation we are exposed to, and the dose ranges the public is subject too

The Fallout Story – Chapter 13 Synopsis (Slide 2)

- Chapter 13-Radiation Health Effects Continued. THE DOE LOW DOSE RESEARCH PROGRAM
- Two research areas that seem to me to be very consequential to be understood, they are: “Bystander Effects” and “Adaptive Responses.”
- Bystander Effects (Major Points):
 - Cells that have energy deposited in them communicate with neighboring cells, which do not have energy deposition. This result in response may potentially be protective or detrimental. Bystander effects exist both *in vitro* and *in vivo*.
 - There are two different types of bystander effects; those that require direct cell-cell and cell/matrix contact and those that result from release of substances into the media or blood.
 - The bystander effect results in changes in several different biological endpoints and depends on the physiological and oxidative status of the cells and tissues.
 - The dose-response relationships for the induction of bystander effects are non-linear, with a low-dose resulting in the maximum response followed by a plateau as the dose increases.
 - The type of damage in bystander cells differs from the type of damage induced in cells with energy deposited in them.
 - Because of bystander effects, tissues respond as a whole to ionizing radiation and not as single cells. These tissue responses are non-linear.
 - There is evidence that bystander cells may either increase or decrease the radiation-related cancer risk.
- Adaptive Responses (Major Points):
 - “There is a long and well-documented history of hormesis research that demonstrates many chemical and physical agents that produce damage at high doses but elicit protective responses at low doses. Much research supports protective adaptive responses for low doses of radiation.”
 - “There are two major types of adaptive responses: (1) when a small tickle dose of radiation is given prior to or shortly after a large radiation dose the response is less than if the large dose is given alone, and (2) low doses of ionizing radiation produce a reduction in the background frequency of many biological responses.”
 - The cellular and molecular responses following exposure to low doses of radiation are different from those induced by high doses, suggesting different mechanisms of action for high and low doses.
 - The radiation-induced adaptive response is a very general biological phenomenon and has been carefully documented for many important biological endpoints including the induction of DNA damage, mutations, micronuclei, chromosome aberrations, cell killing, apoptosis, genomic instability, and cell transformation.
 - The adaptive response has been demonstrated both *in vitro* and *in vivo*.
 - Adaptive response suggests that there is a need for a change in the current paradigms associated with the LNT biophysical models used to estimate risk.
 - The extensive data generated from research on the adaptive response suggests that following exposure to low doses of ionizing radiation, the LNT assumption is conservative.

Dose Ranges



The Fallout Story – Chapter 13 Synopsis (Slide 4)

• **A Critical Assessment of the Linear No-Threshold Hypothesis Its Validity and Applicability for Use in Risk Assessment and Radiation Protection.** The Society of Nuclear Medicine and Molecular Imaging organized a task group to review the validity of the LNT. The Task Group concluded “that the LNT model is not a practical basis for formulating radiation protection standards, and it does not provide reliable risk factors in the low-dose, dose rate region; it is empirically false. No credible evidence shows that low-dose radiation exposure represents a significant toxin. Radiation at relatively high doses is a weak carcinogen, but this is not true at low doses. Credible evidence of low-dose (<100 mGy (10 rad)) carcinogenic risk is nonexistent; it is a hypothetical prediction derived from the LNT hypothesis.”

- **NCRP** – Published in 2015 a report saying that: Science and Scientists cannot find an increased risk in cancer causation when people are exposed to radiation of less than 10 rad (100 mGy) absorbed dose that they can defend scientifically.

• **Council of Scientific Society Presidents** said in 1997 at their conference at Wingspread, Racine, WI: “A substantial body of scientific evidence demonstrates statistically significant increases in cancer incidence for acute whole-body exposures of adults to ionizing radiation at doses of about 10 rem (same as 10 rad) and greater.”

- **THE HEALTH PHYSICS SOCIETY** has recently published a position on Radiation Risk: “However, below levels of about 100 mSv (10 rem) above background from all sources combined, the observed radiation effects in people are not statistically different from zero.” (See appendix 9).

- **Japanese A-Bomb Survivor Studies:**

Atomic Bomb Survivor Excess Cancer

Population of Survivors Studied 86,611

Total Solid Cancers observed after the Bomb	10,127	Total
Solid Cancers Expected without Bomb	9,647	

Total Solid Cancer Excess 479

Excess Tumor	+	Excess Leukemia	=	572
479		93		

Preston et al. 2004

The Fallout - Chapter 13 Synopsis (slide 5)

- **UTAH FALLOUT DOSES & EFFECTS:** The dosimetry for Utah show from multiple sources that the absorbed doses recorded are substantially less than 10 rad (100 mSv) threshold mentioned.

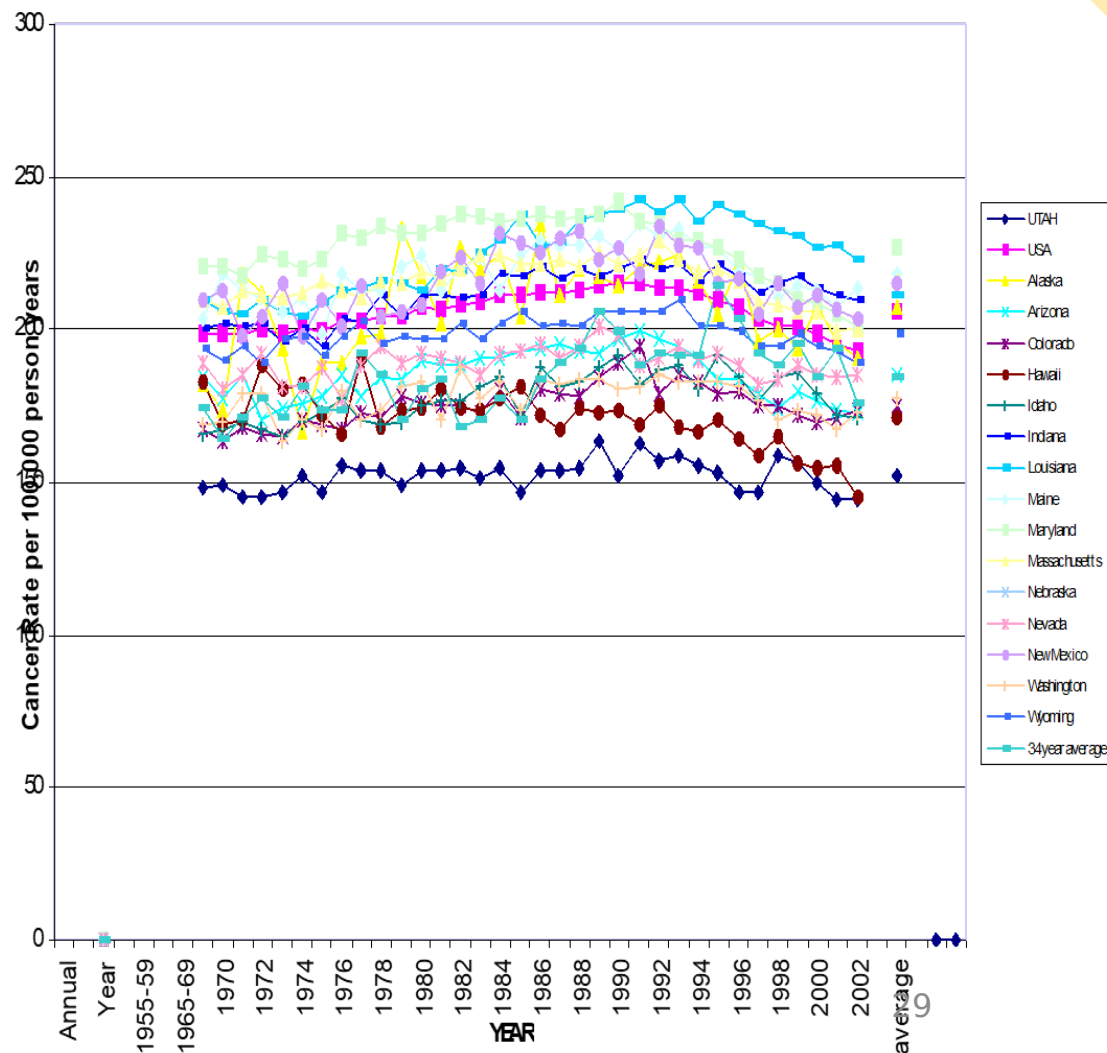
- Land et.al., 1984 concluded: *“that no pattern of excess leukemia mortality was seen which could support a causal association with fallout exposure and that the excess reported earlier was caused by an anomalously low rate in southern Utah for the period 1944-1949.”*

• **Ray Lloyd**, Director of the Dose Assessment for the U of U Epidemiology studies stated in 1997. *“Comparison of the observed number of deaths with non-CLL leukemia (CLL was excluded as it is known as not being caused by radiation) and the expected numbers without NTS fallout exposure suggests that the effect of NTS fallout was small if not entirely absent; that is, the possibility of zero induced cases is not excluded. When I initiated this analysis, I expected that I would be able to identify an unmistakable excess of leukemia in the population. My anticipation was that I could use this value with the collective dose for the county to estimate a leukemia risk coefficient for low-dose radiation exposures, but I was surprised that a clear excess did not emerge from the data.”*

• **Dr. Charles R. Smart**, in sworn testimony (21 July 1982) as a witness in the Irene H. Allen, et al., lawsuit testified in his deposition that he “established the Utah Cancer Registry in 1966 and was the sole Director until 1972. Dr. Smart testifies that: *“That Utah has the lowest cancer rate in the United States in both mortality as well as incidents overall and that it is somewhat specific according to site.”* Dr. Smart further testifies that the Southern Utah Counties have less cancer than the Northern Counties: *“and if you add them all up, the southern Utah counties have 268.3 cases per hundred thousand as compared to the northern Utah counties of 315.5 per hundred thousand which would suggest that there was approximately a one-third decrease in cancer incidents in southern Utah.”*

• See Appendix 13 “Dr. Charles R. Smart’s sworn testimony taken at deposition on July 21, 1982, in preparation for appearing as a witness in the Irene H. Allen Trial.” For more details regarding Dr. Smart’s testimony

Annual Age-Adjusted Cancer Death Rates by State, 1969-2002



The Fallout Story – Chapter 14 Synopsis

- CHAPTER 14 – THE 1953 & 1970 SHEEP DEATH INCIDENTS

- In the spring of 1953 flocks of sheep wintering in southern Nevada north of the Nevada Test Site (NTS) experienced unusual mortality. This was reportedly to have occurred during the trailing of the flocks to Cedar City to the home lambing sheds and as well as upon arrival. Of the 11 flocks (approximately 18,000 sheep) wintering in Nevada 4400 ewes and lambs died. Several causes for the mortality incident were proffered. Those proposed included low range productivity and related poor nutrition, toxic plants, range diseases, and radiation injury from fallout ingestion. However, none of these causal factors were proven by the available data at the time.
- In 1955 Cedar City sheep owners who had heavy losses in 1953 filed suit against the AEC for damages. The September 1956 trial (Bulloch I) was in federal court and lasted 14 days. The presiding Judge was A. Sherman Christensen, who found in favor of the AEC. Agreeing that the fallout levels from the upshot-knothole Test Series were too low to cause the sheep deaths.
- In 1981 six of the original plaintiffs from the 1955 lawsuit brought a new suit in federal court asking for a new trial. They claimed that fraud had been committed upon the court by the AEC and the Justice Department personnel. Judge A. Sherman Christensen again heard the case in May 1982 (Bulloch II) and found that expert witnesses and attorneys had deliberately acted to withhold certain information from the court. Judge Christensen heard the case in May 1982 and ruled in August, that a new trial was to be held.
- The case was appealed to the 10th Circuit Court of Appeals. The following are excerpts, in quotes, from the 10th Circuit's Slip Opinion dated 11/23/83.
- The four particular items mentioned by the trial court are:
 - (1) The Bustad Report – a comparison of radiation tests on sheep at Hanford with the data on the Utah sheep. The Hanford experiments had been made several years before the Utah suit. The trial court concluded that the comparison omitted essential facts.
 - (2) That the Government had given misleading information as to measures of radiation at certain places-radiation dosages.
 - (3) That witnesses, especially the veterinarians, had been “pressured” to testify in a certain way.
 - (4) That the Government had given misleading answers to interrogatories.”
- “It is apparent that in Bulloch II the assertions of fraud against the Government, the witnesses, the Government employees, the experts and the attorneys for the Government were all fully tried and considered. As stated above, there was no evidence whatever of fraud developed in the court hearings which covered all the details. The plaintiffs in Bulloch II again put on the evidence on this issue and were unable to make a case against anyone concerned.” “..... Before judgment was entered in 1956 in plaintiffs were asserting that there had been some sort of “cover-up”. “. However, they acknowledged that they did nothing about it for 20-25 years.” The showing made by plaintiffs in the Bulloch II hearings falls far short of proof of fraud on the court or any other kind of fraud.”
- As mentioned, the trial court concluded in Bulloch II that there had been a fraud on the court (the same judge) in Bulloch I. In so doing, the court seems to have placed much, if not controlling, weight on the hereinabove described development (prior to Bulloch I) of the opinions of the veterinarians during the course of the investigations. We have considered this carefully (with the other factors raised by the trial court) and must conclude that nothing was demonstrated which would constitute fraud on the court.
- We must thus conclude that the trial court was so in error and its conclusion and judgment constituted an abuse of discretion.
- The judgment of the trial court is set aside. The case is REVERSED AND REMANDED!”

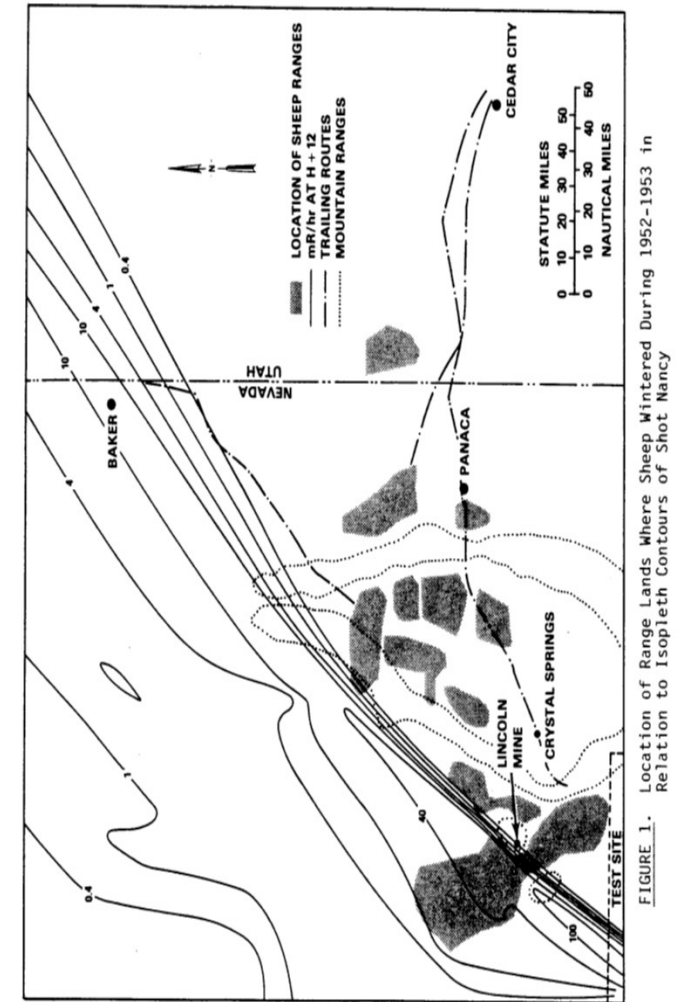
The Fallout Story – Chapter 14 Synopsis Continued (Slide 2)

- Chapter 14 - 1953 Sheep Incident!
- SUMMARY:

- The experimental work performed at Hanford by Bustad et.al. demonstrated that for observable histopathological effects to occur very large doses of I-131 & I-133 had to be consumed. These large doses of 16,000 rads (for minimal observable effects) and 50,000 rads for effects causing substantial organ effects could not be duplicated by the first principal dosimetric approach used by Sasser et.al., evaluating the exposure and consumption of contaminated feed within the fallout pattern where some of the sheep flocks grazed.

- Sasser 1982 showed very few of the herds were actually in the contaminated region, with most grazing outside of the zone defined as the 40 mR/hr contour, where the maximum dose assessment was calculated. Further the data available in the Sasser report allow a comparison to the vegetation biomass contamination; from which the majority of the dose to the sheep occurred; whereas Bustad et.al. reported the consumption of vegetation would require an activity density of forage to be $1\mu\text{Ci }^{131}\text{I/g}$ and $7\mu\text{Ci }^{133}\text{I/g}$ (50,000 rads) 15 days after ground contamination, the observed activity density of forage in the 40 mR/hr contour is 4 orders of magnitude and 3 orders of magnitude less respectively. In other words, the contamination on/in the vegetation consumed by the sheep would have had to been 10,000 times more radioactive than what was measured on the sheep range to expect to see easily observable histological changes in the thyroid cells.

- Conclusion: The doses were way too small to expect to see observable damage and the comparable microscopic pathological examination of the thyroid glands of the Hanford sheep versus the Utah sheep were not similar.



The Fallout Story – Chapter 14 Synopsis Continued (Slide 3)

•**Garrison, UT Sheep incident - 1971!** This incident started after the Baneberry underground test that was conducted at 7:30 a.m., PST, on December 18, 1970. All planned operations proceeded normally until H+3.5 minutes when a vigorous venting occurred from a fissure which had developed radial to surface ground zero. Dynamic venting continued over an extended period even after surface collapse had occurred. The effluent venting rate gradually decreased with time, but visible vapor continued to emanate from the fissure for 24 hours after detonation. The EPA's Laboratory in Las Vegas, NV announced that radioactive material released was detected in environmental media from 12 western states. The EPA report (WERL 1972) for Baneberry recorded that the highest infinite exposure was 35 mR at an unpopulated location 17 miles east of Tonopah on Highway 6. The highest external exposure occurred at Clark Station as a result of cloud passage and subsequent ground deposition. Less than 10 people received exposures of about 20 mrem.

•“The highest estimated thyroid doses were to eight sheepherders in central Nevada who were using melted snow contaminated by the Baneberry release for drinking and cooking. Based on environmental sampling results, information from some of the sheepherders, and records of snowfall, the estimate of the thyroid dose was 500 mrem ± a factor of 3 (i.e., 170 -1500 mrem).”

•One of my colleagues at the Nevada Operations Office (NVOO) received a call from Dr. Robert Pendleton (my former boss and mentor at the U of U) at 1 p.m. on January 21, 1971, who reported that the AEC was about to be credited with having killed a thousand head of sheep in Antelope Valley, Utah. The exact location was 25 miles south of Garrison, Utah. Mr. Davis's report continues: “The Governor of Utah had been notified of the incident and was sending a crew of veterinarians who were currently enroute to Garrison for the purpose of determining the cause of death. The Governor had also contacted Dr. Pendleton with instructions to document the levels of radioactivity which has been accredited as the cause.”

•Early in the morning of January 22, 1971, a team of scientists from Las Vegas, NV flew from McCarren airport to Ely, NV, rented a van and drove to Garrison. The team was made up of myself (health physicist), Jared Davis (Biologist), David Jackson (Public Affairs), representing the AEC and a botanist & veterinarian from the EPA/PHS Western Environmental Research Laboratory. We were all from Las Vegas and represented the AEC presence for the investigation. After surveying with a sensitive instrument and only observing background I called the Las Vegas Office and reported that the kill could not have been a result of radiation, because of the absent of symptoms and that it was most likely Halogeton poisoning.

•The sheep kill was a pathetic sight. We later reported to AEC/HQ that 1150 out of 2400 sheep had died. As I looked on the hillside it looked like patches of snow scattered over the area, there were so many sheep lying on the ground both dead and dying. As I wandered through the death zone I was struck with the sorrowful sight of sheep dying with red froth emanating from the mouth and nostrils (a common symptom of Halogeton poisoning). It looked very inhumane and a very sorrowful sight. Being from a farm background I certainly felt empathy for the sheep ranchers.

•“The acute death near Garrison, Utah, in January 1971, of some 1,250 sheep from a flock of 2,600 was the object of national attention. The implied cause of either nerve gas from Dugway Proving Grounds or radiation from the Nevada Test Site was the principal newsworthy ingredient used to focus national interest and was the reason used to initiate several investigations to determine the true cause of the deaths.” ABC, CBS, & NBC were all there covering the story along with the Associated Press and United Press-International.

The Fallout Story – Chapter 15 Synopsis

- CHAPTER 15 – THE ATOMIC ENERGY ACT, CREATION OF THE AEC AND CONGRESSIONAL OVERSIGHT!
- Following Hiroshima and Nagasaki, the novelty of the bomb as a factor in international affairs and doubts about the trustworthiness of the Soviet Union produced uncertainty on how to proceed in the search for a policy. . In November 1945, the United States, Britain, and Canada agreed to approach the Soviet Union about negotiating an agreement on international control at the new United Nations. Negotiations eventually collapsed when issues of national security and national sovereignty made agreement impossible. The US began to realize in 1946 through the VENONA decryption of Soviet intelligence cables that the Manhattan Project had been penetrated by communist spies. This along with many other factors ultimately led to the Cold War!
- In early May 1945, Secretary of War, Stimson formed an Interim Committee of top officials charged with recommending the proper use of atomic weapons in wartime and developing a position for the United States on postwar atomic policy. The deliberations of the Interim Committee failed to result in a policy and at the urging of the committee and other scientists President Truman advised the Soviets that the US was working on the bomb and intended to use it on Japan!
- In 1945 several bills were submitted to Congress, and after considerable revision the Brien McMahon Bill was approved on July 20, 1946. President Truman signed what became known as the Atomic Energy Act of 1946 on August 1, 1946.
- **Significant Elements of the Atomic Energy Act of 1946.**
 - - The act called for a *commission consisting of five full-time, civilian presidential appointees, serving staggered five-year terms,*
 - and a general manager who administered day-to-day operations.
 - The act mandated four operational divisions: *research, production, engineering, and military application, with the director of the division of military application required to be a member of the armed forces.*
 - Under the act, the commission was to be the “exclusive owner” of *production facilities but could let contracts to operate them.* This meant the commission could, if it so desired, continue the system of contractor operation initiated by the Manhattan Engineer District.
 - The commission was to *take possession as well of “all atomic weapons and parts thereof”* but, unlike in the original McMahon bill, the act contained the provision that the President “from time to time” may direct the commission to deliver “weapons to the armed forces for such use as he deems necessary in the interest of national defense.”
 - The act also created a *General Advisory Committee* and a *Military Liaison Committee*. The General Advisory Committee, consisting of nine presidential appointees, was to provide assistance and advice to the commission on scientific and technical issues. The Military Liaison Committee, consisting of representatives of the War and Navy Departments, was to provide for input by defense officials.
 - **Finally, the act established in Congress a *Joint Committee on Atomic Energy (JCAE)* composed of nine members each from the Senate and House of Representatives to oversee atomic affairs.**

The Fallout Story – Chapter 15-Continued (Slide 2)

- CHAPTER 15-THE AEC AND CONGRESSIONAL OVERSIGHT!

- The Congress, through the JCAE took a very active interest in the nuclear test activities of the AEC, because the nuclear age was NEW, the impact of radiation, especially from fallout was also very new, and the effects of radiation on man was still somewhat in its infancy. The research projects and Laboratories started in the late 1940s and later are too numerous to mention. Hundreds and yes thousands of scientific papers were studied and published. Technical societies were founded and have flourished to the present. : *As an example, the society that I joined over 50 years ago, the “Health Physics Society-hps.org” was founded in 1958 and has published a monthly journal which involves monitoring, measurements and dose determination with thousands of technical papers devoted to the radiological science/safety and is still in existence.*

- LIST OF PRINCIPLE HEARINGS THE JCAE HELD ON FALLOUT, RADIATION PROTECTION CRITERIA, STANDARDS AND EFFECTS ON MAN

- - April 15, 1955 – 84th Congress - Health & Safety Problems & Weather Effects Associated with Atomic Explosions

- - May 27 thru June 7, 1957 – 85th Congress – The Nature of Radioactive Fallout and its Effects on Man.

- - May 5-8, June 22-26, 1959 – 86th Congress – Fallout From Nuclear Weapons Tests, and Biological And Environmental Effects of Nuclear War.

- - May 24 – June 3, 1960 – 86th Congress – Radiation Protection Criteria and Standards: Their Basis and Use.

- - June 4-7, 1962 – 87th Congress – Radiation Standards, Including Fallout

- - June 3-6; August 20-27, 1963 – 88th Congress – Fallout, Radiation Standards, and Countermeasures.

- With the demise of the AEC in 1974 and the creation of the Energy Research Development Agency, in 1978 the Department of Energy with the program elements of the AEC and the creation of the Nuclear Regulatory Commission given the regulatory mission of the AEC the JCAE was disbanded, and Congressional Oversight was remanded to the various committees of both houses.

- A number of Congressional hearings were held in the 1970s & 1980s that were concerned about fallout, effects of low-level radiation exposure and radiation exposure to military participants and the public from nuclear weapons testing.

- The Subcommittee on Oversight and Investigations conducted four hearings – on April 19, 1979, in Salt Lake City, Utah; April 23, 1979, in Las Vegas, NV; and May 24 and August 1, 1979, in Washington D.C. - to examine the consequences of the nuclear tests carried out at the Nevada Test Site during the 1950's and 1960's."

- - October 27, 1981 – 97th Congress, S. 1483 – Radiation Exposure Compensation Act of 1981, Hearing before the Committee on Labor and Human Resources.

- These hearings in the 1980s and early 1990s led to the compensation bill passed in 1990. It took about 12 years from the first bill introduced in 1979 for the passage of the compensation act in 1990.

- October 15, 1990 – 101st Congress, H.R. 2372 – Radiation Exposure Compensation Act of 1990. Became Public Law-101-426.

- RECA – Radiation Exposure Compensation Act. This bill was signed into law in 1990 & broadened in 2000. (See Chapter 15)

- EEOICPA – The Energy Employees Occupational Illness Compensation Program Act. This legislation was enacted in October 2000 and expanded in 2001.

- THIS CHAPTER CONCLUDES WITH MY COMMENTS AND OBSERVATIONS ABOUT CONGRESSIONAL HEARINGS ON RADIATION EFFECTS AND MY OPINION ABOUT POLITICIANS! During my AEC, ERDA, DOE career I spent a lot of time in our nation's capital, and much of that time was interacting with congressional representatives and/or their staffs. I am afraid that after my extensive exposure to what I see politicians say and do, I have a very jaded view of their integrity and intellectual honesty. I think they say in the hearings, over the media etc., information that impact on the public what they think the public wants to hear. I am convinced that their first priority is getting reelected, and they will say and do about anything to make sure that happens. I am sure there is exceptions. You are welcome to disagree!

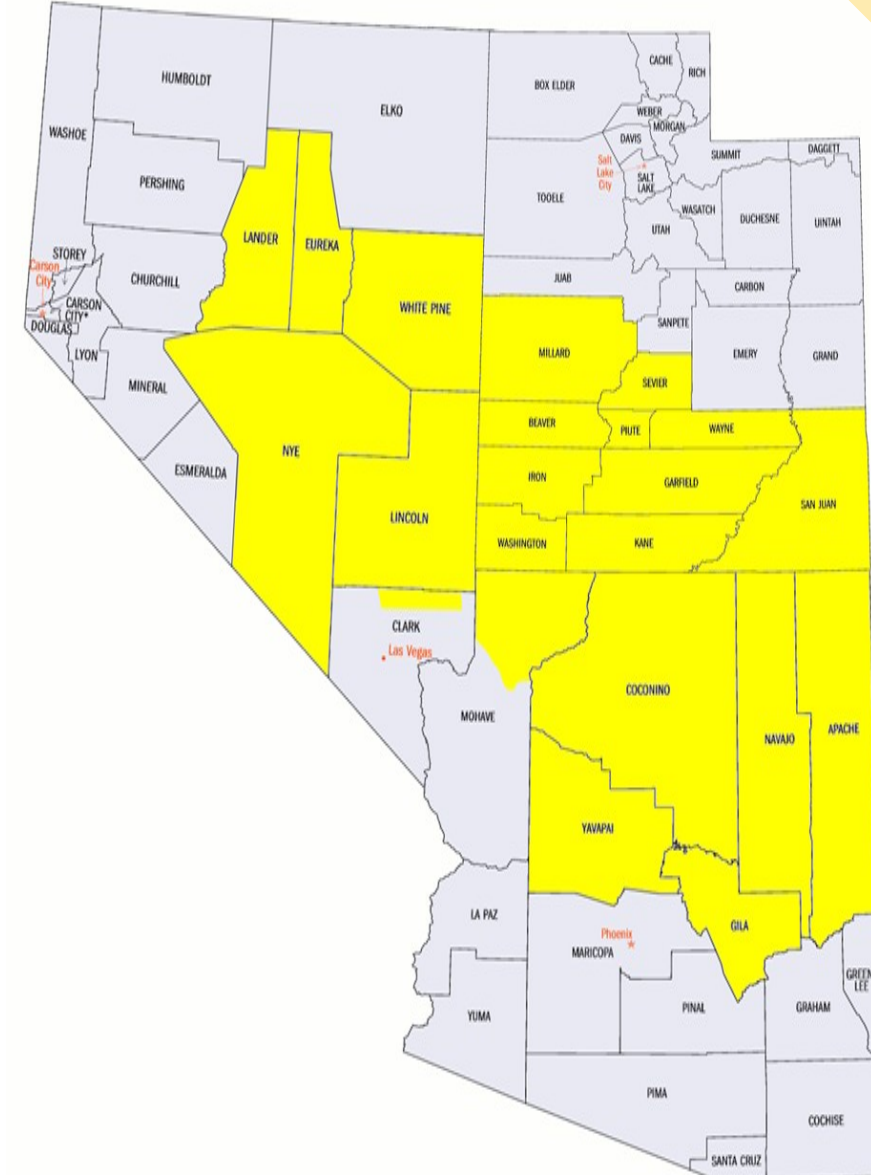
- One last comment. I am always amazed that not much seems to come from Congressional hearings. It would be interesting if the Congress, would add a “conclusion” section at the end of their hearings to let the public know what was accomplished by it all. That is stating something beyond the pontification and scratching of each other's back!

The Fallout Story – Chapter 16

Synopsis

CHAPTER 16 – The Radiation Exposure Compensation Act (RECA) – Revisited

- The Radiation Exposure Compensation Act was passed on October 5, 1990. The Act's scope of coverage was broadened in 2000. The ACT's deadline was extended on June 7, 2022, when President Biden signed into law the RECA Extension act of 2022. This law extends the termination of the RECA Trust Fund and filing deadlines for all claims for two years from its date of enactment.
- The Act presents an apology and monetary compensation to individuals who contracted certain cancers and other serious diseases; following their exposure to radiation released during the atmospheric nuclear weapons tests or following their occupational exposure to radiation while employed in the uranium industry during the Cold War arsenal buildup.
- Quoting from the Act. “This unique statute was designed to serve as an expeditious, low-cost alternative to litigation. Significantly, RECA does not require claimants to establish causation, rather claimants qualify for compensation by establishing the diagnosis of a listed compensable disease after working or residing in a designated location for a specific period of time. The ACT provides compensation to individuals who contracted one of 27 medical conditions. It covers all states where uranium was mined and processed, as well as specified counties in Nevada, Utah, and Arizona, where significant fallout from the atmospheric nuclear testing was measured.”
- RECA ELIGIBILITY REQUIREMENTS
 - Section IV. Downwinders: A payment of \$50,000 is available to an eligible individual who was physically present in one of the affected areas downwind of the Nevada Test Site during a period of atmospheric nuclear testing, and later contracted a specified compensable disease.
 - Section A. Exposure: The claimant must have lived or worked downwind of atmospheric nuclear test in certain counties in Utah, Nevada, and Arizona for a period of at least two years during the period beginning on January 21, 1951 and ending on October 31, 1958, or for the period beginning on June 30, 1962 and ending on July 31, 1962.



The Fallout Story - Chapter 16 Synopsis-Continued (slide 2)

- **Chapter 16-RECA Revisited, Continued!** The following tables show the populations of the Downwind Eligible Counties taken from the 1960 Census, to examine the potential future payout of the RECA ACT based on 2019 data.

The 19 Eligible Cancers	Cancers in downwind population of ~250K multiplied by the percent of the Lifetime Risk of a specific eligible cancer!	Lifetime Risk of Developing the eligible cancer listed for men and women based on 2015-2017 NCI SEERS data.
Leukemia (other than chronic lymphocytic leukemia), multiple myeloma	3750	1.5
Lymphomas (other than Hodgkin's disease)	5250	2.1
Primary cancer of the thyroid	3250	1.3
Male or female breast	32250	12.9
Esophagus	1250	0.5
Stomach	2000	0.8
Pharynx	ND	ND
Small intestine	750	0.3
Pancreas	4000	1.6
Bile ducts, (see liver)	ND	ND
Gall bladder	ND	ND
Salivary gland	ND	ND
Urinary bladder	6000	2.4
Brain	1500	0.6
Colon	10500	4.2
Ovary	3000	1.2
Liver & Bile	2500	1.0
Lung	15750	6.3
Total	91,750	$91750/250000 = 0.367 \times 100 = 36.7\%$

Utah Counties	Population	Nevada Counties	Population	Arizona Counties	Population	Grand Total
Beaver	4331	Eureka	767	Apache	30438	
Garfield	3577	Lander	1566	Coconino	41857	
Iron	10795	Lincoln	2431	Gila	25745	
Kane	2667	Nye	4374	Navajo	37994	
Millard	7866	White Pine	9808	Yavapai	28912	
Piute	1436	Clark- townships 13-16	3000 (estimate)	Mojave - North of the Grand Canyon	1000 (estimate)	
San Juan	9040					
Sevier	10565					
Washington	10271					
Wayne	1728					
Total	62,276		17,572		165,946	245,794
Percent of total	25.33		7.15		67.51	99.99%

The Fallout Story – Chapter 16 Synopsis-Continued (slide 3)

- Chapter 16 – RECA Revisited Continued!
- The primary reason to revisit RECA is to present the technical data available prior to the passage of RECA in 1990. *Did the data available at the time support the decisions/conclusions made in the RECA law? No just the opposite!* The data shows that there was insufficient radiation exposure to cause cancer in the downwind population. And as discussed in Chapter 12, Utah had the lowest cancer fatality rate of all the states in the lower 48 states. And Washington County was near the bottom of the county fatality rates in Utah
- A further reason to revisit RECA is to show how unfairly the Act is applied. Examining the data available indicating the number of potential cancers, according to NCI/SEER data, versus the cancer type, multiplied by the eligible population, gives some indication of the potential payout of the RECA act. It also indicates, based on population that potential Arizona claimants would receive over 2/3rds of the compensation.
- This radiation exposure data indicates that the majority of the Arizona Counties with most of the population, of the three states, received nearly zero NTS fallout. The following discussion is directed to showing where the fallout went, and the radiation dose involved

- DOWNWINDER POTENTIAL FUTURE PAYOUT

Cancers Expected in Eligible Population of approximately 250,000 People – 91,750

Approved Claims to date – 22,196

Potential Cancers that could be claimed – $(91,750 - 22,196 = 69,554)$

Potential Costs Remaining to be Encumbered – $(69,554 \times \$50,000 = \$3,477,700,000.00)$

Potential State Share:

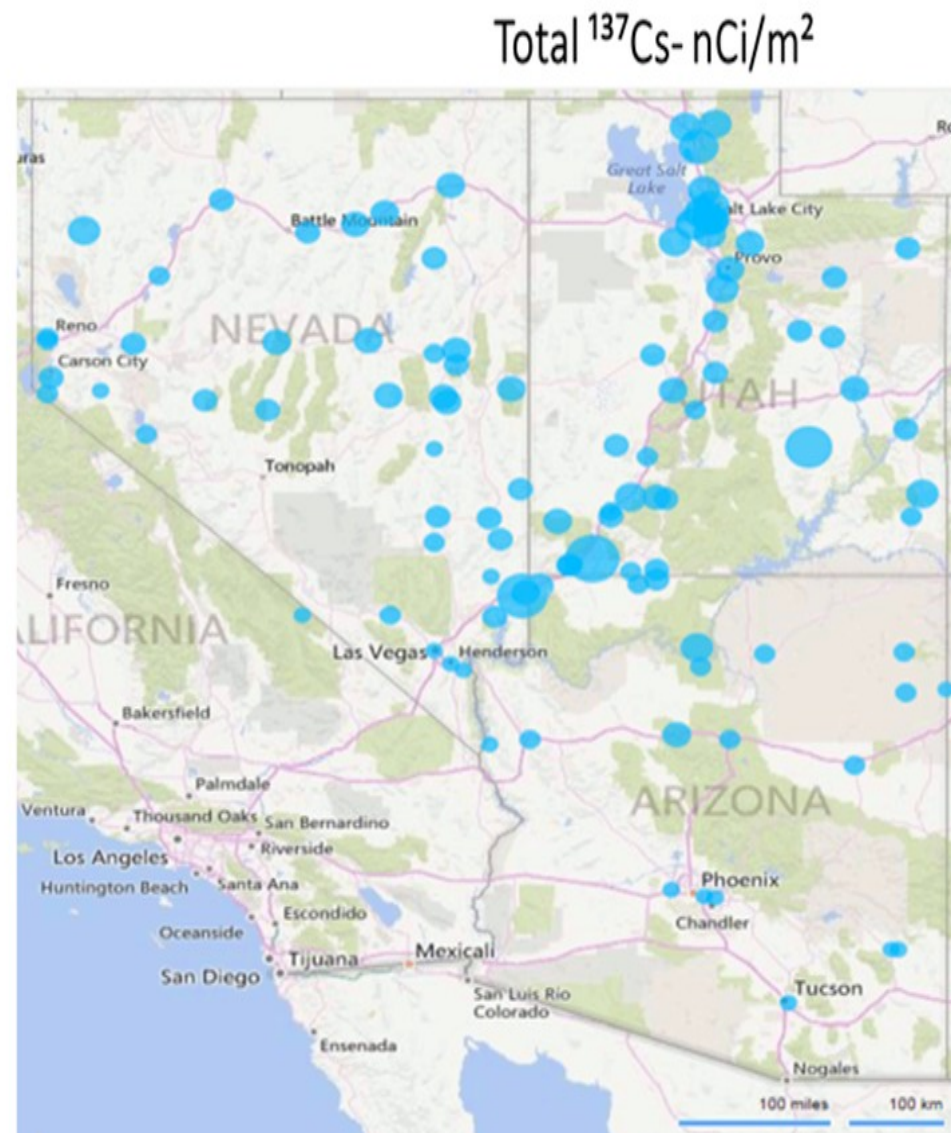
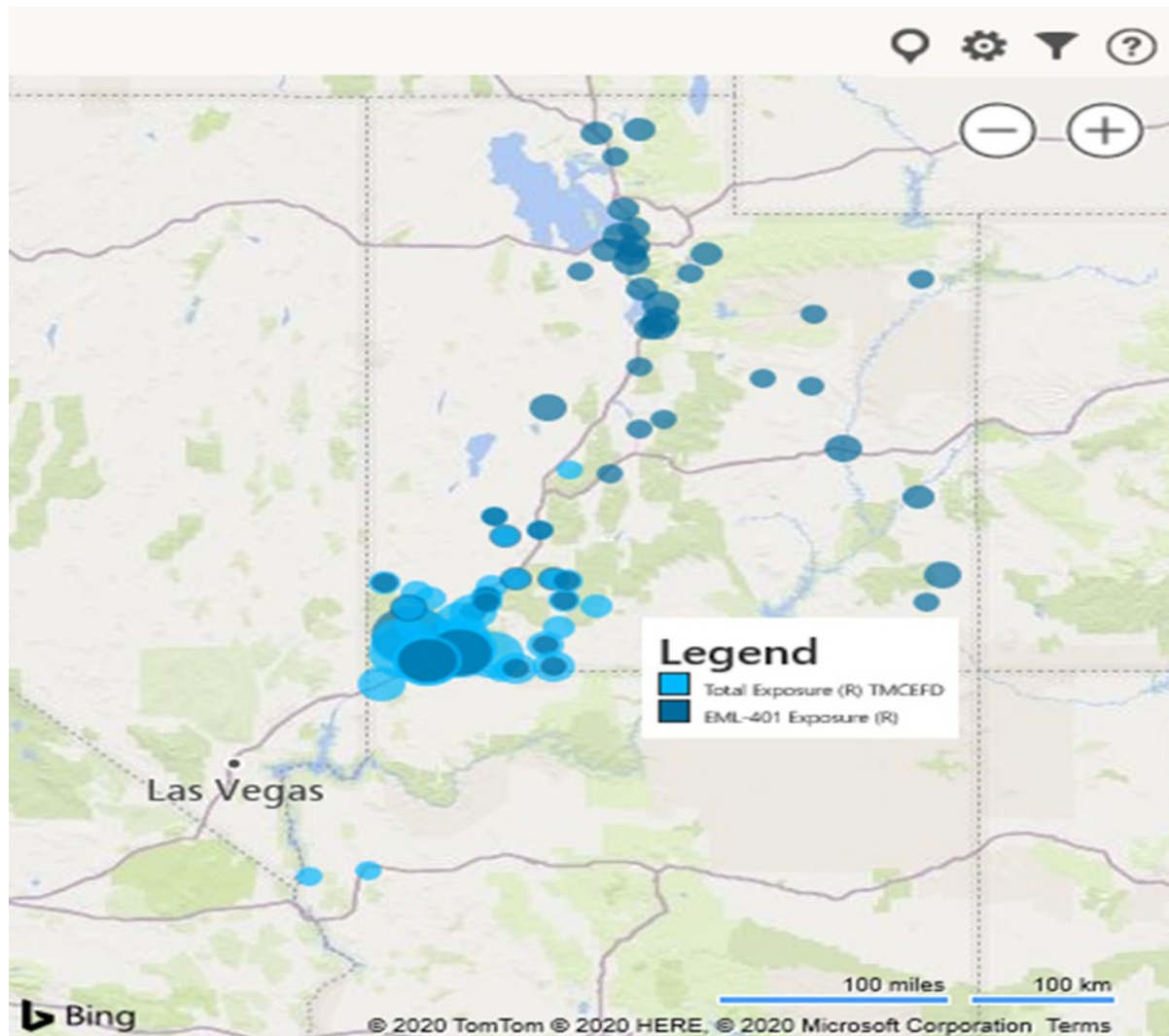
- o Arizona – 67.51 %
- o Utah – 25.35%
- o Nevada – 7.15
- o Total = 100 % As of February 8, 2019

•CONCLUSION: RECA was a fraudulent piece of legislation compensation which compensated many people not exposed at all to fallout and failed to compensate others that had more than the average levels of fallout. In no case was there adequate dose or exposure to fallout radiation to cause cancer (see Chapter 13), and RECA was not fairly or equitably applied. For example, there are counties in Northern Utah that received more radiation exposure than Iron, Garfield, or Kane counties in Utah. And other than those portions of Mojave and Coconino Counties north of the Grand Canyon the other counties in Arizona which received the majority of the money from RECA were exposed to little if any NTS fallout!

The Fallout Story - Chapter 16 synopsis-continued (slide 4)

- Chapter 16 – RECA Revisited Continued!

Graphical display of the Exposure data. The size of the blue circles is proportional to the total exposure measured at the indicated location. Also shows how little data was measured south of the Grand Canyon!



Graphical dep
Cs-137 measu
sampling.

The Fallout Story - Chapter 10 Synopsis-Continued

(slide 4)

AWARDS TO DATE 06/21/2022

Department of Justice Civil Division

Radiation Exposure Compensation System

Claims to Date Summary of Claims Received by 06/20/2022 All Claims

Claim Type Desc	Pending	Approved	% Approved/of Disposed	\$ Approved	Denied	Total
Downwinder	290	25,148	83.8	\$1,257,370,000	4,872	30,310
Onsite Participant	111	5,246	58.4	\$383,065,507	3,744	9,101
Uranium Miner	126	6,837	63.0	\$682,974,560	4,024	10,987
Uranium Miller	35	1,902	75.1	\$190,200,000	632	2,569
Ore Transporter	12	396	70.7	\$39,600,000	164	572
Total:	574	39,529	74.6	\$2,553,210,067	13,436	53,539

The Fallout Story – Chapter 17 Synopsis

- **CHAPTER 17 – THE ALLEN TRIAL**

•The Irene Allen, et al., case was so named after the first name on the list of plaintiffs, was filed in U.S. District Court, in Salt Lake City, Utah on August 30, 1979. The lawsuit was a consolidation of individual claims of the 1,192 named plaintiffs. It was not a class action. The Trial began on September 14, 1982 and concluded on December 17, 1982. The trial encompassed 24 of the claims in their totality. The court suggested the cases be selected by plaintiffs' and defendant's counsel as "bellwether" cases. "This effort was to provide a selection of "typical" cases which when decided and reviewed may provide a legal and factual pattern against which the remaining issues in the pending cases may be subsequently matched." "The trial lasted thirteen weeks. The trial transcript runs more than 7,000 pages; the exhibit evidence more than 54,000 pages. The district court deliberated for seventeen months, then issued an opinion which occupies 225 pages of the Federal Supplement."

•Actions and activities began in the spring of 1976, when a veteran, Paul Cooper called television station KUTV of Salt Lake City, Utah stating that he believed his leukemia was caused from his radiation exposure during military maneuvers at the NTS associated with shot Smoky in 1957. Journalists and activists began to investigate whether or not military participants at the NTS and the Pacific exposed to radiation may have caused their leukemias/cancers. This publicity caught the attention of politicians and the media. This publicity was followed by a congressional hearing on January 24th, 1978, on the effects of radiation on human health (Miles 2008).

•The press stories also caught the attention of Vonda McKinney, whose husband had died of leukemia in 1962 while working in Fredonia, Arizona. McKinney, justice of the peace for Navajo County, was able to get two Arizona attorneys interested in fallout victims. In the fall of 1978, Stewart Udall, with a team of lawyers came to St. George, Utah. There were townhall meetings held with an escalation of publicity by the media and many outrageous statements made, without being substantiated with facts. An example of a statement made by Udall after saying he was stunned by the abnormally high number of suspected fallout cancer victims follows: "There are two to three times more of every type of cancer than we had assumed." (Miles 2008). Shortly thereafter the lawsuit was filed by this team of attorneys in Salt Lake City Federal Court.

•PART 1 (THE TRIAL) – Judge Jenkins goes on for many pages talking about the difficulty the judiciary has with the scientific-technological processes and states that they are profound and pervasive. "During the course of the trial, this court received into evidence the testimony of 98 witnesses as well as more than 1,692 documentary exhibits. It is clear from the record that the Judge wrestled with the scientific evidence versus human suffering."

•Following are a few examples of the statements the Judge made: "Science normally evolves a new, general physical principle from hypotheses proven by numerous specific experiments. The normal judicial process is precisely the reverse, for, when properly conducted, it applies an existing, generally accepted moral or social value an ethical principle a rule of law to a specific problem."

•"Judges and lawyers must approach with great care, the idea that court decisions can be justified solely on the findings of science, lest the quest for justice be lost along the way."

•"The first need, then, is to view technological evidence as merely one evidentiary element in the judicial matrix of decision and not necessarily as the sole justification for the judge's legal decision."

•"At the core of this case is a fundamental principle a time-honored rule of law, an ethical rule, a moral tenet:

•[T]he law imposes [a duty] on everyone to avoid acts in their nature dangerous to the lives of others."

•PART 2 (DAMAGES) – "After careful examination of the factors discussed in detail above in all of the preceding sections, it appears that ten of the twenty-four bellwether cases merit compensation. Eight are wrongful death cases, 2 in Arizona and 6 in Utah. Heirs or survivors seek compensation for themselves for the wrongful deaths of their predecessors."

•"The two additional cases which merit compensation are brought by persons living at the time the action was commenced who claim personal injury to themselves."

•*The damages section then continues at some length to discuss the specific sections of Utah and/or Arizona law that govern compensation. This section concludes by awarding specific sums to the named claimants.*

The Fallout Story – Chapter 1 / Synopsis Continued (slide 2)

- **CHAPTER 17 – THE ALLEN TRIAL** Continued

- **FINDINGS OF ULTIMATE FACT** – “The court finds that defendant failed to adequately warn the plaintiffs or their predecessors of known or foreseeable long-range biological consequences to adults and to children from exposure to fallout radiation from open-air atomic testing and that such failure was negligent.”
 - “The court finds that defendant failed to measure adequately and concurrently with open-air atomic testing the actual fallout in communities and population centers near the Nevada Test Site on a **person-specific basis**, or its equivalent, and that such failure was negligent.”
 - “The court finds that contemporaneously with atmospheric atomic testing the defendant failed to adequately and continuously inform individuals and communities near the test site of well-known and inexpensive methods to prevent, minimize or mitigate the known or foreseeable long-range biological consequences of exposure to radioactive fallout, and that such failure was negligent.”
- **CONCLUSIONS OF LAW** – “This opinion in its entirety shall constitute the Findings of Fact required by Rule 52 F.R.C.P. Based on the findings of specific and ultimate facts set forth above in this opinion and for the reasons set forth herein, the court concludes that each of the 448 designated prevailing plaintiffs (claimants) named in Part X beginning at page 446 above is entitled to judgment against the United States in the amount set forth in that section. As to the remaining plaintiffs of the bellwether group of 24, this court concludes as a matter of law that the evidence is insufficient in each instance to demonstrate with the requisite weight that the defendant's negligence proximately caused the condition of which each complains and further concludes that the United States is entitled to a Judgment of Dismissal as to each of them.”
- **ALLEN APPEAL DECISION:**
 - *The appeal by the defendant was filed in the 10th Circuit, U.S. Court of appeals on April 20, 1987, before McKay, Seth and Logan, Circuit Judges.*
 - *The appeal brief begins by reviewing the framework of the 24 “bellwether” claims. And mentions that the court entered final judgment in favor of the Government on 14 of the claims and against the government on 9, leaving one claim outstanding.*

The Fallout Story – Chapter 17 Synopsis

Continued (slide 3)

• CHAPTER 17 – THE ALLEN TRIAL - Continued

- The district court opinion states the facts fully. *The appeal then continues to summarize the Atomic Energy Act of 1946 which gives the Commission (AEC) broad discretionary power to conduct experiments in the military application of atomic energy.* The commission was authorized to carry on experiments “only to the extent that the express consent and direction of the President of the United States has been obtained, which consent, and direction shall be obtained at least once each year.”
- Additionally, the AEC was “authorized and directed to make arrangements for the protection of health during research and production activities.” These arrangements were to “contain such provisions to protect health, to minimize danger from explosion and other hazards to life or property as the AEC may determine.”
- At trial, as a basis for governmental liability, plaintiffs singled out the alleged failure of the government, especially of the Radsafe Officers and the Test Information Officers, to fully monitor offsite fallout exposure and to fully provide needed public information on radioactive fallout. The district court focused on these two failures in finding government liability.
- “based upon an act or omission of an employee of the Government, exercising due care, in the execution of a statute or regulation, whether or not such statute or regulation be valid, or based upon the exercise or performance or the failure to exercise or perform a discretionary function or duty on the part of a federal agency or an employee of the Government, whether or not the discretion involved be abused.” The key term, “**discretionary function**,” is not defined. “For over thirty-five years the federal courts have been attempting to define it.” The appellate court reviews a number of Supreme Court rulings on the key term “discretionary function”, and reviews in detail the ruling on “Varig vs the FAA.”
- “The “discretionary function or duty” that cannot form a basis for suit under the Tort Claims Act includes more than the initiation of programs and activities. It also includes determinations made by executives or administrators in establishing plans, specifications, or schedules of operations. Where there is room for policy judgment and decision there is discretion. It necessarily follows that acts of subordinates in carrying out the operations of government in accordance with official directions cannot be actionable.” “On appeal, plaintiffs contend that the AEC, in planning and conducting its monitoring and information programs, was not making the kind of policy judgments protected by 2680(a). They point to the general statutory provisions instructing the AEC to consider public health and safety, and claim that these broad congressional directives leave no further room for discretion. **We disagree.**”
“In the instant case, no evidence was presented of any act or omission of the AEC or its employees that clearly contravened a specific statutory or regulatory duty, or that exceeded statutory or regulatory authority. There was no evidence, for example, that the Test Information Officer failed to release information he was required to give out, or that the Radsafe Officer failed to take a specific radiation measurement that had been decided upon. Plaintiffs’ entire case rests on the fact that the government could have made better plans. This is probably correct, but it is insufficient for FTCA liability.” “For the above reasons, we find all challenged actions surrounding the government atomic bomb tests in the 1950s and 1960s to be immune from suit, as the performance by a federal agency of a “discretionary function,” protected by 2680(a).”
- “**We REVERSE the district court’s decision with regard to those nine claims in which the government was found to have liability and REMAND for further proceedings consistent with this opinion.**”
- “On appeal, plaintiffs do assert that “the evidence clearly demonstrates negligent and wrongful failure to execute and deviation from. . . the plans approved by the Commission.” **However, the evidence does not support this allegation.**

The Fallout Story – Chapter 18 Synopsis

- **CHAPTER 18 – MYTHS & OTHER TALES ABOUT FALLOUT**

- I have also tried to show in this book, which focuses on the fallout and related dosimetry, how overstated the effects of low-level radiation was. But perhaps the most common myth and discussed in most of the books was the myth that fallout caused John Wayne's cancer. This particular myth has been very popular with the press, given the popularity of John Wayne. I have given many talks, presentations and interviews concerning this myth, which is perhaps the one that is the mostly easily disproved.

- **THE JOHN WAYNE MYTH – A few facts!**

The Conqueror was filmed in Snow Canyon May-August 1954 (and other nearby locations)!

There was NO nuclear weapons testing in Nevada in 1954 (the testing that year was in the Pacific)!

Other cast members i.e., Dick Powell, Pedro Armendariz, Agnes Moorehead, Susan Hayward were all dead by 1975. JOHN WAYNE was diagnosed with lung cancer September 1964 and died from stomach cancer in 1979!

They were all heavy smokers. John Wayne smoked 5 packs a day!

People Magazine stated in an article on Nov. 10, 1980 that "Of the Conqueror's 220 cast and crew members from Hollywood, an astonishing 91 have contracted cancer." There was no mention of smoking, or that the American Cancer Society (ACS 2019) states that about "42% of newly diagnosed cancers are avoidable and that 19% are caused by smoking!" Or that in the U.S. ~39/100 men and ~38/100 women will develop cancer during their lifetime. Doing the math that suggests that about $0.42 \times 220 = 92$ is close to 91 and about what would be expected for the cast and crew of the Conqueror to contract cancer in their lifetimes. Which would certainly be enhanced by smoking!

Conqueror filming & monitoring Locations



The Fallout Story – Chapter 18 Synopsis-Continued (Slide 2)

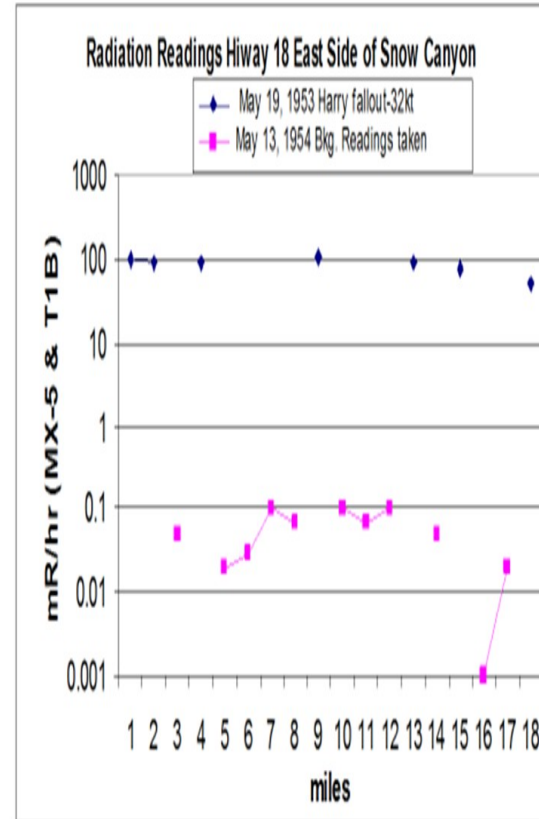
- **CHAPTER 18 – MYTHS & OTHER TALES ABOUT FALLOUT -Continued**

- The radiological facts related to the myth surrounding the causation of John Wayne's cancer are:

Fallout occurred in the Snow Canyon area from the Annie Event (16 kt) March 17, 1953 and the Harry event (32 kt) May 19, 1953.

The readings on May 19, 53 varied from about 9 mr/hr. to about 50 mr/hr. from the edge of St. George (Junction of US 91 & UT 18) north for about 18 miles.

The Instrument readings measured in the vicinity of Snow Canyon in May of 1954 indicates the radiation levels were essentially background (0.001 to 0.01 mr/hr.) during the time the Conqueror was filmed.



The Conqueror - Portable Instrument Readings along Hiway 18 running along the East side of Snow Canyon

Date	Miles from the Center of St. George	Miles from Junction of US 91 & UT 18	Hours since H-Hour	Net mR/hr MX-5/T1B
19-May-53	Center of St. George	-1.1	10.83	100
19-May-53	Junction of US-91 & UT-18	0	10.97	90
19-May-53	3 mi. N. of Junt.	3	11.03	90
19-May-53	8 mi. N. of Junt.	8	11.12	110
19-May-53	13 mi. N. of Junt.	13	11.25	90
19-May-53	16 mi. N. of Junt. (Veyo)	16	11.38	75
19-May-53	18 mi. N. of Junt.	18	11.33	50
13-May-54	1.1 mi. N. of Junt.	1.1	8616	0.05
"	3.2	3.2	8616	0.02
"	5.1	5.1	8616	0.03
"	7.1	7.1	8616	0.1
"	7.6	7.6	8616	0.07
"	9.1	9.1	8616	0.1
"	10.8	10.8	8616	0.07
"	12.7	12.7	8616	0.1
"	15.2	15.2	8616	0.05
"	16.7 (Veyo)	16.7	8616	0
"	17.5	17.5	8616	0.02

The Fallout Story - Chapter 18 Synopsis, Continued (slide 3)

- **CHAPTER 18 – MYTHS & OTHER TALES ABOUT FALLOUT -Continued**

- **EXPOSURE TO RADIOACTIVE FALLOUT CAUSES LOSS OF HAIR:**

- The most celebrated person making this claim was Joann Workman of St. George, Utah. Ms. Workman claims that this occurred within a few hours after observing the Harry Event. Her claim is false because:

It takes an acute exposure of 200-300 rads to cause temporary loss of hair and generally takes about 2 weeks for it to occur (Glasstone 1977).

From all the research and instrument measurements made in the St. George area, it is very clear that the area only received about 4 rads of radiation exposure. A radiation dose is not even close for causing hair loss.

It is interesting that Ms. Workman was a neighbor of Daniel Miles, who observed that she had all her hair during the summer of 1953, and that 5 yearbook pictures attested to the fact she had it all during 1954. She did lose her hair 20 years later due to chemotherapy.

- **FALLOUT APPEARING AS SNOW:**

- In her book, *American Ground Zero* Carole Gallagher quotes a woman who claims, “After a bomb, there (it) would be the fallout, fine like flour, kind of grayish white. We would play like that was our snow.”

- In a St. George Town meeting in 1979, there was stories about children eating fallout debris thinking it was snow. Daniel Miles interviewed more than 30 people who experienced all the fallout episodes in St. George 1951-1958. Not one including him recalls episodes of visible fallout. No photograph of fallout snow has ever surfaced. No column in the Washington County News has ever mentioned visible fallout. (source of these statements is Miles 2008). I can add my personal experience as well. I, nor my friends or family, living in the fallout years in Eastern Washington County do not recall seeing any visible fallout. However, we did see the flash of light when the nuclear devices were detonated, especially before dawn.

- **CLASS REUNIONS HELD AT THE CEMETERY:**

- Ms. Michelle Thomas (Dixie High School) claimed that her class reunions were held at the St. George, City Cemetery! Daniel Miles* called 50 people in Michelle’s high school graduating class “NONE” could recall a classmate dying from cancer and they just laughed at the suggestion that they held reunions at the cemetery!”

- Mr. Preston Truman (Enterprise High School) has claimed that he is the only one of nine friends to reach their 28th birthday. And that reunions were held at the cemetery. However, Lee Bracken, Enterprise Mayor, Truman’s classmate, neighbor, and co-chair of the 2004 reunions for the classes 1968,69 & 70 states: (in an interview with Daniel Miles) “No members of these classes have died from cancer or leukemia.”

- **BIGGEST MYTH OF ALL IS.....FALLOUT CAUSED A CANCER EPIDEMIC!**

- The information previously provided in this presentation pretty well documents how people’s FEAR and political voice perpetuated that there was a cancer epidemic in Southern Utah and the near environs of the NTS. How untrue and yet we see that the congress has yet again passed legislation this June 2022 in response to the hue and cry of the downwind public.

CHAPTER 19 - CONCLUDING THOUGHTS:

- There is no question the belief that folks downwind of the NTS were subject to increased cancer is a culture fact! However untrue that may be. This was again emphasized in the media as we came up on the 70th anniversary of the first test in Nevada (February 27th, 1951). This belief was chronicled again in PBS Utah's airing on January 21, 2021, their program: "Downwinders and The Radioactive West" several activists, who tell tall tales were featured. The same thing occurred in the Las Vegas papers, as their articles featured statements from several well-known activists, also telling tales.
- It gives me pause to think that radiological science has had so little impact on the minds of people and the media. They do not stop to think or realize that fallout occurred around the world during the cold war's race to achieve nuclear parity. And that fallout occurred more in the northern hemisphere, and also in the southern hemisphere, albeit at a much lesser amount, because of fewer atmospheric tests in that hemisphere (See Chapter 10).
-
- We know (at least I hope we know) that we are all subject to background ionizing radiation, and that there are some places in the world that receive fairly large doses. We also know that these locations have not had an increase in cancer caused by their exposure to radiation, in some cases the cancer rate is even less than expected. We also know that the Japanese bomb survivors (86,611) had a measurable increase in cancer, the total cancer cases (572) were small (10,127 observed, 9,647 expected-see Table 13-5), in relation to the number of survivors. The Japanese were exposed to an acute radiation dose, which is much more effective in showing an effect, than the chronic exposure that the downwinders, and the rest of the world received. Acute radiation dose is commonly used in external cancer radiation therapy, usually in the Gray range (1 Gy = 100 rad), the downwinders were exposed in the <0.1 Gray range. We know that ionization radiation is a good cell killer, which is why it is used in cancer therapy, but it is not a good mutagen (cancer causing). Check it out!
- There is no question that nuclear weapons can cause horrific and devastating effects on human homes and lives. The Japanese visualization has had a lasting impact! However, the FEAR that has been propagated and fed by the media, government officials and activists, has also had an equally devastating effect on humanity.
- The scare tactics employed to shutdown nuclear power, the cleanest and safest form of energy, has been very effective in bringing this potentially useful energy source to its knees. The world should deplore the fact that FEAR drove the unnecessary evacuation of Fukushima, Japan at the cost of thousands of lives. None have been lost to radiation!
- Even more of an alarm is the war going on to fight against the use of diagnostic x-rays and CAT scans to thwart their use in helping those individuals who need critical diagnostic medical exams.
- The use of regulatory actions in the form of espousing concepts such as the use of the LNT model to project fictitious radiation caused cancers down to near zero exposure (meaning that any exposure to radiation can cause cancer) has caused significant FEAR.
- It was interesting to see that the NCI data compares cancer death rates by state for all states, but also lists the highest 5 states and the lowest 5 states. Utah is listed as the lowest State for all races, males, and females for the years 2013-2017 at 125.5 deaths per 100,000. Interestingly the 5 lowest states are all in the mountain west (i.e., AZ, WY, CO, & UT), except Hawaii.
- It might interest you to know that the Western States have the highest natural background radiation in the Nation.

CHAPTER 19 - CONCLUDING THOUGHTS Continued:

- This all translates to the fact that cancer is very prevalent in our society, that cancer death rates are high compared to other causes of death and that Utah has the lowest death rate from cancer than all the other states. And that higher levels of natural background radiation just might be beneficial. Considering all this information and what has been presented in other places in the book, that for people to cite downwinder people as having cancer caused by radiation is a very false premise despite the activist testimonials.

- As I have been reading these testimonials of downwinders who claim that their cancer was caused by being exposed to radioactive fallout, the word “fair” kept coming up. I have thought a lot about that and had the following thoughts on “what is fairness?”

- It seemed to me that many of these folks must not have been aware that the combined atmospheric nuclear testing and resultant fallout of Russia, U.S. and the UK and others exposed the whole world to fallout. As mentioned previously most of the fallout occurred in the northern hemisphere. Was it fair to give compensation to a few UT, NV & AZ county residents? Was it fair when many of the northern Utah counties also received substantial amounts of fallout, but no compensation and had/has 1/3 more cancer fatalities than Southern Utah? Was it fair that the Northeast U.S. received substantial fallout and did not receive compensation? Was it fair that Utah, having the lowest cancer rate in the nation also received compensation and congressional apologies for being downwind of the NTS? Is it fair that the counties receiving compensation also benefited from the testing that made the U.S. the guardian of the free world?

- It has been my intent in going to the trouble of writing and compiling this, mostly history book that readers will see the long-time scientific evidence that refutes the tall tales and misinformation currently being disseminated by regulatory agencies, media, and activists.

- Sincerely, Bruce W. Church, a downwinder and Health Physicist and fellow of the Health Physics Society