The Issue

• We are supposed to be discussing the cleanup of SSFL.
• Nevertheless, the Workgroup at its last meeting devoted a lot of time and energy trying to scare the public about the dangers of radioactive contamination at SSFL resulting from the 1959 SRE accident.
• At the DOE SRE workshop on August 29, 2009, Dr. Tom Cochran of the NRDC agreed that the SRE accident was not a public health risk when it happened and was not a risk in 2009.
• The purpose of my presentation is to give you the information needed to reach the same conclusion as Dr. Cochran, and allow you to possibly persuade others based on your detailed knowledge.
• The SRE accident is irrelevant to the cleanup of contamination remaining at SSFL, which is almost entirely chemical in nature.
• There is no purpose to the ongoing SRE publicity other than fearmongering.
DOE Radiological Activities in Area IV

Systems for Nuclear Auxiliary Power (SNAP):
- Atomic Energy Commission (AEC) program to develop space nuclear power systems.
- A system was launched from Vandenberg Air Force Base on April 3, 1965.
- Remains the only nuclear reactor placed in space by the U.S.

The Hot Lab:
- Used for 30 years to handle, examine, and disassemble highly radioactive items.
- Activities done remotely in heavily shielded rooms.
- Decontaminated and decommissioned in the mid-1990s.

Sodium Reactor Experiment (SRE):
- Atomic Energy Commission program to test a sodium-cooled power reactor.
- Supplied power to the City of Moorpark.
- The first nuclear reactor in the U.S. to produce power for a commercial power grid.
- Partial melting of 13 of the 43 reactor fuel assemblies occurred in 1959, which released nuclear gases.

Radioactive Materials Handling Facility (RMHF):
- Used for packaging radioactive material for offsite disposal.
- Septic tank leach field was contaminated by cesium and strontium in 1962.
- Leach field was cleaned up and released for unrestricted use.
- RMHF remains in use supporting the cleanup of other facilities.
SRE Accident: What Happened

- July 1959, pump fluid leaked into primary reactor coolant, creating a sticky residue.
- Loss of coolant circulation caused overheating of the fuel rods.
- The steel cladding in 13 of 43 fuel rods melted.
- Radioactivity leaked into the coolant and was contained within the reactor.
- The reactor was shut down.
- Some radioactive gasses were released to the air.
- Contaminated sodium coolant was shipped to Hanford, Washington.
Reactor Building

• “The reactor building is not designed as a containment pressure vessel, since the maximum credible accident would not release enough gas volume to require pressure containment. It is designed, however, to retain gases at about atmospheric pressure, and to reduce diffusion leakage of potentially contaminated gas.”
SRE: Back in Operation

- A new core and new sodium coolant were loaded and the reactor continued operation from 1960-1964.
- Decontaminated in early 1970’s, released for unrestricted use and used for storage.
- In 1999, the SRE facility was completely removed.
There are hundreds of fission products, mostly low yields or short-lived and of no interest. Iodine-131 has 8 day half-life. Krypton and xenon are short-lived noble gases and do not interact with matter. The shorter the half-life, the higher the activity.
Detailed Description of SRE Accident

SRE FUEL ELEMENT DAMAGE
AN INTERIM REPORT

OF
THE ATOMICS INTERNATIONAL AD HOC COMMITTEE
R. L. ASHLEY B. R. HAYWARD, JR.
R. J. BEELEY T. L. GERSHUN
F. L. FILLMORE
W. J. HALLETT J. G. LUNDHOLM, JR., CHAIRMAN

GENERAL EDITOR
A. A. JARRETT

(NoV 15, 1959)

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
P.O. BOX 309 CANOGA PARK, CALIFORNIA

CONTRACT: AT(ll-1)-GEN-8
ISSUED:
SRE Operating Conditions

**TABLE III-2**

**REACTOR OPERATING CONDITIONS RUN 14**
*(1700 July 12, 1959)*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power (Mw)</td>
<td>2.7</td>
</tr>
<tr>
<td>Inlet Temperature (°F)</td>
<td>470</td>
</tr>
<tr>
<td>Outlet Temperature (°F)</td>
<td>550</td>
</tr>
<tr>
<td>Flow (gpm)</td>
<td>800</td>
</tr>
<tr>
<td>Fuel-Channel Exit Temperature</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>510</td>
</tr>
<tr>
<td>Maximum</td>
<td>770</td>
</tr>
<tr>
<td>Moderator Coolant Temperature (°F)</td>
<td>650</td>
</tr>
</tbody>
</table>
Radioactivity in Air Monitors

2. High Air Activity

At 1530, both reactor room (high bay area) air monitors showed a sharp increase in activity. In an attempt to reduce the activity level, the reactor pressure was lowered to less than 1 psig from its former pressure of 2 psig. A survey of the loading face shield revealed that an excessive radiation reading existed over the reactor sodium level coil thimble located in core channel 7. The initial reading was 500 mR/hr. A high bay air sample had an activity of $3 \times 10^{-7} \mu c/cm^3$ after 15 min of decay and $4.5 \times 10^{-8} \mu c/cm^3$ after 90 min of decay. At 1620, it was noted that the filter from the air sampler showed an activity level of 160,000 c/m. At 1700, a sharp increase in the stack activity to $1.5 \times 10^{-4} \mu c/cm^3$ was noted. This returned to normal by 2200.
3. Reactor Excursion

At 1728, the reactor power was at about 1.6 Mw, and a planned increase was started so as to be able to deliver heat to Southern California Edison electrical substation. After the start, the power level persisted in rising somewhat faster than expected even though control rods were being slowly inserted in an attempt to hold it back. By 1807, the power had increased to about 4.2 Mw. At this time a negative period of about 45 sec was observed and the power fell to about 2.4 Mw in about 3 min. Control rod withdrawal was started and the reactor restored to criticality at 1811. Control rod withdrawal was continued and the power slowly rose to 3.0 Mw by 1821. At this time the power started to increase more rapidly, so control rod insertion was started. In spite of this rod insertion the rate of power rise continued to increase. Three positive period transients indicating about a 50-sec period were observed at about 1824, and at 1825 a 7-1/2 sec period was indicated. At this time the reactor power was rising rapidly; so the reactor was scammed manually by the operator. The peak power indicated on the recorder was about 24 Mw. An analysis of this sequence of events is given in section IV-D.
Technical Explanation of Excursion

- **Criticality and reactivity (k is multiplication factor)**
  - At critical (k=1) -- no power change
  - Positive reactivity (k>1) -- power goes up
  - Negative reactivity (k<1) -- power goes down

- **Fuel Damage and Loss** - reactivity goes down

- **Control rods inserted** -- reactivity goes down

- **Fission gasses escape from fission gas plenum in fuel element** -- Xe-135 is strong neutron poison -- reactivity goes up

- **Sodium has positive void coefficient** -- gas bubbles and tetralin would add reactivity.
Reactor Shutdown

7. **Reactor Shutdown**

On July 23, it was decided to shut the reactor down, in view of the previously reported high fuel temperature for the element in channel 55 and since the fuel-channel exit-temperature spread was not improving noticeably. Shutdown was set for 1700, July 24. Until 0900, July 24, reactor outlet temperature was kept between 700 and 800°F. A few fuel-channel exit temperatures reached the 900 to 1000°F range. Most of the fuel-channel exit temperatures were below 900°F. At 0950, July 23, a reactor scram was caused by a fast period indication. It was believed that this indication was due to an electrical transient. The reactor was critical again at 1015.
Fuel Temperature

• “During the day of July 22, the fuel temperature recorder on the element in core channel 55 showed fluctuating temperatures in the 1100 to 1200°F range. This cluster was composed of various experimental fuels. The temperatures of six fuel slugs in three experimental elements were being recorded on a point recording instrument located in the high bay area. After the end of this run, a calibration of this instrument was made and it was found to be in good operating condition. This instrument was being repaired during the period July 12 to July 15, so no record from its exists during the power excursion that occurred on July 13.”

• “During the interval between 1400 on July 20 to 1300 on July 21, the instrument in the high bay area which records the temperatures in the experimental fuel elements was not completely operative. At some time during this period the maximum temperature recorded was 1350 °F. An examination of the record on this experimental instrument, made after the end of the run, shows a maximum temperature of 1465 °F recorded at 1300 on July 23.”
Fuel Damage

- Fission gas plenum – initial release of fission products to coolant and cover gas
- Maximum 1-2% of fuel melts if all cladding in hottest portion of core forms eutectic

<table>
<thead>
<tr>
<th>Material</th>
<th>Melting Point (°F)</th>
<th>Boiling Point (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>iodine</td>
<td>237</td>
<td>363</td>
</tr>
<tr>
<td>cesium</td>
<td>83</td>
<td>1253</td>
</tr>
<tr>
<td>sodium</td>
<td>208</td>
<td>1621</td>
</tr>
<tr>
<td>strontium</td>
<td>1416</td>
<td>2523</td>
</tr>
<tr>
<td>uranium-iron eutectic</td>
<td>1328</td>
<td></td>
</tr>
<tr>
<td>uranium</td>
<td>2070</td>
<td></td>
</tr>
<tr>
<td>iron</td>
<td>2800</td>
<td></td>
</tr>
<tr>
<td>uranium dioxide</td>
<td>5189</td>
<td></td>
</tr>
</tbody>
</table>

Peak Recorded SRE Fuel Temperature – 1465 (°F)
DISTRIBUTION OF FISSION PRODUCT
CONTAMINATION IN THE SRE

By
R. S. HART

DISTRIBUTION

This report has been distributed according to the categories
"Reactor Technology" and "Health and Safety," as given in "Standard
Distribution Lists for Unclassified Scientific and Technical Reports,"
TID-4500 (16th Ed.) December 15, 1960. Additional special distribu-
tion has been made. A total of 830 copies was printed.

ATOMICS INTERNATIONAL
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CONTRACT: AT(11-1)-GEN-8
ISSUED: MAR 1 1962
“One of the unique qualities of sodium-cooled reactors with respect to radiological safety is the potential fission product retention ability of the coolant. The principal factors providing this ability are:

(1) the occurrence of chemical reactions between the coolant and certain fission product species leading to less volatile compounds (e.g. NaI), and

(2) the mechanical trapping nature of the liquid coolant for particulate fission products in general. The maintenance of a coolant pool above the core in sodium reactors even with the postulation of severe reactor accidents ensures the continued effectiveness of this capacity.”
Some Conclusions

• “Only Xe and Kr isotopes were found in the reactor cover gas (helium).

• The carbonaceous particulate material, resulting from the decomposition of tetralin which leaked into the primary sodium, proved to be an effective fission product scavenger. A generally non-selective concentration of activity by this material of $10^3$ to $10^4$ times that of the filtered sodium was measured.

• The cold trap located in the primary system was effective in removing fission product contamination.

• Appreciable deposition of fission product contamination occurred throughout the primary piping system. A marked selectivity was evident in this process, with Sr, Ce and Zr-Nb deposition being much greater than that of Cs or I.

• The same sodium is still in use during current operation of the SRE, with only Cs-137 and possibly Sb-125 remaining as significant, dissolved, long-lived contamination. Even these are now reduced to the same order as the Na-22 activity ($10^{-2} \mu$C/gram), and their presence should not appreciably affect future operations of the reactor.”
COVER GAS SAMPLES

• “The first helium cover gas sample during run 14 which gave an indication of unusually high radioactivity was taken on July 18. Since the radiation level at the surface of the 0.2-liter sample chamber was ~30 mr/hr, no further attempt was made to assay the concentration quantitatively. However, assuming that the activity was principally Xe-133 + Xe-135, a rough estimate would place the level at 2 to 10 µc/cc. It is difficult to interpret cover gas samples subsequent to the July 26 shutdown since bleeding and flushing operations to the gas decay tanks and out the stack were almost immediately commenced. A sample taken on August 12, indicated a gross level of about 1 µc/cc. A gamma spectrum scan on September 14, of this sample identified the principal remaining contributions as Xe-133 and Kr-85.”

Notes: Temperature of gas is reduced rapidly as it leaves reactor. Cesium and iodine would no longer be in vapor phase if they were ever present in cover gas. Xe-135 has a 9 hr half-life and would be long gone by September 14. I-131 has 6 day half-life and is not present in gas sample.
Release of Iodine from Uranium Fuel

• Elemental iodine has a low boiling point.
  – When the fuel melts, some radioactive iodine would be released if it existed in the fuel in elemental form.
  – However, the iodine reacts chemically with uranium to form a chemical compound U₁₃, which does not have a low boiling point (see excellent review by Krsul)
    • This is the principal reason why the release of iodine in the accident was small.

• Concern for radioactive iodine primarily arose from the Windscale Accident in England. In that accident, there was a large release of iodine but the chemistry was entirely different from the conditions at SRE.
  – Although the fuel was metallic uranium, it was being oxidized by air flowing through the burning graphite.
Release of Iodine from Uranium Fuel (Cont)

- In modern commercial reactors, fuel is in the form of an oxide rather than a metal.
  - Although this fuel melts at a lower temperature than the melting point of pure uranium dioxide (by forming a mixture with zirconium cladding), this melting temperature is much higher than the melting temperature of metallic uranium fuel.
  - Small differences in temperature have a very large effect on the release rates of fission products.
  - Under the chemical conditions of the oxide fuel, nearly 100 percent of the iodine would be released from molten fuel in a core uncovered accident.

- Mr. Lochbaum was familiar with severe accident behavior in modern commercial (oxide fueled) reactors.
  - This is why he so dramatically over-estimated the release from fuel in the SRE accident.
Release of Cesium from Uranium Fuel

- Elemental cesium also has a low boiling point but higher than that of iodine. However, the amount of cesium actually released as vapor from molten uranium fuel is reduced by two key effects:
  - When there is a contaminant (cesium) in solution in another material (uranium), the vaporization of the contaminant is reduced by the relative ratio of the number of contaminant atoms to solvent atoms. There were 10,000 uranium atoms in the core for each cesium-137 atom.
  - Uranium is an exceptionally good solvent – Retains cesium a factor of 100 better than an ideal solution.
  - Thus, very little cesium would be expected to be released from the molten fuel.

- In contrast, for commercial reactors, in a hypothetical core uncovery accident nearly 100 percent of cesium would be expected to be released from molten fuel.
Fission Products in Sodium Coolant

### TABLE IV-C-3

**ISOTOPIC CONTENT OF SODIUM SAMPLE 8**

(Analyzed August 11, 1959)

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Specific Activity ($\mu$C/gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ce$^{141}$</td>
<td>5.96</td>
</tr>
<tr>
<td>I$^{131}$</td>
<td>0.74*</td>
</tr>
<tr>
<td>Ru$^{103}$</td>
<td>0.95*</td>
</tr>
<tr>
<td>Cs$^{137}$</td>
<td>1.26*</td>
</tr>
<tr>
<td>Zr$^{95}$ - Nb$^{95}$</td>
<td>13.9</td>
</tr>
<tr>
<td>Cs$^{134}$</td>
<td>0.02*</td>
</tr>
<tr>
<td>Ba$^{140}$ - La$^{140}$</td>
<td>3.30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26.1</strong></td>
</tr>
</tbody>
</table>

*Activity determined after chemical separation and corrected to date of reactor shutdown July 26, 1959.

**Note absence of strontium, and presence of iodine and cesium.**
Potential Pathways to the Environment

Sources

Pathways

Area 3 Sanitary Sewer System

Via Stack

Air

Via Building Drains

Surface Soil

Via Surface Water Runoff

Subsurface soils/Bedrock

Via Leaks and Spills

Groundwater

DOE Slide
Environmental Contamination

“A continuous program of routine monitoring of soil, vegetation, water and airborne activity in the Santa Susana area has been underway since 1954. For the last several years, the environmental monitoring program has included monthly sampling of 14 different locations for soil and vegetation and 4 locations for water. A single continuous air monitor is also operated. The sampling locations are shown on Figure IV - C-3.”

“All soil, vegetation, and water samples are analyzed for α and β-γ activity. The analysis is performed by conventional techniques. Analysis of the results obtained from the soil and vegetation samples have clearly indicated increased activity levels resultant from nuclear explosions and rainfall. For example, the relatively large increase noted in both the α and β-γ activity associated with soil and vegetation samples in March and April of 1958 is attributable to a combination of (a) the 3 to 6 detonations of megaton size reportedly set off in eastern Russia in March of 1958 and (b) the rather heavy rainfall that occurred during the last half of March (a total of 4.3 in. from March 14-31.”
"The increase noted in the $\beta$-$\gamma$ activity of vegetation samples taken in October 1958 is attributed to the series of nuclear explosions set off at the Nevada Test Site during the period from September 19 to October 20. This series of detonations included a total of 19 shots, the energy equivalence of which varied from sub-kiloton to about 20 kilotons. The peak in the $\beta$-$\gamma$ activity in vegetation, as found in February 1959, can be attributed to a rather heavy rainfall in the Santa Susana area, amounting to nearly 2 in. in a six-day period."

Note that any cesium from SRE would be no more than from fallout!
Environmental Air Activity

“The activity levels measured by the continuous air monitor (which is of the type that collects activity on a filter paper for a 24-hr period and then counts the $\beta$-$\gamma$ activity collected for a 24-hr period) are briefly summarized in Table IV-C-12.

<table>
<thead>
<tr>
<th>Month</th>
<th>Average $\beta$-$\gamma$ Activity Level ($\mu$C/cm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 1958</td>
<td>$\sim 1 \times 10^{-12}$</td>
</tr>
<tr>
<td>September</td>
<td>$\sim 1 \times 10^{-12}$</td>
</tr>
<tr>
<td>October</td>
<td>$\sim 1 \times 10^{-12}$*</td>
</tr>
<tr>
<td>November</td>
<td></td>
</tr>
<tr>
<td>February 1959</td>
<td>$\sim 1 \times 10^{-12}$</td>
</tr>
<tr>
<td>March to May</td>
<td>$\sim 2 \times 10^{-12}$</td>
</tr>
<tr>
<td>June</td>
<td>$\sim 1 \times 10^{-12}$</td>
</tr>
<tr>
<td>July</td>
<td>$\sim 7 \times 10^{-13}$</td>
</tr>
<tr>
<td>August to September</td>
<td>$\sim 2.5 \times 10^{-13}$</td>
</tr>
</tbody>
</table>

*To October 19; at this time the activity level started to increase, reaching a value of $\sim 10^{-10}$ on October 29; by November 24 the level had decreased to $\sim 3 \times 10^{-12}$.

• The marked increase in airborne activity concentration during the mid and late part of October 1958 further substantiates the data recorded by soil, vegetation, and water sampling; the increase being attributable to the nuclear tests being performed at the Nevada Test Site.
• Fallout is primarily identified by gross decay measurements.
• Considering all the environmental data which is available, it appears that SRE operations have not been responsible for the release of any significant quantities of radioactivity to the environs, at least above that normally accompanying period of rainfall or fallout following nuclear tests.”
SRE Bottom Line – whether you call it a partial meltdown or an accident

• No evidence of cesium or iodine outside of SRE sodium coolant.
• No evidence of strontium except in primary SRE piping.
• Only evidence from SRE gaseous release is krypton and xenon.
• Plenty of evidence of environmental dispersal of strontium and cesium from weapons testing.
• Any strontium or cesium at SSFL did not come from SRE.
• The SRE accident is irrelevant to the SSFL cleanup, except for the unwarranted fear it engenders in the neighboring communities.
Q & A
Workgroup Handout – Misinformation to Generate Fear

“One one-millionth of an ounce of plutonium-239 if inhaled (but is physically impossible!; 140 μ vs. 10 μ) causes cancer with 100% statistical certainty. Cesium-137 is a powerful gamma emitter, irradiating the whole body. Strontium-90 concentrates in the bone, where it causes bone cancer and leukemia. Perchlorate is a thyroid disrupter, where it can interfere with development. Dioxins are carcinogens.”

By Bernard L. Cohen, Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260

Plutonium is constantly referred to by the news media as `the most toxic substance known to man.' Ralph Nader has said that a pound of plutonium could cause 8 billion cancers, and former Senator Ribicoff has said that a single particle of plutonium inhaled into the lung can cause cancer. There is no scientific basis for any of these statements as I have shown in a paper in the refereed scientific journal Health Physics (Vol. 32, pp. 359-379, 1977). Nader asked the Nuclear Regulatory Commission to evaluate my paper, which they did in considerable depth and detail, but when they gave it a ``clean bill of health'' he ignored their report. When he accuses me of ``trying to detoxify plutonium with a pen,'' I offered to eat as much plutonium as he would eat of caffeine, which my paper shows is comparably dangerous, or given reasonable TV coverage, to personally inhale 1000 times as much plutonium as he says would be fatal, or in response to former Senator Ribicoff's statement to inhale 1000 particles of plutonium of any size that can be suspended in air. My offer was made to all major TV networks but there has never been a reply beyond a request for a copy of my paper. Yet the false statements continue in the news media and surely 95% of the public accept them as fact although virtually no one in the radiation health scientific community gives them credence. We have here a complete breakdown in communication between the scientific community and the news media, and an unprecedented display of irresponsibility by the latter. One must also question the ethics of Nader and Ribicoff; I have sent them my papers and written them personal letters, but I have never received a reply.
CANCER DEATHS AND OCCUPATIONAL EXPOSURE IN A GROUP OF PLUTONIUM WORKERS

Abstract -- An exploratory epidemiological study was conducted for 319 deceased nuclear workers who had intakes of transuranic radionuclides and histories of employment during the time period from 1943 to 1995. The workers were employed at various facilities throughout the United States, including the Department of Energy defense facilities and uranium mining and milling sites. The majority of individuals were involved in documented radiological incidents during their careers. All had voluntarily agreed to donate their organs or whole body to the United States Transuranium and Uranium Registries. External and internal dose assessments were performed using occupational exposure histories and postmortem concentrations of transuranic radionuclides in critical organs. Statistical data analyses were performed to investigate the potential relationship between radiation exposure and causes of death within this population due to cancers of the lungs, liver, and all sites combined while controlling for the effects of other confounders. No association was found between radiation exposure and death due to cancer ($> = 0.05$). However, statistically significant associations were found between death due to any type of cancer and smoking (yes or no) (odds ratio = 5.41; 95% CI: 1.42
Cesium Dose
Subarea 6 Cs-137

Note: All doses and health assessments are based on semi-infinite source planes (~100 ft by 100 ft), not a point source. Risks from these point sources are negligible. K-40 gamma ray is twice as energetic as Cs-137.
Breast Cancer Study

California Breast Cancer Mapping Project:
Identifying Areas of Concern in California

November 2012
Figure 1. Areas of concern in California for invasive breast cancer among women

Data Source: California Cancer Registry, 2000-2008, prepared by the California Breast Cancer Mapping Project
West LA/Ventura AOC
Moorpark to Beverly Hills

Note: Increased cancer diagnosis correlates with significantly higher socioeconomic areas, greater access to medical care and cancer screening, and lower proportion of Hispanic women who statistically have lower rates of breast cancer.
More Workgroup Misinformation

The Workgroup Handout says:

- The Public Health Institute’s 2012 California Breast Cancer Mapping Project identified the following cities as “area of concern”: Thousand Oaks, Simi Valley, Oak Park and Moorpark, finding that the rate of cancer is higher than there than in almost any other place in the state.

The report shows:

The report says nothing about cities, and does not even report individual census tracts.
Q & A
Census Tract Data and Cancers

Abe Weitzberg, Ph. D.

October 22, 2014
2010 Census Tracts

2 miles
2010 Census Tracts
1990 and 2000 Census Tracts
BELL CANYON LETTER, 2006

• Addresses census tract 75.03 cancers from 1988-2004.

• Only 297 total cancers observed vs. 283 expected in 16 years.

• Only 7 thyroid cancers observed vs. 7 expected over 16 year period.

**Table 1. Observed and Expected Numbers of Newly Diagnosed Cancers in Census Tract 75.03, Ventura County, California 1988-2004**

<table>
<thead>
<tr>
<th>Cancer Sites</th>
<th>MALE</th>
<th>FEMALE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Sites</td>
<td>OBS</td>
<td>EXP</td>
<td>OBS</td>
</tr>
<tr>
<td>Mean</td>
<td>172</td>
<td>175</td>
<td>128</td>
</tr>
<tr>
<td>Breast</td>
<td>51</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>Lung and Bronchus</td>
<td>19</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Colon and Rectum</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Melanoma of the Skin</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Thyroid</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Non-Hodgkin Lymphomas</td>
<td>12</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Uterine Bladder</td>
<td>11</td>
<td>10</td>
<td>-</td>
</tr>
</tbody>
</table>

* Counts of less than 5 are not presented according to preserve confidentiality of the data based on the guidelines of the California Cancer Registry.
* Not Applicable
MORGENSTERN RESULTS

• Acknowledges lack of precision, transient population, and use of distance as proxy for exposure.
• Uncertainty is worse when one uncertain number is divided by another uncertain number and results presented as a ratio.
• Actual cancer numbers differ from Bell Canyon studies, but are still small.
Bottom Line

• After a presentation containing 102 charts, Dr. Mack concluded:
  “It is not possible to completely rule out any offsite carcinogenic effects from SSFL
  No evidence of measureable offsite cancer causation occurring as a result of emissions from the SSFL was found.”

• In my several conversations Dr. Morgenstern, he said that he was in agreement with Dr. Mack's conclusions.

• Dr. Mack’s conclusions seem to be consistent with all previous studies, and should be accepted by the community as a basis for cleanup decisions.

• Nevertheless, the Workgroup continues to only present a small part of Dr. Morgenstern’s report, and ignores all of his caveats and qualifiers, as well as all of the other reports.

  WHY?
Simple Question

How many people living within two miles of SSFL at the time of the SRE accident in 1959 got thyroid cancer in census area 75.03 in either of Dr. Morgenstern’s time periods (1988-2002)?

Clues: I-131 completely decayed in away in 1959 and perchlorate is not a component of the liquid fueled rockets tested at SSFL. The Bell Canyon development started in late 1960’s.
Q & A