

## **Summary of Cancer Study and Exposure Assessment Activities and Document Release Dates related to the Santa Susana Field Lab (Rocketdyne) Site**

**January 1991-** CDHS released a preliminary report reviewing cancer among residents living in five census tracts located in Los Angeles County and within 5 miles of SSFL in two five year groupings from 1978 to 1987. Census tract age-adjusted incidence rates were found to be significantly higher than comparable county rates in three comparisons: 1) tract 1352 , all sites, 1978 to 1982; 2) tract 1132, bladder cancer, 1983 to 1987; and 3) tract 1352, ANLL leukemia, 1983-1987. Four census tract incidence rates were in the top quartile in both time periods when age-adjusted incidence rates were ranked: 1) tract 1343; bladder cancer; 2) tract 1344, bladder cancer; 3) tract 1344, Hodgkin's lymphoma, and 4) tract 1351, CML leukemia.

**March 27, 1992-** CDHS released a report that examined the incidence of cancer among residents of Los Angeles (1978 to 1988) and Ventura Counties (1988 to 1989). Cancers were divided into three groups of very radiosensitive (thyroid, bone & joints, all leukemia, excluding chronic lymphocytic leukemia), moderately radiosensitive (breast, lung & bronchus), and possibly radiosensitive (esophagus, stomach, liver, brain & other nervous system, urinary bladder, other urinary system, salivary gland and parathyroid, and multiple myeloma). The analyses found that people living near the SSFL were not at increased risk for developing cancers associated with radiation exposure. The analyses suggested that male residents living in Los Angeles County near SSFL may have had an increased rate of bladder cancer relative to residents living elsewhere in the county. There was also an increased proportion of lung cancer among Ventura men.

**September 1997-** Release of the UCLA health study of the Rocketdyne workers who were exposed to radiation. In 1990, the legislature requested an investigation of SSFL Rocketdyne workers to be overseen by the CDHS Occupational Health Branch. The Department of Energy provided funds to the California Public Health Foundation to work with CDHS and oversee the study. CDHS convened an Advisory Panel made up of independent scientists, community and government representatives, and a representative of the union to choose a research team (UCLA) and monitor the progress of the study.

The UCLA study included 4, 607 employees who worked at Rocketdyne between 1950 and 1993. This group had been monitored for radiation exposure and were enrolled in the company's Health Physics Radiation Monitoring Program. The researchers searched death certificates to find out which Rocketdyne workers have died and the causes of death. The study investigators found that among Rocketdyne workers who were monitored for external radiation, those who received higher doses (especially more than 200 mSv) had an increased risk of dying from cancers of the blood and lymph system (such as leukemia and lymphoma), and from lung cancer. As the dose of external radiation among Rocketdyne workers increased, the investigators also found an increased risk of dying from all cancers. They also found that among Rocketdyne workers who were monitored for internal radiation, those who received a relatively higher dose (especially more than 30 mSV) had an increased risk of dying from cancers

of the blood and lymph system, and upper aero-digestive tract cancers (mouth, throat, esophagus and stomach).

**September 29, 1997-** The Tri-Counties Regional Cancer Registry responds to an inquiry from Ventura County Public Health for cancer incidence in Simi Valley. The registry epidemiologist sends a letter to the health director in which he summarizes cancer incidence data from 1988-1995 for 19 census tracts combined. The cancers examined were the same as the CDHS 1992 study except salivary and parathyroid gland cancers were not included in the “possibly radiosensitive.” They found that the residents of the study area appeared to have cancer incidence risk similar to that of the other residents of the Tri-Counties Region, except for leukemia in women which was significantly lower, and cancer of the lung & bronchus which is higher.

**January 1999-** UCLA released the final report for the second part of the DOE-funded occupational study. The addendum report focused on the chemical exposure portion, and included a cohort based on presumed exposure to the hydrazine (6,107 workers with 176,886 person-years) and a cohort with presumed exposure to asbestos (4,563 workers with 118,749 person-years). Employing an internal comparison method described in the 1997 report, this study reported the observed positive association between presumptive exposures to hydrazine and the rates of dying from cancers of the lung.

**June 3, 1999-** CalEPA released an investigation of CDHS’ handling of the health studies at SSFL. The investigation was ordered by Governor Gray Davis in response to Assemblywoman Kuehl’s concerns. CalEPA focused their investigation on the three cancer-related documents described above.

CalEPA found that the combined evidence from all three studies did not indicate an increased rate of cancer incidence in the regions examined. The extremely modest cancer incidence increases associated with known radiosensitive tumors could be easily explained by uncontrolled confounding or impression in the data. The results do not support the presence of any major environmental hazard. Further CalEPA suggested that a population based case study focused on radiosensitive tumors that addresses occupational and environmental exposures to radiation, while controlling for all known risk factors, should be discussed. Alternatively, a study could include socioeconomic data from the census, all types of cancer, all time periods for which data are available, and consistent epidemiologic methods over time, which would improve confidence in the results of the three earlier studies. Further studies should only be embarked upon if the proposed protocol can provide improved exposure assessment and control for confounders, while substantially improving the precision of the estimates.

**December 3, 1999-** ATSDR released a Draft Preliminary Site Evaluation in which they found:

- The preliminary results of the exposure pathway analyses for air, ground water and surface water, and soil and sediment indicate that it is unlikely that people living in communities near the site have been exposed to substances from the site at levels that would have resulted in adverse health effects.

- Although chemicals and radionuclides were released from the site, the likelihood of those releases resulting in human exposure is limited by a number of factors, including; 1) the distance from the release sources to the offsite residential areas that results in rapid dispersion and degradation of oxidants and solvents in air; 2) the predominant wind patterns that normally blow away from the nearest residential areas; 3) other meteorological conditions at the site such as the atmospheric mixing height; and 4) drawdowns in ground water levels that reduce the rates of contaminant migration. Considering these factors, it is unlikely that residents living near the site are, or were exposed to SSFL-related chemicals and radionuclides at levels that would result in adverse human health effects. Changes in site operations, such as reduced frequency of rocket engine testing, discontinuation of trichloroethylene use, and shut down of nuclear operations make it unlikely that future exposures to the offsite community will occur.
- A more in-depth evaluation of exposure pathways that addresses past, current, and future exposure to chemicals and radionuclides from the SSFL should be conducted to improve the assessment of potential offsite exposures and public health implications associated with this site. Such an assessment must be facilitated through community outreach and participation and must include health education activities. ATSDR further recommends that this assessment address the following related issues:
  - More in-depth evaluation of airborne chemical releases from SSFL operations, including air dispersion modeling of past accidents and disposal activities, and compilation and use of a consistent, site-specific meteorological data set to improve the assessment of past exposures to these substances.
  - Development of a regional hydrogeological flow model and additional monitoring at down-gradient springs or seeps in Simi Valley and Santa Susana Knolls to evaluate the potential for deep fracture flow and potential future exposure. Also, even though it may not be related to SSFL, additional source characterization of the perchlorate detection in Simi Valley should be conducted.
  - Additional radiological characterization of Area IV with more sensitive instrumentation and appropriate grid spacing to assure a lower detection limit.
- A re-analysis of the cancer registry data including additional years of newly available cancer data and updated demographic information should be conducted to see if the apparent increase in the incidence rates of bladder and lung cancers persist. A more in-depth evaluation of cancer data should be conducted that addresses environmental exposures from the SSFL, possible confounding exposures from other nearby contaminant release sources, and residential histories.

**2005 and 2006-** UCLA continued their worker study with additional funding to include 5 more years of follow-up, the collection of cancer incidence data, and refinement of the job-exposure matrix to measure trichloroethylene (TCE), mineral oils, polycyclic aromatic hydrocarbons (PAHs), and benzene. The findings were released in journal articles. Zhao et al. (2005) found that TCE exposure was positively associated with the incidence of kidney and bladder cancers and that exposure to mineral oils was associated with the incidence and mortality of several cancers, including lung and

melanoma. Ritz et al. (2006) found a positive association between hydrazine exposure and the incidence of lung and colorectal cancers.

**February 2, 2006-** UCLA's Center for Environmental Risk Reduction releases the final report entitled, "The Potential for Offsite Exposures Associated with Santa Susana Field Laboratory, Ventura County, California". This report was funded by ATSDR. Their findings and recommendations are:

- 1) Past community exposures of concern include (but cannot be limited to):
  - a) Potential chronic exposures to TCE and hydrazine resulting from emissions associated with rocket engine testing and open-pit burning between 1953 and early 1980s. Potential residential receptor locations of inhalation exposure include West Hills, Bell Canyon, Dayton Canyon, Simi Valley, Canoga Park, Chatsworth, Woodland Hills, and Hidden Hills.
  - b) Chronic exposure to TCE and associated degradation products in groundwater from 1953 to the late 1970s via use of private wells east and north of SSFL. Potential receptors include residents using private wells and residents who habitually ingested area-grown crops or livestock.
- 2) There is potential for chronic exposures, in areas within ~1-2 miles of SSFL, which include, but are not limited to:
  - a) TCE, vinyl chloride, and 1,1-DCE in the northeast quadrant off site of SSFL through use of private groundwater wells or from habitual home-grown crop ingestion.
  - b) Arsenic (source unknown) via habitual home-grown crop ingestion in Bell Canyon, Brandeis-Bardin, and potentially all areas north and east of SSFL, including Simi Valley, Dayton Canyon, and West Hills.
  - c) Lead (source unknown) via incidental soil ingestion/inhalation or from habitual homegrown crop ingestion in Bell Canyon and potentially areas east of the facility; as well as extended use of private water wells or habitual home-grown crop ingestion.
- 3) Removal of the large amount of TCE that is estimated to reside in the soil subsurface and groundwater at SSFL is beyond the capabilities of current remediation technologies. Therefore, there is potential for long-term exposure to TCE if contaminated groundwater if it comes in contact with human and ecological receptors and also due to volatilization from the soil subsurface.
- 4) There area areas of exposure concern (AEC) where: (i) contaminant levels exceed health-based standards; (ii) there is potential for exposure; (iii) exposure could result an adverse health effects at the levels detected, include: a) The upper northeast (offsite) quadrant and Bell Canyon. These are areas of exposure concern due to: i) the potential for the use of domestic wells in the northeast quadrant area, and existence of mobile home communities that have used wells in the past, and ii) lead and arsenic levels in Bell Canyon soils and the potential for exposure of children in this area.
- 5) There area potential areas of exposure concern where: (i) monitoring is inadequate; (ii) onsite to offsite transport pathways exist; and (iii) exposure is possible include: West Hills, and Dayton, Woolsey, Meier, Runckle, and Black Canyons.

The researchers made the following recommendations:

- 1) Need data to understand the extent of groundwater contamination especially to understand the DNAPL and TCE.
- 2) Need to know the extent of private well use and location of ephemeral springs that could have potential contamination within three miles of SSFL:
- 3) Considering the ongoing extensive development at and in the vicinity of SSFL, there should be an enforcement of sampling/monitoring of soil/sediment, groundwater, and re-suspended dust for all construction sites.
- 4) Due to extensive onsite contamination, information on potential security gaps is needed for (1) SSFL9-1 and (2) Chatsworth Reservoir9-2. Precautionary defensive measures around these areas should be taken to prevent access to children.
- 5) The following chemicals should be considered for continuing offsite monitoring: PCBs, PCDDs/PCDFs, perchlorate, beryllium, asbestos, arsenic, chromium, mercury, lead, N-nitroso-dimethylamine, TCE and DCE.
- 6) Areas that warrant continuing future monitoring include: Meier and Runckle Canyons, BellCanyon campground, playground and Bell Creek, Dayton Canyon and Creek, Orcutt Ranch, Woolsey Canyon and Creek, Santa Monica Mountains Conservancy / Sage Ranch (ephemeral streams), Black Canyon, West Hills, Brandeis-Bardin Institute campground and garden.
- 7) A comprehensive offsite monitoring of radionuclides is warranted given the recent detection of tritium at levels as high as 83,000 pCi/L in new groundwater wells (Area IV, DOE Community Meeting, Simi Valley, 6/3/2004). Some radionuclides to monitor include: tritium, cesium-137, strontium-90, radium-226/228, plutonium-238, thorium-230, and uranium-235.
- 8) Municipal water supply companies using groundwater wells in Ventura and Los Angeles counties (within 3 miles of SSFL) should regularly monitor for perchlorate, NDMA, 1,4-dioxane, and chromium and assess the ability of their water treatment systems to remove these chemicals.

**2006-** The Boeing Company-funded retrospective cohort study of cancer mortality among Rocketdyne workers is released. The results of this study were published in two journal articles—one focusing on radiation workers, and the other focusing on aerospace workers who tested rocket engines. On the basis of their findings, the authors concluded that “radiation exposure has not caused a detectable increase in cancer deaths” in their cohort of radiation workers. Their study differed in several ways from the first study conducted at UCLA: 1) they included about 1,000 additional workers who were occasionally monitored for radiation, but who were not part of the Rocketdyne Health Physics Monitoring Program; 2) subjects were followed for an additional 5 years through the end of 1999; 3) they estimated radiation doses from biokinetic models for 16 organs or tissues and combined external and internal dose measurements in their analyses of specific cancers; 4) using other databases, they included radiation doses received before and after employment at Rocketdyne; 5) to estimate radiation effects, they compared radiation-monitored workers with unmonitored workers assumed to be unexposed; and 6) they relied heavily on significance testing (whether the null  $p$  value is less than or greater than 0.05) to interpret their findings.

**2006-** The SSFL Advisory Panel (2006), funded by the California State Legislature and the Citizens' Monitoring and Technical Assistance Fund, conducted independent analyses of potential offsite impacts of contamination and accidents at SSFL, in particular the 1959 partial meltdown of a nuclear reactor (the Sodium Reactor Experiment) at the site. The Panel's consultants estimated that, contrary to previous governmental reports, the partial meltdown could have released appreciable amounts of radioactive cesium and iodine—much more than was released at Three Mile Island in 1979—and they estimated that those radioactive releases produced about 260 excess cancers (95% confidence bounds of 0 to 1,800), of which 5% were thyroid cancers. The Panel also assessed the potential for offsite contamination of perchlorate, which is a component of rocket fuel that was used in large quantities at SSFL and is known to disrupt thyroid function in humans. The Panel's consultant determined that perchlorate migrated rapidly off the SSFL site via surface water runoff until it reached the flood plain of the valley floor; then it percolated into the groundwater where it has been detected in several wells in recent years.

**March 2007-** The former UCLA researcher involved in the occupational studies (now at the University of Michigan) released the final report entitled Cancer Incidence in the Community Surrounding the Rocketdyne Facility in Southern California. The study was funded by ATSDR.

The investigators of this study explored the rates at which newly diagnosed cases of cancer occurred in Ventura and Los Angeles Counties between 1988 and 2002 in relation to distance from SSFL. The two-county region was divided into three exposure areas (less than 2 miles, 2-5 miles, and greater than 5 miles from SSFL), and the study period was divided into two follow-up periods (1988-1995 and 1996-2002).

The researchers found associations between distance from SSFL and cancer incidence differed by type of cancer outcome. Standardized incidence rate ratios were close to 1, indicating little or no association, for total cancers and radiosensitive cancers among adults; but the incidence rate of chemosensitive cancers was slightly elevated during both follow-up periods in the population living within 2 miles of SSFL. Results for the 9 specific cancers revealed some elevated incidence rates between 1988 and 1995 among persons living within 2 miles of SSFL. Specifically, the standardized incidence rate ratio was greater than 1.6 for cancers of blood and lymph tissue, bladder, thyroid, and upper aero-digestive tract. Between 1996 and 2002, the rate ratio among persons living within 2 miles of SSFL was greater than 1.6 for thyroid cancer. There were too few childhood cancers to yield informative results.

**2007-** The California Cancer Registry (CCR) was asked by Senator Sheila Kuehl to review the incidence of retinoblastoma in Los Angeles and Ventura Counties, with a focus on the area around SSFL. There was a community concern that the risk of retinoblastoma (RB) was increased in children as a result of potential cancer-causing contaminants in the vicinity of SSFL. Senator Kuehl asked the CCR to update previous analyses that included cases diagnosed through 2002 and showed no excess incidence of retinoblastoma in this area.

Based on the incidence of retinoblastoma among children under age 5 in California, and the population under age 5 in the SSFL area, the number of cases that would be expected to occur in this area between 1988 and 2005 was calculated to be 7.5. The total number of retinoblastoma cases observed in this area between 1988 and 2005 was 11, with a 99% confidence interval of 4.3-22.8 cases. Since the confidence interval around the observed included the expected number, the incidence of retinoblastoma in the area of interest was not statistically significantly elevated.

The age distribution of the 11 cases was: 5 under age 1, 1 age 1, 3 age 2, 1 age 3, 1 age 4. Five of the cases had bilateral disease and 6 had unilateral disease. Nearly half (5 cases) were Hispanic, the remainder were non-Hispanic white (n=3), non-Hispanic black (n=1), non-Hispanic Asian/Pacific Islander (n=1), and unknown race/ethnicity (n=1). All 11 cases were diagnosed in 1998 or later: 1 in 1998, 1 in 1999, 1 in 2000, 1 in 2001, 2 in 2002, 1 in 2003, 3 in 2004, and 1 in 2005. All cases resided in the three neighborhoods with the largest populations (Canoga Park, Woodland Hills, Simi Valley) but there were too few cases to analyze incidence in individual neighborhoods. This analysis is consistent with the 2005 report that showed no significant increased risk of retinoblastoma between 1972 and 2002.