Out of Control – On Purpose:

DOE's Dispersal of Radioactive Waste into Landfills and Consumer Products

Principal Authors:
Diane D'Arrigo
Mary Olson
Nuclear Information and Resource Service

Print Version

May 14, 2007

Nuclear Information and Resource Service
6930 Carroll Avenue, #340, Takoma Park, MD 20912
301-270-6477; fax: 301-270-4291; www.nirs.org

Produced thanks to a grant from the Citizens' Monitoring and Technical Assessment Fund

Out of Control – On Purpose:

DOE's Dispersal of Radioactive Waste into Landfills and Consumer Products

Principal Authors:
Diane D'Arrigo
Mary Olson
Nuclear Information and Resource Service

Contributors
Dr. Marvin Resnikoff
Dan Guttman
Cynthia Folkers
Michael H. Gibson

Print Version

May 14, 2007

Nuclear Information and Resource Service
6930 Carroll Avenue, #340, Takoma Park, MD 20912
301-270-6477; fax: 301-270-4291; www.nirs.org

Table of Contents

Appendices

- A 1999 Tennessee Radioactive Materials/Waste Processors Licenses and Licensees
- B 2006 Tennessee Radioactive Materials/Waste Processors Licenses and Licensees
- C Department of Energy press release: Secretarial Announcement Blocking Nickel Recycling at Oak Ridge and "prohibiting the release of all volumetrically contaminated metals" January 12, 2000
- D Department of Energy press release: Secretarial Announcement of Suspension of Release of Materials (Recycling of Metals) from DOE Facilities July 13, 2000
- E DOE Secretarial Memo on Release of Surplus and Scrap Materials July 13, 2000
- F DOE Radiological Release of Property: Procedural Flow Chart
- G 2001 Tennessee Department of Environment and Conservation (TDEC) Division of Radiological Health White Paper streamlining accepting nuclear waste at landfills
- H 2006 TDEC Memo of Agreement between Divisions of Solid Waste and Radiological Health allowing landfill disposal of radioactive waste as "special" without "permit-by-rule"
- I DOE Internal Order 5400.5 Surface Contamination Release Levels
- J Table of Fatal Cancer Risk from Ionizing Radiation from Nuclear Regulatory Commission's 1990 expanded 'Below Regulatory Concern' policy
- K Public Concerns Presented to Department of Energy re: 2001 Notice of Intent to Prepare a Programmatic Environmental Impact Statement on the Disposition of Radioactive Materials/ Scrap Metals
- L 2007 Freedom of Information Act (FOIA) Request to DOE/NNSA re: All Authorized and Supplemental Radioactive Release Limits, submitted from NIRS
- M "Concentrated Benefit over Diffuse Injury," by John W. Gofman, M.D., Ph.D., and Egan O'Connor, 1993
- N Why Radioactive Wastes Should be Sequestered for the Full Duration of their Hazard: Considering the "MACS Effect," by Judith Johnsrud, Ph.D.
- O Reg. Guide 1.86, Atomic Energy Commission, June 1974
- P References
- Q 3/10/1981 Wall Street Journal article, pg. 1, "Want Skillets That Contain Atomic Waste?"

EXECUTIVE SUMMARY

Background

Are the byproducts of building nuclear weapons–and generating atomic electric power–getting out-of-control—on purpose? Are they winding up in unregulated landfills and unrestricted re-uses, including consumer products? These questions inspired this study by Nuclear Information and Resource Service on the policies and practices for releasing radioactively contaminated wastes, properties and materials belonging to the U.S. Department of Energy in its vast nuclear weapons production complex.

The purpose of this project was to understand how much nuclear weapons-generated radioactive waste, material and property the Department of Energy (DOE) releases into the marketplace. We sought to identify how the radioactivity gets out, legally and practically, and to the extent possible, where it goes. Since the production of atomic power and weapons involves many of the same radioactive-waste generating facilities throughout the nuclear fuel chain, we also sought to understand the larger context in which this man-made radioactivity is managed and released into general commerce.

We reviewed DOE's national and site-specific policies, guidance, rules and procedures which allow some radioactive contamination out of the weapons complex. This DOE-generated radioactivity can go directly to hazardous and solid waste facilities, to recyclers of scrap, concrete, plastics, soil, asphalt, rubble, paper, equipment and other media--none of which are intended to take Atomic Energy Act regulated radioactivity.

Since much basic information about ionizing radiation is written by those who seek to minimize concern about its impact, NIRS offers extensive framing of these issues including the difficulties of detecting radioactivity and concerns about bias and inadequacy of even the fundamental units of radiation. NIRS is mandated to work in the public interest, not the nuclear waste generators' interest. Therefore, we emphasize the effects of small doses on the public and point to inadequacies of the "updated" radiation "protection standards." The standards do not protect all phases of human development and instead assume that the recipient of radiation doses is an adult male, and do not consider all of the known, potential health effects from ionizing radiation.

A timeline of several decades of efforts by U.S. and international government and nuclear advocacy organizations to release and "justify" release of radioactive materials from control, and the opposition, is presented. The key governance on continued control vs. release is reviewed. It is clear from this record that there is, and has been for some time, a concerted and deliberate effort on the part of the Department of Energy to reduce and relieve the burden of radioactive waste that must be under institutional control.

The report has a special focus on Tennessee, which leads the nation in nuclear waste processors, incinerators, radioactive "recycling" and release from control. It gives new meaning to the state's chosen motto, "The Volunteer State," since residents and downwinders are at elevated risk for undisclosed, unmonitored, ongoing radiation exposure.

Key Findings and Recommendations

The key findings and recommendations of this report: *Out of Control – On Purpose: DOE's Dispersal of Radioactive Waste into Landfills and Consumer Products* are:

The US Department of Energy (DOE) on its own and in conjunction with other federal, state and international agencies is directly and indirectly releasing nuclear waste, materials and property from radioactive controls within the vast Department of Energy weapons complex, into the public realm.

DOE is allowing some radioactivity generated by its activities to go to unregulated disposal, recycling and reuse using its internal orders and guidance. By permitting radioactivity to go directly to unregulated destinations and to licensed processors who subsequently release it, DOE is enabling manmade radioactivity to get out into the open marketplace, landfills, commercial recycling and into everyday consumer products, construction supplies and equipment, roads, piping, buildings, vehicles, playgrounds, basements, furniture, toys, zippers, personal items, without warning, notification or consent.

This dispersal of supposedly small amounts is being done without comprehensive complex-wide tracking, without routine public reporting of the releases from each site and processor and usually without independent verification that it is within the self-imposed limits.

The DOE has failed to "improve record keeping or reporting" as required in the Secretarial memo which announced the ban on recycling radioactive metal. No records were found "related to a Headquarters tracking system developed by the Office of Management and Administration" as promised in the 2000 DOE Secretarial Memo. Thus, the public's main questions about where contamination is going remain largely unanswered.

DOE should immediately implement clear, understandable reporting of all radioactive releases including amounts and types of radioactivity and the destinations, including those since the 2000 memo committing to doing so.

NIRS is submitting a new Freedom of Information Act request to the Department of Energy and National Nuclear Security Administration to identify and quantify how much nuclear weapons-generated radioactivity has been released, is being released and may be released and its destinations. Our previous efforts have only begun to answer these questions. We encourage the public to make efforts to track DOE's releases from sites near them. We encourage the public to comment on the DOE's current proposal for "restricted" recycling of radioactive metal.

Ideally, DOE should shift its policies to conform with the precautionary principle and work to prevent deliberate radioactive releases to uncontrolled destinations.

The federal policies that allow radioactive waste out of control, with the important exception of the ban on recycling radioactive metal, are resulting in increased potential for proliferation of radioactive releases into general commerce, unregulated disposal sites, reuse and recycle. The chapter, **Timeline: Efforts to Remove Control Over Radioactive Waste**, reports on decades of the DOE and other nuclear establishment attempts to legalize releasing and dispersing nuclear waste into commerce and uncontrolled disposal. It also includes the successful prevention of those efforts by the concerned public, workers, local and state governments and affected industries.

Some state governments are not working to prevent releases however. The State of Tennessee is licensing processors that can make the determination to "free release" radioactive materials and wastes for reuse, recycling or regular landfills. The report reviews this and identifies some of the landfills that are receiving this waste. The report points out the need for residents of Tennessee and other states to investigate these practices. Other states could be doing the same.

The Department of Energy ban on radioactive metal recycling, in conjunction with active monitoring by the metal industries, appears to be successful in preventing radioactive metal from the weapons complex from getting into commerce in the United States. Most DOE sites we interviewed reported respecting the ban even if the requirements were not incorporated into the written procedural manuals, which is of concern. There are pathways that the commercial nuclear industry could be taking to release radioactive metal since it is not bound by the DOE ban. There are releases of radioactive metal from international sources that must be confronted. There are also loopholes and efforts to bypass the ban that require public vigilance and assertiveness to stop.

The public call has been for the radioactive metal recycling ban to be expanded to cover all nuclear wastes and contaminated materials, not only metals, and the loopholes plugged.

DOE has internal orders and guidance that provide a complicated roadmap to justify releasing radioactively contaminated waste, materials and property in violation of Congressional intent, public will and DOE Secretarial statements made to the public in 2000. The processes used to release radioactively contaminated materials from regulatory control are far from comprehensive, consistent, or protective. DOE provides itself varying release levels and methods of compliance including reliance on institutional memory about whether an object might have been exposed to radiation. The responsible action for DOE here is to use precaution and halt release of any potentially contaminated materials and wastes.

From the public perspective, more work needs to be done to track, identify, demand accountability and stop DOE's radioactive releases. Public interest and environmental organizations along with affected industries especially recyclers and landfill associations, unions and local governments must also continue to track the Nuclear Regulatory Commission and the Environmental Protection Agency pathways for letting DOE and commercial nuclear waste out of control—on purpose. Public health, public interest, environmental organizations and the general public should join international allies in rejecting international recommendations that could lead to increased release of radioactive materials in the U.S. and around the world.

CHAPTER 1: INTRODUCTION AND OVERVIEW

The objective of this study was to identify the national and site-specific policies, laws, regulations and procedures regarding the management and release (or clearance) of radioactive wastes, materials and property from the Department of Energy (DOE) nuclear weapons sites. The goal was to compare the national policies to the actual practices being carried out at several sites: some closing and some continuing operation, some with on-site or easy access to disposal capacity and some with more limited access.

The Questions

First, we wanted to get as much information on the question of what everyday products are likely to be contaminated with nuclear weapons or power waste. What steps does the waste take to get out-of-control and into the items we contact daily?

The commitment to greater public information on releases would be key to answering this but the promised information mechanisms are not materializing.

Second, we sought to identify the various ways that DOE lets nuclear waste out of its control, intentionally, directly, indirectly.

Another important question posed was whether DOE's national bans put in place in January and July of 2000 (prohibiting the release of potentially radioactive metal into commercial metal recycling and requiring comprehensive and publicly available records) are being implemented at the sites. We intended to identify what impacts, if any, the national policies were having at the various sites.

We provide a timeline revealing the maneuvering of multiple entities: state, federal and international to legalize letting nuclear waste out-of-control.

The Findings

The most important finding of this project is that the US Department of Energy (DOE) on its own and in conjunction with other federal, state and international agencies is working to facilitate the direct and indirect release of nuclear waste, materials and property from radioactive controls within the vast Department of Energy facilities complex, into the public realm. DOE is allowing radioactivity generated by its own activities to go to unregulated disposal, recycling and reuse. By permitting radioactivity to go directly to unregulated destinations and to licensed processors who subsequently release it, manmade radioactivity could be getting into the open marketplace, commercial recycling and into everyday consumer products, construction supplies and equipment, roads, piping, buildings, vehicles, playgrounds, basements, furniture, toys, personal items, without warning, notification or consent. There are some important exceptions but the overall trend, guidance and pressure are increasing in the direction of "clearing" radioactivity from control rather than preventing release with a goal of isolation.

Even though there are many DOE and contractor staff who are sincere and dedicated, the incentive in the system in which they are working is designed to release radioactive waste, materials and property from regulatory control. Common sense incentives for recycling and reuse of non-contaminated materials are being inappropriately applied to radioactive wastes, materials and properties from DOE nuclear weapons production.

DOE has unilaterally chosen allowable radioactive contamination and public exposure levels to facilitate operations and "clean-up" at its sites.

Even though public opposition to release of radioactivity is clear and consistent in the United States, and Congress revoked the policies for deregulating nuclear wastes, materials, emissions and practices back in the 1990s, DOE is proceeding on its own and in conjunction with Tennessee-licensed facilities to release radioactive waste from radioactive controls by sending it to unregulated destinations –for disposal, recycling or reuse in everyday commerce.

The Radioactive Metal Recycling Bans

In 2000, the Secretary of Energy banned the commercial recycling of potentially radioactive metal (see Appendices). Although the ban leaves several loopholes for radioactive metal to get out, and there have been efforts within DOE to circumvent these bans, nonetheless, it is likely that much less radioactive metal is making it into the marketplace than otherwise would have absent the moratorium and suspension. But this could change without notice.

The secretarial bans do not apply to metal disposal or to reuse of metal equipment, components, pipes, or to the disposal, reuse or recycling of other materials such as soil, concrete, asphalt, chemicals, carbon for filtration, wood, plastic, equipment, buildings, land, or any other substances or properties. DOE is now (2007) interpreting that the bans do not apply to "restricted" recycling of radioactive metal even though the restrictions may not keep the metal out of commerce as was the intent. DOE is reviewing "expressions of interest" by companies that would recycle DOE radioactive metal for supposedly "restricted" use with no guarantees it would stay restricted for as long as it is radioactively contaminated.

Some mixed radioactive and hazardous wastes are being disposed at hazardous waste sites with no controls or regulations to protect from radioactivity. A previous DOE ban from the early 1990s that prohibited DOE sending potentially radioactive waste to hazardous waste sites, has apparently been reversed. In other words, DOE has determined that some amount of radioactive contamination is acceptable and can be sent to hazardous waste sites not designed to receive or isolate it.

DOE is also "flexible" for better or worse. The allowable contamination levels are custom fit for each site and each waste stream to facilitate their release or "clearance." This flexibility makes assessing DOE policy on the release of radioactivity and its application extremely challenging and complex. This report shares some of the information on how DOE controls, and releases from control, excess property, material and waste that could be radioactive.

Independent Verification—or lack of it

We discovered in the course of this examination that judgments on the disposition of wastes, materials and properties and on whether to do 'independent' verification are left to individuals with conflicting responsibilities and motivations. Especially at sites that are closing, managers with incentives to quickly release the entire site from restrictions and controls have the option of choosing to have their measurements and procedures "independently" verified at their own expense or, alternately, to skip that step. They, with budget restrictions and profit incentives, are the final decision makers on whether to pay to send wastes to radioactive disposal sites, donate it or to sell it into "recycling" and commerce.

We observed some of the procedures used to detect radioactivity and learned of situations in which it was not detected on materials that had been released.

The Sites

We reviewed seven DOE/NNSA sites with varying levels of detail. These sites were Oak Ridge, Tennessee; Mound, Ohio; Fernald, Ohio; Rocky Flats, Colorado; Los Alamos, New Mexico; Paducah, Kentucky and West Valley, New York.

Release Mechanisms –How Radioactive Waste Can Get Out-of-Control

Although metal from radiological areas is prohibited from going to commercial recycling we questioned whether it was getting into recycling via loopholes such as being sent to waste sites not regulated for radioactivity where it could be scavenged, or being sent to facilities with licensed radioactive processors who could subsequently release it to recycling.

Several agreement-state licensed processors in Tennessee have permits to make their own determinations on releasing or clearing radioactive materials, wastes and sites from regulatory control.

There is also the loophole permitting reuse of radioactive materials within the nuclear industry—DOE, NNSA, NRC and Agreement-state licensees--but not requiring it to be treated as radioactive, setting the stage for secondary or subsequent release to unregulated destinations.

Another question of great concern is if and how non-metal radioactive wastes, materials, equipment and properties (none subject to the year 2000 national prohibition on commercial recycling of metal) are being released, to unregulated destinations such as solid and hazardous waste sites, commercial recycling, or directly or indirectly reused as if not radioactive. Concrete, asphalt, chemicals, soil and other substances are being free released if they are not in controlled areas or they are determined to be within DOE's unilaterally "acceptable" calculated doses or surface contamination levels. Equipment, furniture, buildings, areas and rooms can be released for public reuse, sometimes relying on institutional memory that they were never exposed to contamination or, if they were, that they meet the criteria for free release.

Finally, efforts were made to determine whether the national requirements for improved record keeping across the board at DOE and NNSA are being implemented. We traced how "clean" materials are managed and released. We also tracked how and by whom the determination is made about what is "clean," or rather how much radioactive contamination is allowed on "clean" waste, materials, properties and equipment that is released to unrestricted destinations. Some sites demonstrated scanning procedures.

Our exploration delved into who decides what is contaminated and how hard they look—DOE screening and scanning procedural guidance clearly encourages and incorporates the concept of releasing rather than isolating radioactively contaminated wastes, materials, property, equipment and sites.

The project was originally intended to observe and track releases with independent monitoring equipment such as a multi-channel analyzer. This proved to be very expensive, complicated and difficult, leading to reaffirmation of that the burden of proof should fall to the generators of radioactive waste to prove the absence of radioactive contamination from the DOE's activities rather than on the public to prove the presence.

The chapters on radioactivity describe some of the characteristics of radiation and radioactivity. The conclusions and where we go from here identify suspected avenues that will lead to more radioactive waste getting out-of-control and suggesting closer scrutiny by the public to prevent that from happening.

The Team

Nuclear Information and Resource Service (NIRS) has been tracking U.S. and international efforts by nuclear waste generators and regulators to deregulate radioactive wastes and materials since the 1980s. Several NIRS staff experts participated in this project, including Diane D'Arrigo, Radioactive Waste Project; Mary Fox Olson, NIRS Southeast Office Director; and Cynthia Folkers, Health and Environment Project. NIRS developed the project, compiled, reviewed and analyzed the DOE documents, pursued independent research and participated in the headquarters and site specific interviews.

Dr. Marvin Resnikoff, PhD., nuclear physicist and principle of Radioactive Waste Management Associates, and Amanda Schneider, former associate, provided radiological and technical expertise regarding the project scope and implementation. They provided important input regarding the types of radioactivity at DOE sites and at off-site locations suspected to have received DOE-generated radioactive wastes and materials.

Michael Gibson, former electrician at the US DOE Mound facility, presidential appointee to the Energy Employees Occupational Illness Compensation Program Act Federal Advisory Board on Radiation and Worker Health, and former officer of the Paper, Allied-Industrial, Chemical and Energy International Union local and Atomic Energy Workers Council, trained in use of the detection instrument and participated in the interviews at Mound and Fernald.

Dan Guttman, attorney, educator, advisor to government and NGOs, former commissioner to the U.S. Occupational Safety and Health Review Commission and executive director of the Presidential Advisory Committee on Human Radiation Experiments was instrumental in the development of the project scope, organization and initial research. Due to relocation as a Fulbright Scholar in China, he did not participate beyond the early stages.

Residents and safety advocates in the vicinity of some of the DOE sites and near sites that are believed to have received radioactive materials or wastes from DOE provided input, perspective, historical knowledge and encouragement.

Funding for this project was provided by the Citizens' Monitoring and Technical Assessment Fund.

CHAPTER 2: IONIZING RADIATION

Since this report explores the addition of radiation doses from man-made radioactivity to "background" radiation exposures received from sources in nature, it is important to offer the reader some basic information on the distinction as well as new perspectives.

Radioactivity refers to unstable atoms (elements) that emit particles and waves of energy from the nucleus, called ***ionizing radiation***.

Radiation refers to the particles and waves of energy emitted from a radioactive element.

Radioactivity occurs naturally in the Earth, since when the planet was formed, some of the matter was radioactive. Extraterrestrial radioactivity arrives on Earth with meteors and other objects, and penetrates the atmosphere from the sun and other sources in outer space.

Ionizing radiation means that the energy in the particles and waves is great enough to change the electric charge of atoms and molecules it hits, and therefore its chemical nature. Disruption of electrical and chemical processes in living systems takes its toll. Ionizing radiation, particularly alpha particles, can cause physical, structural damage to cell components including chromosomes. Radiation can initiate, or contribute to, mutations in genes. Genetic damage can cause a large array of health impacts in the individual--notably cancer; it can also produce birth and other defects in subsequent generations.

Uranium is bound in rocks and typically lies underground. To make nuclear power and weapons it is dug up, extracted from the rocks, crushed, processed and separated from the other elements in the natural ore.

Uranium is sought because the nucleus of the uranium 235 atom can be split–or fissioned--in a self-sustaining reaction. Splitting the atom releases energy in the form of heat, neutrons and smaller radioactive and non-radioactive nuclides. Since there is a lot of binding energy in each uranium atom, it is a very concentrated power source. A portion (~30%) of the heat from fission is harnessed to make electric power, or unleashed to destroy whole cities in a microsecond. Heat or thermal pollution (~70%) is a byproduct of all fission, in addition to radiation and radioactive waste.

Splitting atoms is called fission. Traces of non-androgenic (not man-made) fission have been found in the most concentrated uranium deposits, but for the

RADIATION UNITS

RADIOACTIVITY UNITS

In general, a **disintegration** is an alpha or beta particle or gamma ray being forcefully emitted from the nucleus of an atom. (Other subatomic particles including neutrons, protons, positrons and electrons can burst from the nucleus.)

Becquerel (Bq)
1 Bq = 1 disintegration per second; 1 Bq = 27 picoCuries (see below).
The Becquerel was named for Henri Becquerel who shared the Nobel Prize with the Curies for the discovery of radioactivity.

Curie (Ci)
1 Ci = 37 billion disintegrations per second = 37,000,000,000 Bq = 3.7 x 10^{10} Bq

The Curie was named for Marie Curie, co-discoverer of radioactivity. One Curie is a very large unit. One gram of radium emits one Curie. Fractions of a Curie are reported in metric subunits:
millicuries (1 mCi = 10^{-3} Ci) a thousandth of a curie = 37,000,000 Bq
microcuries (1 uCi = 10^{-6} Ci) a millionth of a curie= 37,000 Bq
nanocuries (1 nCi = 10^{-9} Ci) a billionth of a curie = 37 Bq
picocuries (1 pCi = 10^{-12} Ci) a trillionth of a curie = .037 Bq

Each alpha or beta particle or gamma ray has a characteristic amount of energy as it is hurls from the nucleus of an atom. These energetic particles and rays zoom out hitting other atoms (that comprise air, water, solids, living tissue, etc.) and **ionizing** them (changing their charge) by knocking their electrons out of orbit. This can disrupt cell functions and initiate disease. The amount of energy imparted on a target such as a plant or animal tissue can be measured but requires a destructive assay. When living tissue is hit, it is not possible to actually measure the energy absorbed or damage done, so calculations are done to estimate dose. To convert from amount of radiation to amount of damage requires knowing which particles or rays imparted their energy at what angle. It can be a complicated calculation. Studies now indicate that cells that are not directly hit can also be damaged. This additional injury is not included in dose calculations.

most part, fission occurs because of human activity in operating nuclear power and weapons reactors, or with the detonation of a nuclear weapon.

Splitting atoms results in radioactive elements known as fission products that are the lighter atoms that form, literally, from the fragments of the larger atom. Many of these elements are present on Earth in non-radioactive, stable forms. The radioactive forms of these elements, known as radioisotopes or radionuclides, include cesium-137, strontium-90, and an alphabet soup of others. [See box on Fission Products.]

Plutonium, americium, and other elements heavier than uranium, called transuranics (TRU), are formed when neutrons are absorbed and electrons emitted from the Uranium-238 nucleus. Neither radioactive fission products nor transuranics can be found concentrated in large quantities except as a byproduct of human activity; therefore they are termed androgenic (man-made) radioactivity rather than naturally occurring.

Radioactive elements decay. 'Decay' is the term for each emission of radiation that an unstable atomic nucleus gives off in its own unique journey towards stability. Each decay event produces either energetic particles or waves of energy and also results in a transition of the atom to a new elemental form. Uranium decays through a very long sequence of 15 steps; in the end uranium becomes stable lead.

Radioactive emissions from decay processes are typically lower energy than those generated in the moment of atomic fission. Decay is generally described in terms of the time it takes–each atom decays spontaneously, however each radioactive isotope has a characteristic period of time it takes for half of a given quantity to undergo decay. Some half-lives are so short as to be nearly instantaneous, while others, like the most common form of uranium (4.5 billion years) are so long that Earth is just now completing the first half-life.

One Dose Is Never the Same as Another

Many documents describing radiation assume that all radiation doses are the same. A classic assertion is that "radiation is radiation" or "a rem is a rem." Dr. Donnell Boardman, a physician who treated many radiation workers during his career, made the case that it is physically impossible for any two radiation doses to be "the same." Dr. Boardman's point was that the impact of the radiation will always have as much to do with the health and unique genetic make-up of the recipient, as of the radioactivity itself.

RADIATION UNITS (continued)

DOSE UNITS

Rad (r) -- an absorbed dose of radiation; an amount of ionizing energy deposited per unit mass in matter (such as tissue); 1 Rad = 0.01 joule of energy absorbed per kilogram of matter;
1 Rad = 1/100th Gray = 10 milliGray; RAD stands for Radiation Absorbed Dose; used in the U.S.

Gray (Gy)[1] – an absorbed dose of radiation; an amount of ionizing energy deposited per unit mass in matter (such as tissue); 1 Gy = 1 joule of energy absorbed per kilogram of matter;
1 Gray = 100 Rads; Gray is the international unit, named for a pioneer of radiobiology.

Rem (r) – a calculated unit expressing the amount of biological damage to tissue from absorbed ionizing radiation; it is calculated by multiplying the amount of energy absorbed (in Rads) by a factor for the amount of damage inflicted by the kind of radiation absorbed;
1 rem = 1 rad x "biological efficiency" (varies for type of radiation)
Alpha particles do 5 to 20 times or more damage than gamma rays to tissues they hit, so give higher doses in rems than gamma. The rem is a large unit, often reported in subunits such as millirems (mr). **1 rem= 1,000 mr = 10^3 mr; 1 rem = 0.01Sv = 10mSv; 1 mr = 10 uSv**

Sievert (Sv) – an expression of biological damage to tissue from ionizing radiation; a dimensionless derived unit expressing "equivalent dose" which is the absorbed dose (in Grays) multiplied by a factor that accounts for biological harm. "For beta, gamma and X-rays, 1 Gy is the same as 1 Sv, but neutrons and alpha rays are more damaging and, for these, 1 Gy is worth between 5 Sv and 20 Sv."[2]
1 Sv = 1 gray x radiation quality factor (specific to radiation source);
1 Sv = 100 rems; 10 microSieverts = 1 millirem
This (10 uSv or 1 millirem) is the annual dose that some in the radiation establishment claim is an "acceptable" risk or trivial exposure from an unlimited number of deregulated nuclear waste streams. Some say it is not. Most have never been asked.

[1] derived from UK National Physics Laboratory –Beginners Guide to Measurement-Ionising Radiation http://www.npl.co.uk/publications/ionising_radiation/#instruments accessed 3/23/07

[2] UK National Physical Laboratory Beginners Guides to Measurement - Ionising Radiation http://www.npl.co.uk/publications/ionising_radiation/#units accessed 3/23/07

RADIOACTIVE EMISSIONS

Radioisotopes or radionuclides are atoms with unstable nuclei, which emit energy in the form of particles or waves while becoming more stable. The nucleus of an atom is composed of protons and neutrons; an electron field surrounds it. The energetic particles and waves are formed as they are emitted and are the result of changes in the protons, neutrons or electrons.

Radioactivity is the event–the emission of the particle or wave of energy from the radioisotope. It also refers to the unstable atoms themselves which, depending on their location and origin may be termed "radioactive waste," "radioactive emission," "radioactive contamination," etc.

Radiation is the particle or wave of energy once it has been discharged from the unstable atom and is traveling/impacting a target.

Ionizing Radiation – both particles and waves resulting from radioactive decay or fission have sufficient force to knock an electron off atoms in the target, leaving behind an ion or electrically charged atom or molecule, potentially resulting in chemical changes within the system. This is not the only type of damage that particle and wave radiation can inflict on living cells and tissues. Particularly in the case of particle emissions, damage resulting from radiation exposure may include structural damage to biological building blocks such as chromosomes, DNA itself, complex biochemical molecules and other cellular components. This may lead to cancer or genetic effects to offspring.

Ionizing Energy Wave Emissions

The electromagnetic spectrum describes energy that has no mass, and includes heat, light, and higher energies called "rays." Rays are composed of energy moving in very short wavelengths, in a linear fashion, with directionality. X rays and gamma rays pack sufficient force to chemically alter other atoms, and to damage biological structures. The term ionizing applies because these energy rays have sufficient force to knock an electron off another atom. The loss of an electron in the target leaves it in a charged, or ionic, state thereby changing its reactivity, and likely its biochemical functionality.

X Rays – originate from the electron field of an atom. Medical x rays are produced by a machine, and do not result in radioactive waste. Most x rays resulting from non-medical activity are the result of the bombardment of certain shielding materials (e.g. lead) by an intensely radioactive source.

Gamma Rays – originate from the nucleus of an atom that has too much energy. The gamma ray is released as the nucleus becomes more stable. Often gamma emissions come after the release of a beta particle.

Gamma and X rays have a similar quality of impact on living tissue. Both x rays and gamma rays are officially assigned the "biological effectiveness" or "quality" factor of "1" in dose calculations, such that 1 Rad = 1 Rem.

Ionizing Particle Emissions

The laws of our universe (the second law of thermodynamics, to be exact) dictate that all matter will move towards its lowest energy state, unless there is an input of energy that reverses this process. In the case of unstable radioactive atoms, there is too much energy in the nucleus (this may be the result of the fission of a larger atom) or it is not balanced. The movement to lower energy can be seen as a dance and each type of matter has its own steps and tempo. Particle emissions are key in this dance since the particle is an enormous block of energy. The departure of a particle from the nucleus leaves a new configuration of protons and neutrons, and therefore a new atomic (or isotopic) identity; the atom that was there is gone, and what is there is a different atom.

Alpha – Alpha particles are made up of 2 protons and 2 neutrons. Except for the extra energy expressed as motion, alphas are the same as the nucleus of a helium atom. Alpha particles are enormous by comparison to beta particles – on the order of 8000 times larger. Since the loss of an alpha particle removes protons from the source nucleus, atomic transformation occurs and a different element emerges. Only the heavier elements emit alpha radiation. Both uranium and plutonium emit alpha particles. Due to the large size of the particle, the alpha cannot penetrate skin, however if emitted by a radioisotope inside the body, alpha radiation is the most damaging form of radiation. Some studies focusing on damage to individual cells have found that it takes as many as 1000 x-rays to inflict the same level of damage inflicted by a single alpha particle.
Alpha particle emissions, like waves, travel with directionality in a linear path. Since they have both mass and velocity, they exert a much greater force on any target than gamma or x-rays, and are therefore poten-

tially more destructive. Radiation from alpha particles and neutrons has a “biological effectiveness” or “quality factor” greater than 1, so 1 Rad ≠ 1 Rem if the radiation exposure includes alpha particle emissions. Peer-reviewed research suggests that current official values for “biological effectiveness” (damage) are not accurate, that radiation is more damaging than currently acknowledged, and therefore even our fundamental units of dose may not accurately reflect what is really happening.[1]

Beta – Beta particles emerge from the atomic nucleus when a neutron transforms into a proton. Essentially a turbo-charged electron, the beta particle is ~ 1/2000th the size of the proton that is left behind in the nucleus as it departs. Since atomic identity is determined by the number of protons in the atom’s nucleus, the departure of a beta particle means that elemental transformation has occurred. Often additional energy is discharged by the nucleus in the form of a gamma ray after the beta particle leaves. Beta particles can travel at a wide range of speeds, reflecting the amount of additional energy they carry. High- energy beta particles can penetrate skin, whereas lower-energy betas bounce off. Nonetheless, any beta particle is more damaging if it is emitted inside the body. Internal exposures result from radioactive food, water, inhalation of gases and particles, or by injection.

Neutron – single neutrons are emitted from an unstable nucleus. Neutrons are about ¼ the size of an alpha particle, and may occur as part of the natural decay processes. Most intense neutron radiation occurs as the result of atomic fission. Nuclear reactor operation, nuclear weapons detonation, or any other self-sustaining nuclear chain event, result in massive neutron release. Neutron radiation also dominates the doses to workers and proximal public during the transportation of irradiated nuclear fuel. Neutron bombardment can activate metal—making it radioactive.

Collateral Damage: Biochemical Nonsense

Radioactive decay–particularly the steps that result in one atom transforming into another–has the potential for biochemical “collateral damage” that is rarely discussed in primers on radiation. In addition to the destructive force of the particles and rays, there is also the matter of the chemical attributes of the “parent” atom vs. the chemical attributes of the “progeny” atom. If the radioactive element in question is already incorporated into a biological structure–or complex molecule active

[1] Committee Examining Radiation Risks of Internal Emitters, London; www.cerrie.org; ISBN 0-85951-545-1; October 2004

RADIATION RISK:

Even though radiation causes myriad more health effects than cancer, radiation risk typically is expressed as the number of cancers or fatal cancers in a population exposed at a given dose or dose rate, or the likelihood one will get cancer if exposed at a given dose or dose rate.

According to the National Academy Sciences’ most recent reports on radiation risks (Biological Effects of Ionizing Radiation: BEIR V and VII), there is approximately a 1 in 1000 chance of getting cancer when exposed to 1,000 millirads (mr) or 1 in a million at a millirad.

Specifically, according to **BEIR V** (National Academy of Sciences 1990) and EPA FGR 13 Federal Radiation Guidance, the risk of getting cancer is **8.46 per 10,000 population at 1000 millirads**. **BEIR VII**** came out in 2005 and reported that the risks were about 30% higher. The projection is that there will be **11.41 cancers per 10,000 population at 1000 millirads**. The new risks are higher, but there is much uncertainty so in general the risk rounds out to about 10 per 10,000 at 1000 millirads or 1 in 1000 at 1000 millirads or 1 in a million/millirad.

But the claim is that exposures are from to a few a millirads (mr) *per year so multiply times the number of years of exposure…*

That means if a person gets a millirad a year for 35 years that they have 35 in a million or 1 in 28,571 chance of getting cancer from that exposure. Over 70 years the risk is 1 in 14,286. The general rule in calculating cancer risks is that half the cancers induced will be fatal. We can easily be exposed to more than one of these releases and for continuing duration…and DOE permits “a few millirads per year” for an unlimited number of releases. There is no meaningful verification or enforcement of the millirad or a-few-millirad or even the 25 to 100 millirad levels that DOE permits for public exposure to ionizing radiation.

Even natural background radiation from cosmic rays and rocks with uranium decay products in them increase our risks but those are generally unavoidable risks. Additional exposures (no matter what percent or multiple of the background they may be) add additional risks.

** Millirads are about the same as millirems when the exposure is from gamma rays and beta particles. Alpha particles cause more damage -- more millirems per millirad--because they pack more punch in the shorter distance they travel.*

** Biological Effects of Ionizing Radiation *BEIR VII Phase 2, Health Risks From Exposure to Ionizing Radiation*, Board on Radiation Effects Research, Div on Earth and Life Studies, Nat’l Research Council, Nat’l Academies of Science, Nat’l Academies Press, Wash, DC, June 29, 2005, page 500 of prepublication copy.

in a living system–then the consequences of this atomic transformation may have additional biological impact.

A simple example is a radioactive phosphorus (P32) atom bound in a sugar molecule: When the phosphorus decays it emits a beta particle, and becomes sulfur 32. In addition to the potential damage from the beta particle, the sugar molecule will be transformed thanks to changes in the chemical characteristics of sulfur. The resulting biochemical nonsense may or may not be significant, but is the direct consequence of internal radioactive emissions

CHAPTER 3: RADIATION DETECTION AND RELEASE

It is expensive and difficult to monitor and detect all the forms and levels of ionizing radioactivity that are being and could be released and recycled. Although man-made radioactivity can be distinguished from naturally occurring if enough effort and expense are expended, this is not the routine.

Human beings cannot sense radioactivity. Unlike dirty pollution that people can see, smell and taste, radioactive emissions are invisible. While some extremely high levels of radioactivity can cause a "glow in the dark" effect, lower levels don't glow but still pose a life-threatening hazard. There is no level of radioactivity that is safe, as even naturally-occurring background radiation at background levels causes some cancer, birth defects and other radiation health effects. DOE and other generators of radioactive wastes, materials and emissions are attempting to codify and implement rules, procedures and guidelines that allow them to release radioactivity and emit radiation that adds to the ongoing health impacts that originate from natural background radiation.

Key to the justification of these releases of radioactive material, waste and property from the nuclear weapons complex is the technical challenge of detecting radioactivity. It bears repeating: we cannot sense radioactivity or radiation. It was the Mescalero Apaches, once targets for a high-level nuclear waste dump, who coined the phrase "invisible bullets" to describe radioactivity.

A compounding factor in the discussion (primarily in justification of costs) is the fact that most radiation health impacts are not immediate or immediately visible—they can occur well after the radiation exposure or exposures. Even extremely small radiation doses have the potential to cause cancer but the effects of such an exposure may not be seen for several years (latency periods can range from 2 to more than 20 years). Causing cancer by such preventable exposures has been called the "perfect crime."

The inability to detect radioactivity with our own built-in sensory apparatus means that we must turn to engineered detection devices. These instruments must be maintained, calibrated and used by trained, experienced people in a system designed to detect the kind of radiation that is present. Historical knowledge, if accurate, can help but can also be incorrect. This means that time, and therefore money, must be expended. Radiation detection can be costly and complicated.

Since the health consequences of this increased radiation exposure are not easily identifiable and quantifiable, they are basically ignored or denied. Isolation and management of the waste as radioactive is proclaimed to cost too much. Meanwhile DOE, its contractors, processors and community-reuse organizations (which hope to receive some of the revenue) focus on profits to be made from the sale, "recycling," and reuse of contaminated property and materials while denying the presence of radioactivity or the health dangers or both.

When the radiation source is strong--concentrated and penetrating--detection is not as difficult. Hot spots can elude detection, though, if the process is not thorough. When radioactivity is weaker, slower decaying or well shielded, then "picking it up" is more challenging, and requires multiple readings and more time. The collection, management and analysis of multiple data points become very demanding if done properly.

In addition, measurements are confounded by the fact that radioactivity is not a static parameter–it is a series of events (see section on radioactive emissions)--each of which may require different detection strategies. Some detection systems record gamma and x- rays but cannot detect alpha and beta particle emissions at all; others will detect some alpha and beta particles, but not as reliably. There is no one instrument that can detect **all** of the manmade radioactivity present since all detectors can detect only the radioactive emissions that actually hit the probe device. All of it is a matter of sampling.

Taken together these issues reveal that aspects of radiation detection are fundamentally institutional issues, and the veracity of the finding rests on basic questions like:

- Who decides what type of radioactivity to look for?
- On what basis is that decision made?
- Who does the data collection – are they trained? Do they have experience?
- Is there motivation or incentive to find or to miss the radioactivity?
- Is the appropriate monitoring equipment being used?
- How is it calibrated?
- What are the budget and budgetary pressures?
- How much time is allowed?
- How is data collected and stored?
- What models are applied to the data during analysis?

In other words, how do we believe a statement about detected radiation if the protocol used during detection is not credible? Any radiation survey is subject to issues of credibility if it does not address parameters like these in a systematic way.

Radiation detection is an effort to count the number of disintegrations from the nuclei of radioactive material. Some simply measure gamma hits. With a sensitive window, some can count alpha and beta particles. Some instruments (multi-channel analyzers) can identify the type and amount of radionuclides by the characteristics of the gamma rays emitted.

Some extrapolation and a variable level of uncertainty are involved with all the instruments and methods. The uncertainties compound when a radiation dose is then calculated from the measurement.

Radiation workers, victims and the public are left in a realm where it is very difficult to get "hard information." Indeed, in a very famous case, the victims of Three Mile Island were left with no recovery of any damages in a court proceeding that required that they prove that they had received a radiation dose above a certain level. The court upheld the finding offered on behalf of the dose perpetrators that it was impossible for any victim to prove any level of radiation dose at all, thus forcing the victims to bear all the liability.

One of the first radiation detection instruments invented was the Geiger counter. This type of instrument is portable and depending on the design of the probe may be able to detect both energy ray emissions and particle emissions. The Geiger counter is one of the most sensitive forms of field probe, able to read even a single radioactive decay, if it enters the device. Alpha particles, for example, cannot penetrate the metal liner of the Geiger tube so won't be counted, unless a special window is provided for alpha detection. The use of the counter creates a "sample" and may or may not be representative of all the radioactivity present.

In addition to Geiger counters, scintillators are commonly used. Radiation that impacts a sodium iodide crystal is converted to light and then amplified so that it can be counted. Further information about the energy spectrum and isotope identification can be derived from the amplitude of the light pulse.

Thermo Luminescent Dosimeter (TLD) films may be hung for a specified time period and the total radiation determined by the light emitted in a counting device. Workers often carry dosimeters that can be read in the field. A dosimeter stores the ions impinging on the device. Radioactive particles in air can be measured by devices that draw in air onto a filter. The filters can be read in a laboratory to determine the concentration of particles in air.

Many of these tools have sophisticated electronic interfaces and software designed to handle the collection and analysis of multiple readings. The level of data collection and display can be truly impressive. On the other hand, challenges of accurately representing the real situation remain. The amount of time that a worker takes to scan a particular item may determine the accuracy of the reading. In some cases a negative reading– apparently no radioactivity present--may simply be that the reading was taken too quickly.

In addition, since radiation moves in a directed, linear fashion, the orientation of the source with respect to the probe, scanner or sample may be critical. If the source material is positioned such that the particle or wave emissions are not "pointing" towards the detector, they may be missed, or under-reported. Examples include textured and also curved surfaces. The instruction books for these instruments flag these issues, but the implementation in the field is likely not 100% consistent on these points, and yet field scanning is a predominant form of check for radioactivity prior to release of wastes, materials and other property.

As an example of the challenges to comprehensive radiation detection, NIRS had the goal of independently verifying levels of radioactivity in wastes and materials that the DOE had "cleared" for release. The intention was to use different monitoring equipment than the DOE routinely uses, and to discern the level of compliance DOE practice has with DOE policy. NIRS did obtain a technically sophisticated monitor (a multichannel analyzer) with training, but encountered insurmountable obstacles in implementation of this plan. Issues included difficulty getting access to DOE cleared materials, and the equipment itself, revolving around suspected factory calibration problems, outdated software and then subsequent breakage of the wiring in the probe. In any case the exercise was very instructive in demonstrating the challenges associated with radiation detection, especially isotope-specific detection.

A truly comprehensive evaluation of radioactive contamination would include independent verification. By definition, this step involves an additional expenditure of time and money, and is rarely accomplished, leaving the door open to the fact that most information about levels of radioactivity in or out of the DOE nuclear weapons complex are not independently verified or validated .

Within the Department of Energy weapons complex, the decisions about whether, how much and where to use "independent verification" are made at each site by the same official who is in charge of the clean-up and release. The same entity that is responsible for completing the project quickly at minimal cost decides whether to increase the credibility of the project by having it "independently" verified. If the decision is made to hire an Independent Verification Organization (IVO), the entity that does the hiring controls release of the results, so the public may never learn the IVO conclusions. This appears to be a structural concern and potential conflict of interest.

The most popular IVO within the DOE complex and among commercial and other government nuclear officials appears to be ORISE, the Oak Ridge Institute for Science and Education. ORISE (from its website http://orise.orau.gov) is "the primary independent verification contractor for all DOE cleanup projects and the only verification contractor for the NRC…" "The Oak Ridge Institute for Science and Education (ORISE) is a U.S. Department of Energy (DOE) Institute. ORISE's mission is to address national needs in the assessment and analysis of the environmental and health effects of radiation, beryllium, and other hazardous materials; …" The institute has collaborated on guidance documents for decommissioning release of contaminated property including development of MARSSIM (Multiagency Radiation Survey and Site Investigation Manual for DOE, DOD, NRC and EPA).

Although ORISE sometimes has been critical of the sites it has been hired to verify, the results are not always made public and their oversight is limited. ORISE was hired to do independent verification of the large 1997 fixed-price DOE/BNFL/SAIC contract at Oak Ridge's K-25 area which, as of 2000, had released 6.6 million pounds of metal for recycling. According to a DOE Inspector General Audit Report (DOE/IG-0481), inaccurate surveys, inadequately supervised surveyors and selective verification resulted in an "increased risk to the public that contaminated metals were released from the site." The inspector general revealed this publicly, not the independent verification outfit.

Below detectable levels does not mean below harmful levels

All levels of ionizing radiation are potentially harmful, but they are not all economically detectable. Nuclear power and weapons-generated radioactivity can be present but elude detection. That is why it is hard to guarantee or prove the absence of man-made contamination. Since there is no safe exposure level the goal should be preventing release of any contamination. There is great variability in detection capability so it is important to use the best, appropriate equipment in the best system with an incentive to find contamination before letting suspect materials go. Today the technology exists to detect levels of radioactivity below natural background levels as well as to characterize the type of radioactivity (natural or manmade) in detail. These technologies require more time and money than waste generators can practically spend especially on the enormous volumes from decommissioning. Instead of careful complete monitoring of all released surfaces and materials, simple scans are performed on a small percentage of the materials released. Extrapolations and statistical guesstimates are made for entire batches and areas. The goal of releasing waste, material and property with residual radioactivity is to save money – and in some cases generate income. So the deck is stacked against the public in that the industry and DOE would need to spend more to do better detection and monitoring if they really wanted to be sure they were not releasing industry generated radioactivity. If they do find contamination, the waste would need to be considered radioactive and go to a more expensive radioactive waste site, not free released. That costs more than sending it to regular trash or selling into recycling. We cannot trust the waste generators themselves to spend more to find more of their own contamination because it would mean they could release less waste and make less profit.

A major goal of DOE and NRC in legalizing the release of radioactively contaminated materials is to assure that the generator is cleared of liability. In developing criteria to implement its Alternative Disposal Regulations 10 CFR 20.2002, NRC made clear that the priority is to remove liability from the nuclear waste generator as the waste is transferred to an unregulated/unlicensed recipient. Thus if the contamination is ever found and health effects can be proven, the generator cannot be held responsible. This NRC provision is being used by NRC-licensees and agreement-state-licensees to allow radioactively contaminated waste to go to hazardous or solid waste sites that were never intended to take nuclear power and weapons-generated radioactive materials (it is also used to allow burial onsite at reactors). The applications to NRC and decisions by NRC are not automatically made public although NRC provides information on the process on its website. It was necessary to use the Freedom of Information Act to get information on some of the 20.2002 petitions that NRC has considered.

One example of NRC's 10 CFR 20.2002 provision being used to release radioactive waste was during the decommissioning of the Connecticut Yankee Haddam

Neck nuclear power reactor. The Nuclear Regulatory Commission approved a large amount of decommissioning waste to go to the US Ecology hazardous waste disposal site near Grand View, Idaho. Public opposition in Idaho is believed to have persuaded the company to reject the waste, even though NRC had approved its release and dumping there. The company president had previously stated "The use of hazardous waste disposal facilities permitted under the Resource Conservation and Recovery Act ("RCRA") to dispose of low concentration and exempt radioactive materials is a cost-effective option for government and industry waste generators." [1] But in 2005 US Ecology announced it would not take the reactor decommissioning waste from Connecticut Yankee. It has been approved to receive waste from other sites.

The Connecticut Yankee nuclear reactor decommissioning waste was redirected to one of two state-licensed radioactive waste processors in Memphis, Tennessee. RACE, or Radiological Assistance, Engineering and Consulting, LLC, has since been purchased and is now called Studsvik/RACE. The company has six "free release" licenses from the TN Department of Environment and Conservation (TDEC) Radiological Health Division. Some are called BSFR--Bulk Survey for Release. Studsvik/RACE can carry out:
Decontamination for Free Release,
Survey for Free Release using Regulatory Guide 1.86 (surface contamination),
Volumetric Free Release (to approved landfill),
Free Release of Soil and Other Bulk Materials,
Free Release of Equipment and
Free Release of Concrete and Asphalt.

Appendices A and B list some types of radioactive licenses TDEC gives and companies that have or had those licenses in 1999 and in 2006.

It would take some research into the TDEC files or a TN Open Records Act request to determine if, how much and the source of nuclear waste free released, as if not radioactive, and where it went. RACE has authorization (Amendments 5 and 21 of R-24003-D05, 3/05/01 and 11/13/01 respectively) from TDEC to send volumetrically-contaminated radioactive waste to the BFI North Shelby County Landfill in Millington, near Memphis, Tennessee. RACE also has authority to import waste from international customers (Amendment 37, 7/16/03). The South Shelby landfill closer in to Memphis also takes some radioactive waste.

[1] "Environmentally Sound Disposal of Radioactive Materials at a RCRA Hazardous Waste Disposal Facility," Romano, Steven, Welling, Steven and Bell, Simon, American Ecology Corporation, Boise, Idaho at the Waste Management 2003 Conference, Tucson, AZ, February 23-27, 2003, page 1.

This is one of several companies in Tennessee with state licenses to free release radioactively contaminated wastes. Several nuclear reactor operators sent portions of their decommissioning wastes to processors in Tennessee. From their sites, the materials can be sold into recycling or disposed in Tennessee landfills which TDEC has approved for receipt of this "special" waste. A 2006 Memo of Agreement between the TDEC Solid Waste Management Division and Radiological Health Division streamlines this process (Appendix G). Although the DOE (as of 2000) is not permitting radioactive metal from its sites into commercial recycling, the commercial nuclear power industry has no such prohibition. TDEC gives licenses for processed metal to be free- released so there is a potential pathway for contaminated metal to be getting into commerce through Tennessee. The metal industries (except aluminum) have taken a strong stance opposing radioactive metal coming into their facilities and have erected gamma detectors at portals and throughout their facilities to prevent such materials from contaminating their processes, workers and products. They have formed the Metal Industries Recycling Coalition (MIRC) to express their opposition to DOE, NRC and Congress. Unfortunately detection can be imperfect, difficult and expensive. The burden of nuclear waste disposal is being shifted unfairly from the nuclear industry directly and via TN-licensed processors to the metal industries.

There are many other types of radioactive materials that can be released from DOE sites and some are expressly permitted through Tennessee to be surveyed and released. TDEC gives permits for Bulk Survey for Release or free release for concrete, asphalt, lead, soil, equipment and other bulk materials. It also allows radioactive metal melting. Metal, concrete, building rubble, asphalt, chemicals, wood, soil, plastic, equipment, pipes, glass, paper can all be contaminated but if "cleared" and "free released" can be sold or donated to avoid the costs of isolating, storing, managing or disposing of it as radioactive waste.

The NRC licenses a processor in Wampum, Pennsylvania, Alaron, permitting some releases from that site. Pennsylvanians are questioning the NRC's authority to allow such releases but information flow is very slow. Alaron has or has had DOE contracts with facilities in Paducah, Kentucky and in Ohio for their radioactive materials. It is never explicit when a processor releases radioactive materials to unregulated destinations. Pennsylvania has a law requiring that all radioactive wastes be kept at licensed facilities but the State Department of Environmental Protection adopted regulations that permit radioactivity into those sites at higher than natural background levels.

The government and industries that make and have liability for radioactive wastes have an unfair advantage in choosing a path other than public protection. It is difficult to catch illegal release and dispersal. Historically and according to common law, it is wrong to spoil the commons—to release poisons or dangerous substances into the shared resources. So if the nuclear power and weapons industry (including DOE) radioactive contamination is discovered outside their facilities, the public expectation is that it is illegal. If the federal agencies succeed in their deregulation efforts, the generators of the contamination will be free of liability.

Expanded interpretation of Reg Guide 1.86 (beyond its original intent) is being used to allow surface-contaminated releases. Authorized limits (from DOE) and alternative methods of disposal (via NRC 10 CFR 20.2002) are two ways now being implemented to allow volumetrically contaminated materials out to destinations that are not intended to take nuclear materials.

The Precautionary Principle should be applied since the released radioactivity is irretrievable and the decision is irreversible. Once the radioactive materials are released from licensed sites and weapons-production facilities into commerce, there is no further tracking or verification of contamination. The radioactivity can never be recaptured. The contaminated materials retain, spread or even reconcentrate the radioactivity making it effectively "forevermore." The DOE handles and is currently releasing wastes, materials and property contaminated with every type of radionuclide, including:

Radionuclide	Length of Hazard
Plutonium 239	240,000 to 480,000 Years
Iodine 129	170 to 340 Million Years
Strontium 90	280 to 560 Years
Cesium 137	300 to 600 Years
Cesium 135	230 to 460 Million Years
Tritium (Hydrogen 3)	120 to 240 Years

The "benefits" of nuclear activity have accrued to the present generation and our immediate forefathers, but the true costs and hazards will be with many, many generations to come.

Two major concerns about the weakness and difficulty of radiation detection are:

1. A release or clearance level, especially expressed as a dose limit, is not enforceable. It is impossible to identify the actual doses we receive; therefore there is no real ability to enforce any "legal" level of exposure.

2. There is no economic way to verify compliance. We are being asked to trust the same nuclear weapons and power producers and promoters that created the waste to release it at or below some specified levels they choose, using their own methods, equipment and statistical sampling, if any.

CHAPTER 4: PREVENTING VS JUSTIFYING RADIOACTIVE RELEASES: REFRAMING DOE'S QUESTIONS AND CLAIMS

What does "clean-up" of a nuclear facility really mean?

Clean-up generally means to remove dirt. In the case of radioactivity, which is invisible, long-lasting, carcinogenic and expensive-to-detect, what does it mean? From a practical perspective, "clean-up" at nuclear sites has meant capturing the most intensely radioactive and hazardous material and moving it "somewhere else," to another location onsite or offsite. The rest of the contamination is often left in place or dispersed, because it is difficult to detect and requires the correct expensive equipment, training and the proper procedures and motivation. Of course the problem with "somewhere else" is that nowhere is guaranteed to isolate long-lasting nuclear waste for as long as it is hazardous.

The Wrong Questions

In dealing with any challenge, it is important first, to define the problem. A major disconnect in the struggle to clean up the massive nuclear weapons complex is lack of good problem definition. Most often the issue is framed as needing to determine "***how clean is clean***?" That is the wrong question because if there is any industrially generated radioactivity remaining or "radioactivity added" it is simply **not** "clean." The **real** question behind the stated inquiry is ***"how dirty can we say is clean?"*** *Or* ***"How dirty can we get away with leaving the place or the material?"*** The fundamental problem that is being addressed, but not stated, is the reduction of cost now and liability later in the event someone detects the contamination down the road.

Clean-up in the true sense would have a goal of capturing and isolating ALL of the waste and contamination generated by the processes. If this is not technically possible, not reasonable or practical, as most contend, then building nuclear facilities is effectively creating sacrifice zones–labeled or not. Further, the infeasibility of a real clean-up should be admitted *before* any new nuclear facility is opened. This information is rarely, if ever, provided when new nuclear sites are proposed--in fact, contamination is often denied by proponents.

Repeatedly the Department of Energy, Environmental Protection Agency and Nuclear Regulatory Commission have tried to "engage" the public in discussing an allowable level of contamination for release into unregulated commerce and disposal. The DOE and other agencies seek stakeholder input into the amount of exposure, above background, we are willing to accept. In reality though, rather than "engage" the public, the DOE uses these occasions to lecture the public on the harmlessness of radioactivity. DOE is not a disinterested observer, however. More clean-up means more cost. In every instance, the public, including the environmental, public interest, health and religious organizations, as well as metal industries and steel and landfill workers unions, has called for prevention of man-made radioactive releases at any level. The consistent public response has been to ask how we can prevent unnecessary intentional releases of man-made radioactivity.

The right question is "How can radioactive releases be prevented?" not "How much can be released?" or "How much risk are we willing to accept to save money on radioactive cleanups?"

Even more fundamental however is the false impression that the industry or regulators or DOE actually could limit our risks by imposing a regulatory release level. Part of why the concerned public has repeatedly rejected any regulatory framework that sets up "official release levels" or "clearance levels" is that setting generic release levels still allows unlimited numbers of releases. In other words, *no matter how low the limit, an unlimited amount of radioactivity could be "legally" allowed out of regulatory control as long as it can be shown that it left control in small pieces.*

For example, Oak Ridge is comprised of facilities given the code names X-10, Y-12 and K-25. Radioactive waste has amassed in many places throughout these areas and can be released in batches from each location at the authorized release levels. Each clean-up contract for portions of these areas can involve dismantlement and disposal of multiple enormous buildings and large amounts of waste. There is no limit on the number of batches or sources that can be released overall so an unlimited amount of radioactivity can get out. There are no publicly available records of the amount of radioactivity released from each job, each portion of the site or comprehensively from the entire Oak Ridge Reservation, let alone all of DOE. There is no publicly available comprehensive reporting of all the radioactive wastes and materials that have been and are being released under DOE's "authorized release" processes. These processes involve some evaluation before the materials are released. Clearly no tracking or effort at tracking released materials is carried out to determine health consequences. People offsite could be exposed to multiple, additive, cumulative and synergistic radioactivity from various parts of Oak Ridge, other DOE sites and other NRC and Agreement-state licensed facilities.

Given industrial scale nuclear weapons operations, some DOE-generated radioactivity inevitably escapes the complex, even without deliberate allowable release levels. Intentionally permitting contaminated materials, wastes and properties out would result in much more radioactivity getting out. But the intentional release of potentially radioactive wastes, materials and properties is avoidable.

On the international level, no meaningful public input has been incorporated in setting allegedly "acceptable" contamination levels or "trivial" risks. There are no mechanisms for input from the "dose receptors," as the public is often termed, into the work of most of the committees and subcommittees that develop the international recommendations. Representatives of the nuclear establishment in different nuclear nations comprise the international agencies and participate to create international recommendations which they bring home to adopt as national regulations. These national representatives are often from federal agencies that have failed to incorporate public concerns into their own standards and thus cannot be expected to reflect them in the international committees. The International Commission on Radiological Protection (ICRP) has begun sharing its drafts with the public, an improvement over past secrecy, but the organization is not structured in a way that is accountable to the public. Public opposition to clearance and free release of nuclear waste into commerce has been completely ignored, among many important radiation issues.

The ICRP, International Atomic Energy Agency (IAEA), and EURATOM (the European Atomic Energy Community) on behalf of the European Commission have chosen risk and contamination levels that they consider acceptable and called them "consensus." These bodies are self-appointing nuclear advocacy groups. Their function is to create recommendations that form the basis for national laws and regulations that allow the government and private industry to engage in nuclear technology. They do not represent those who are exposed and their committees, processes and reports are exclusive, generally closed from public participation. When public comments are sought, the public's recommendations are regularly ignored, unless they are from the nuclear industry.

In May 1996, Euratom adopted its 'Basic Safety Standards' Directive on radiological protection (Council Directive 96/29/Euratom) which included provisions for recycling and reuse of radioactively contaminated wastes and materials at levels deemed economically worthwhile for the nuclear industry, especially as large decommissioning projects were about to begin. The public, including members of the European Parliament, was very disturbed that man-made radioactivity would be incorporated into consumer goods if the provision were implemented. They were also unhappy with the lack of democratic process over the adoption of that policy, which could affect human health. (As EURATOM turns 50 in 2007, these concerns have only worsened.) In 1997, the European Committee on Radiation Risk (ECRR) was formed with Dr. Alice Stewart (famous for her brilliant research on radiation and childhood cancer) as the first chair. The *2003 Recommendations of the ECRR: The Health Effects of Ionizing Radiation Exposure at Low Doses and Low Dose Rates for Radiation Protection Purposes: Regulators' Edition* were released. One of the main findings is that the risk models used by the main international radiation advisory committees and national regulators are inadequate to reflect the risks from radiation and recommended that additional weighting factors be included in the calculation of effective dose. ICRP has not adopted these recommendations.

More Wrong Questions; Excuses

The fact that detecting radioactivity is a technically challenging activity gives DOE and other nuclear waste generators pretext about expense and time that may sound "reasonable" in policy discussions, debates and decisions on clean-up of the messes they have made.

The public is demanding prevention of man-made radiation exposures–prevention of more messes, while DOE, the nuclear industry and the nuclear "regulators" confuse the radiation discussion by making unsubstantiated claims and implications.

They:

1) Claim inability to distinguish between naturally occurring background radiation and the man-made radioactivity from nuclear industrial processes; whereas use of more sophisticated detection equipment and protocols make this level of distinction possible.

2) Imply that the presence of naturally-occurring radiation justifies additional man-made exposures; assuming the authority to increase the public's risk without consent, while making uninformed value judgments about the public's willingness to accept additional risks and exposures above background.

3) Claim that it is ***possible*** for DOE, its contractors and subcontractors to know the amount of radiation exposure that anyone would receive from DOE-process-generated radioactivity released in addition to natural background; whereas all of these determinations are derived from processes with enormous uncertainties– starting with the characterization of the contamination and ending with only a generic assumption that the individual receiving the dose is a healthy adult male, with no details as to the circumstances or duration of the contact.

4) Claim that they can accurately predict the total amount of exposure from all DOE sources that anyone would receive; whereas the compounding of uncertainties in number 3 render this exercise absurd.

5) Claim that low levels of man-made ionizing radiation are harmless or even beneficial while dismissing statistically significant findings from population studies which show that low levels of radiation exposure are more damaging and dangerous per unit of dose than higher levels.

While these various claims from the industry and DOE are often diffuse, or well masked, they result in a level of self-contradiction that is unsupportable. The claim of inability to distinguish man-made from natural background radiation stands in direct contradiction to the assumption that it is possible to guarantee specific, "acceptable" doses delivered from the man-made radioactivity releases.

Burden of Proof and Precaution

From *Wikipedia*, the free encyclopedia:

> *The Precautionary Principle is a moral and political principle that states that if an action or policy might cause severe or irreversible harm to the public, in absence of a scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action.*

From the January 1998 Wingspread Statement on the Precautionary Principle:

> When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically.

CHAPTER 5: TIMELINE: EFFORTS TO REMOVE CONTROL OVER RADIOACTIVE WASTE

1962-1986 Atomic Energy Commission/ ERDA/DOE at Paducah, KY. Smelter and machine shop recovered "large quantities of steel, nickel, aluminum, copper, monel, cobalt, gold and silver" from nuclear weapons, research reactors and other classified sources. Some of this was sold into commerce including radioactively contaminated gold and aluminum.[1]

1970 US Environmental Protection Agency Created by Congress and directed to protect the public from radiation.[2]

1974 Atomic Energy Commission Regulatory Guide 1.86 GUIDANCE (not regulation) on terminating nuclear reactor operating licenses to possession-only or unrestricted release, setting allowable contamination levels for some categories of radionuclides remaining on building surfaces. Has been subsequently misused by DOE and NRC to release radioactively contaminated materials into commerce and regular landfills.

1980 NRC Draft Environmental Statement, part of proposed rulemaking to allow recycling radioactive metals in commercial recycling facilities, specifically smelted alloys containing residual technetium-99 and low-enriched uranium (NUREG-0518, October 1980). Opposition stopped official approval but DOE has let some materials out according to local observers, especially around uranium enrichment facilities.

1981 A *Wall Street Journal* article documents public opposition to the government proposal to recycle radioactive metal and includes a "satiric ad" for a 'Fabulous 8-Piece Cookware Set that is Krypton clad– Now Every Household Can Be A Nuclear Family.'

1985 NRC publishes NUREG-1444, the Site Decommissioning Management Plan, reportedly incorporating the levels from the AEC's1974 Regulatory Guide 1.86 into cleanup for specific sites.

1986 NRC adopts the initial Below Regulatory Concern (BRC) Policy, which would have allowed some nuclear wastes to be treated as not radioactive. EPA estimated that 30 to 40% of the commercial "low-level" radioactive waste in the country would have been exempted from regulatory control, primarily from nuclear power.

1986 – 1992 Largely in response to the NRC's proposed BRC policy 15 states: ME, VT, CT, OH, WI, PA, WV, IA, MN, OR, TX, NM, IL, SD, CO*,* passed laws or regulations that were stricter than federal, most requiring continued regulatory control over radioactive wastes and materials even if the federal government or other states exempted them from regulatory control. Three states passed similar resolutions in at least one of the state legislative bodies *(*OK, GA, VA*).*

1988 DOE adopts internal *Order 5820.2A* 'Radioactive Waste Management,' stating that DOE will use the federal BRC policy and incorporating the basic performance objectives of the Nuclear Regulatory Commission's so-called "low-level" radioactive waste disposal rule promulgated at 10 CFR 61.

1988 IAEA Safety Series 89: Principles for the Exemption of Radiation Sources and Practices from Regulatory Control; international nuclear promoters weigh in to help alleviate decommissioning costs internationally.

1989 RESRAD computer code issued by Argonne National Labs–funded by DOE to predict doses from RESidual RADioactivity; developed to implement DOE's internal *Order 5400.5* release of radioactivity and NRC's license termination.

1990 NRC adopted its final, expanded Below Regulatory Concern (BRC) policy. In addition to some radioactive wastes some radioactive materials, emissions and practices would also be treated as not radioactive.

1990 DOE quietly adopted *Internal Order 5400.5* including Chapters 2 and 4 allowing radioactively contaminated materials to be released or cleared from

[1] "DOE Issues Two Reports on Cold War Era Activities at the Paducah Site," DOE Press Release December 21, 2000, contact Steven L. Wyatt, www.oakridge.doe.gov. 865-576-0885

[2] "Under the terms of Reorganization Plan No.3 (July 9, 1970), the following would be moved to the new Environmental Protection Agency: … Certain functions respecting radiation criteria and standards now vested in the Atomic Energy Commission and the Federal Radiation Council [including] establishing generally applicable environmental standards for the protection of the general environment from radioactive material. As used herein, standards mean limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material…[and A]ll functions of the Federal Radiation Council (42 U.S.C., 2021 (h))."

DOE control at levels (100 millirems per year; up to 500 millirems a year on a temporary basis) far exceeding those in the NRC BRC policies. Release or "clearance" of items with residual radioactivity including shipment of radioactive waste to landfills and incinerators, as well as release of materials and properties for reuse and recycle.

1991 US House and Senate incorporate provisions to revoke the NRC BRC policies in pending legislation.

1991 Public Citizen, et al v. NRC challenges fact that NRC did not do formal rulemaking process to promulgate its final BRC policies. When Congress revoked the policies in 1992, the case ended without court ruling.

1991 NRC initiates a "consensus-building" process and invites environmental and public interest groups to participate on the condition that they not participate in legislative activity or litigation during the term of the process. All groups working on the BRC issue decline the invitation.

1992 Congress revokes both of the Nuclear Regulatory Commission's 1986 and 1990 Below Regulatory Concern (BRC) Policies to deregulate some radioactive waste, materials, emissions and practices, and reaffirms state authority to be more protective, in the Energy Policy Act of 1992.

1992 NRC initiates the Enhanced Rulemaking on Residual Radioactivity (ERORR) to set new decommissioning site release standards. NRC tries to shift the question of 'how much contamination can we deregulate (BRC)?' to 'how clean is clean?' or 'how dirty can we leave contaminated sites?;' NRC provides a plush public and "stakeholder" participation process – all members of the public call for standards that require continued regulatory control over sites that would expose the public to additional radioactivity over and above natural background levels.

1992 NRC Begins strengthened effort to "develop" a technical basis" for deregulating nuclear waste. Eventually expands promotional efforts to include staff in at least four divisions of the NRC and hires contractor SAIC to develop NUREG-1640 to justify deregulating metal and concrete. (Note SAIC simultaneously is hired for large DOE Oak Ridge cleanup contract.) NRC also seeks support from international nuclear advocacy organizations such as IAEA, European Atomic Energy Agency (EURATOM) and OECD NEA, to sway American opposition and later to force "harmonization." Like NRC, the international allies are committed to the promotion of nuclear power and technology, not public protection from radiation—NRC staff and commissioners are active and highly influential in many of them. They actively participate in developing international policies exempting nuclear waste from regulatory control and allowing it into normal recycling streams and daily use items. These international recommendations are now being used as an additional rationale by the NRC to adopt policies that allow deregulation and dispersal of nuclear waste into the public sector and the environment.

1992 DOE caught by investigative journalist, sending mixed radioactive and hazardous waste to incinerators and cement kilns approved for burning hazardous waste only. DOE institutes a temporary ban on the practice.

1995 DOE Headquarters Air, Water and Radiation Division issues letter to Field Offices and Elements outlining how to release property and materials that are volumetrically contaminated with radioactivity…[3] identifying up to 25 millirems per year per release as acceptable doses (pg 2). If doses are less than a millirem per year, DOE field office managers can approve the release; if more than a millirem, head of Office of Environment, Safety and Health–restructured in 2006 to Office of Health, Safety and Security must approve (was EH-1 now HS-1).

Mid 1990's EPA signed on as technical contractor for DOE for analysis of radioactive metal recycling, to project doses to public and locations where metal processing would occur. Produced 1997 draft and 2001 final Technical Support Documents and Cost-Benefit Analysis on Potential Recycling of Scrap Metal from Nuclear Facilities.[4]

1996 European Commission adopts European Council Directive 96/29/EURATOM, the "Basic Safety Standards Directive" (OJ L159 29th June 1996), including provisions for radioactive clearance against public opposition. Some members did not adopt the exemptions. Public and government concern led to formation of the independent radiation group, Euro-

---

[3] Application of DOE 5400.5 requirements for release and control of property; November 17, 1995. Department of Energy Memo from Air, Water and Radiation Division: EH-412: Wallo:2025864996.

[4] Anigstein,R, WC Thurber, JJ Mauro, SF Marschke and UH Behling, S. Cohen and Associates, Technical Support Document, Potential Recycling of Scrap Metal from Nuclear Facilities, Volumes 1-3. Prepared for US EPA Office of Radiation and Indoor Air, Deborah Kopsick September 2001, under contract 1-W-2603-LTNX; and
Radiation Protection Standards for Scrap Metal: Preliminary cost-Benefit Analyis prepared for Radiation Protection Division ORIA, EPA under contract numbers 68-D4-0102 and 0155, June 1997. Accessible at www.epa.gov/radiation/cleanmetals

pean Committee on Radiation Risk (ECRR). In 2007, the 50th anniversary of EURATOM, there is growing opposition throughout Europe to the power of EURATOM to direct pronuclear policy for member states.

1996-1998 EPA considered, published for public comment and rejected making a rule legalizing recycling of radioactive metals; decided to focus on capture of sealed sources instead. It was ironically called "clean metals."

1996 DOE published "Closing the Circle on the Atom," reflecting the shift during the Clinton administration of supporting the end of nuclear weapons production and commitment to characterizing the problems, wastes and other legacies and committing resources to clean-up. "Linking Legacies" was published in 1997, further documenting the clean-up challenge and this work.

1997 NRC publishes its License Termination Rule for decommissioning (10 CFR 20.1401-20.1406 Subpart E—Radiological Criteria for License Termination), with total disregard for the public consensus calling for complete clean-up before release of contaminated sites for unrestricted use. Despite the public consensus, documented in the 1992 ERORR process and officially designed to inform this decommissioning rule, NRC allows the "average member of the critical group" to be exposed to 25 millirems per year (TEDE) from unrestricted release of sites (or portions of sites 10 CFR 50.83) and to 100–500 millirems per year (TEDE) from restricted released sites (or portions of sites).

1997 DOE entered a $278 million "fixed price contract with BNFL and SAIC and others to gut 3 enormous uranium enrichment buildings at Oak Ridge K-25 site, including the sale and commercial recycling of radioactively contaminated metals. Move meets with opposition from metal industry, public, environmental organizations.

1997 Oil, Chemical & Atomic Workers [became PACE Paper, Allied – Industrial, Chemical, and Energy Workers International], AFL-CIO, Natural Resources Defense Council, Nuclear Information and Resource Service, Oak Ridge Environmental Peace Alliance sue DOE, British Nuclear Fuels, Limited and SAIC et al for violating the National Environmental Policy Act in the Oak Ridge K-25 contract that would release radioactive metal into commercial recycling and consumer goods.

1998 NRC Commission issues SECY-98-028, Staff Requirements Memo, Regulatory Options for Setting Standards on Clearance of Materials and Equipment Having Residual Radioactivity, dubbed the "Smoking Gun" since it directs that NRC staff should "focus on the codified clearance levels above background for unrestricted use…based on scenarios of health effects from low doses that still allows quantities of materials to be released. The rule should be comprehensive and apply to all metals, equipment, and materials, including soil..." thus revealing NRC's ongoing commitment to expanded deregulation of radioactivity.

1999 NRC announces scoping for Release of Solid (radioactive) Materials at Licensed Facilities 64FR125 June 30, 1999; public meetings boycotted by public interest and environmental groups because option of preventing release at all was not seriously considered.

1999 Health Physics Society and American National Standards Institute, without public input, develop proposed clearance levels for volumetric contamination. Later the National Academy of Sciences panel review criticizes the methods as not reproducible.

1999 IAEA adopts TSR-1 transport regulations that adjust exempt levels for transport to coincide with chosen levels to deregulate decommissioned nuclear facilities in Europe. Although the world is already unified on a preexisting exempt amount for transport, this new standard is adopted precisely to overcome the need to label and track levels (mostly higher than before) that IAEA wants to exempt to save money for the decommissioning nuclear industries. Also creates new exemptions and justifies it all by calling for international "harmonization." Once UN transport agencies adopt it, member nations must and do. U.S. adopts in 2004, sued by critics.

1999 Federal District Court Judge Kessler, in *OCAW et al. v. Pena*, et al. 62 F.Supp. 2d 1 (D.D.C. 1999) confirmed that DOE awarded its quarter billion dollar recycling contract to BNFL without regard for the basic requirements of environmental law and openness and found that the concerns raised by the union and environmental groups were valid.[5]

2000-2003 NRC and DOT propose adoption of new transport regulations that exempt various levels of all radionuclides from regulatory control in transport, increasing the exempt amounts and initiating new ex-

[5] Statement of Dan Guttman to National Academies National Research Council, Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission - Licensed Facilities, March 27, 2001) The judge stated that "The potential for environmental harm is great, especially given the unprecedented amount of hazardous materials which [DOE and BNFL] seek to release."

emptions. This is done under the guise of "harmonization" between the federal and international agencies.

2000 DOE put a moratorium on releasing volumetrically contaminated radioactive metal (January) and suspended the release of any metal from DOE radiological areas into commercial public recycling (July); began rulemaking to make the moratorium and suspension permanent in DOE *Order 5400.5*. In October "Control of Releases of Materials with Residual Radioactive Contamination from DOE Facilities" was published for comment.

2001 EPA adopted mixed waste rule that allows mixed radioactive/hazardous waste to be considered radioactive only, thus exempt from RCRA hazardous waste requirements for storage, treatment, disposal and transport; Specifically EPA adopted subpart N to 40 CFR part 266 "Conditional Exemption for Low-Level Mixed Waste Storage, Treatment, Transportation and Disposal" (66 FR 27218, May 16, 2001).

2001 DOE announces a halt to the proposed changes in its *Order 5400.5* on contaminated material and metals and begins a Programmatic Environmental Impact Statement on Disposition of Scrap Metals (FR66 July 12, 2001 No 134), holds scoping meetings and opens public comment period. Denies public access to comments received. As of April 2007, DOE is reporting that the PEIS is "on hold." SAIC was again hired by DOE at one point to carry out the PEIS but dropped due to repeated conflict-of-interest.

2001 DOE covertly circulates within its Field Management Council a memo that outlines ways for DOE site personnel to circumvent DOE's own ban on the release and recycle of contaminated metal; a draft of the internal memo is obtained by metal industry and environmental community; strength of opposition causes item to be removed from an FMC meeting agenda.

2001-2002 National Academy of Sciences (NAS) hired by Nuclear Regulatory Commission to provide technical legitimacy for radioactive deregulation; *The Disposition Dilemma: Controlling the Release of Solid Materials from NRC-Licensed Facilities* (National Academy Press 2002) is produced recommending NRC deal more effectively with the public and public concerns.

2003 NRC announces new rulemaking on Controlling the Disposition of Solid Materials: Scoping Process for Environmental Issues and Notice of Workshop (68 FR 40 February 28, 2003). Public comments taken on Scoping for new rule to deregulate radioactive waste and materials, projected for issuance in 2004.

2003 EPA published Advance Notice of Proposed Rulemaking on "Approaches to an Integrated Framework for Management and Disposal of 'Low-Activity' Radioactive Waste" (65120 Federal Register/Vol. 68, No. 222 / Tues, November 18, 2003) potentially allowing radioactive waste to be considered non-radioactive and considers a "non-regulatory approach" to management of radioactive waste. Still pending early 2007.

2004 Department of Transportation (DOT) and NRC adopt proposed TSR-1 "harmonized" and weakened transport regulations, exempting more radioactivity.

2004 Nuclear Information and Resource Service, Public Citizen, Committee to Bridge the Gap, Redwood Alliance and Sierra Club sue DOT and NRC to stop increased exemption levels in transport. Rule defines higher levels of radioactivity that need not be labeled during transport. Since many solid waste facilities had used DOT levels as their cutoff to accept radioactively contaminated wastes, higher amounts of radioactivity could be getting into non-nuclear waste facilities, illegally, as a result of the change. In 2006 both cases end due to technicalities without review of merit of content.

2005 NRC announces decision to defer further action (for possibly 2 years) on Controlling the Disposition of Solid Materials rulemaking and to proceed with case-by-case exemptions under its alternative disposal provision 10 CFR 20.2002 and through technical specifications in licenses.

2006 DOE proposal appearing to weaken the definition of "contaminated area" (radiological area) by allowing DOE *Order 5400.5* authorization limits to be codified into 10 CFR 835; *Federal Register* / Vol. 71, No. 154 / Thursday, August 10, 2006 / Proposed Rules).

2006 NRC sues SAIC over conflict of interest. SAIC was hired to develop NUREG 1640 to make it appear that radiation doses can be known and limited, giving the misimpression that there is a technical basis justifying deregulating nuclear waste. It was later revealed that the contractor (SAIC) that set up NRC's technical justification for allowing radioactive metal and concrete to be released into general recycling to make everyday household items was actually part of the team hired by Dept of Energy to 'recycle' nuclear waste from the Oak Ridge K-25 site, the largest radioactive recycling project known. SAIC was fired by NRC due to the conflict of interest but the conflicted work product is still in use today. Thus, NRC sued SAIC for not revealing the conflict of interest.

2007 DOE seeks *Expressions of Interest* from industry on restricted recycling of 15,300 tons of nickel scrap recovered from uranium enrichment process equipment and stored at Oak Ridge, TN, and Paducah, KY. Companies are being asked to propose declassifying the nickel, cleaning it and fabricating it into forms that will have restricted use under DOE, NRC or DOD Navy radiation control. (Solicitation # DE-EI30-07CC40008)

2007 DOE, DOD, NRC and EPA *MARSAME*, Multi-Agency Radiological Survey and Assessment of Materials and Equipment Manual in final stages. It provides technical procedures and analysis to comply with the four federal entities' rules to release radioactive equipment, materials and property. More information at www.epa.gov/radiation/marssim/publicpreview.htm.

TERMS Used to Remove Control Over Radioactive Waste

International, federal and state agencies, regulators, private contractors, waste generators and academics use many terms to describe and justify releasing man-made radioactivity to the public sector. Some have other meanings but are being applied for this purpose. Here are a few:

Alternative methods of disposal (NRC 10 CFR 20.2002)
BRC, Below Regulatory Concern
Beneath Regulatory Control
'Beneficial' Reuse
Clean
Clearance, Clear
Deminimus or "de minimis" (so minimal that it is not worth considering)
Deregulation (DOE doesn't regulate to begin with so can't "deregulate.")
Dose-Based Standard
Exempt, Exemptions
Exempt from regulatory control
Excluded from regulation (IAEA term for naturally occurring radioactivity)
Health-based Standard
Indistinguishable from Background (depends on detection equipment used)
Free Release
Law of Concentrated Benefit over Diffuse Injury (see appendix)
Linguistic Detoxification
Low Activity Radioactive Waste
Low Activity Waste (new category being created to facilitate generic release)
Non-detect (depends on detection equipment used)
Non-regulatory approach to management of radioactive waste (EPA)
Not Amenable to Control
Not Radioactive
Not Relevant to Radiation Protection Dispositions
Optimization (cost benefit analysis carried out by waste generator)
Out-of Control—On Purpose
Reclassification
Recycling
Release
Restricted Release
Restricted Reuse (usually over 1st reuse only)
Risk-Based Standard
Risk-informing or Risk-informed (analysis carried out by generator)
Slightly Radioactive Scrap Metal or Material (SRSM)
Slightly Radioactive Waste
Special Waste
Trivial (risk, dose, contamination)
Very Low Level Radioactive Waste (VLLW)

NIRS has called it "Let's pretend it's not radioactive." Let us know any other terms you hear or create and we will add them to the list.

CHAPTER 6: DOE'S ORDERS, GUIDANCE AND SUPPORT DOCUMENTS

This section reviews the "rulebook" by which DOE is supposed to operate, as well as some of the other regulatory documents that have contributed to its guidance. Our discussion should not be interpreted as any endorsement of whether DOE actually implements these rules. The DOE is the generator of the radioactivity, the handler of it, the entity that must make the policies and also implement them. That is, DOE sets the rules, regulates itself and decides whether it is doing a good job. There is an inherent conflict of interest in the fact that there is no external regulation, assessment of compliance or enforcement. The reporting that DOE and its sites have done provide no confidence that the processes outlined in this chapter are, in fact followed.

Background

As a result of decommissioning their numerous nuclear facilities, DOE has to deal with large amounts of potentially contaminated material. In order to cut costs, the department tries to sell (or give away for free) as much as possible, because every ounce of waste deposited in a radioactive waste facility costs money.

In the course of discussions with DOE staff, it has been stated repeatedly that DOE does not "deregulate" radioactivity–because they do not "regulate" it in the first place. Since DOE is a generator of radioactive waste, contaminated materials and properties, it is more correct to say that they act–sometimes to control, and sometimes to release radioactivity. In some cases DOE becomes subject to an external regulatory authority, such as the EPA, but this is primarily in the context of programs such as Superfund, and applies only to a subset of their operations. New regulatory relationships between DOE and the Nuclear Regulatory Commission are being explored for some DOE facilities–notably the proposed MOX factory that would use DOE surplus weapons grade plutonium to make Mixed Oxide plutonium fuel for commercial nuclear power reactors, but again, for the most part, NRC authority at the federal level does not apply.

Since release of residual radioactivity is sometimes a multi-step process–DOE may sell the material to or alternately pay a licensed commercial contractor to take material that is subsequently released by the licensed contractor. These commercial entities either have an NRC license, or where NRC authority has been delegated via the NRC Agreement States program, a state license. At these links in the chain of control and release, the terms "regulation" and "deregulation" do apply.

Contaminated material was routinely released by DOE under its own guidance and Orders until 2000, when former Energy Secretary Bill Richardson declared a moratorium on the commercial recycling of metal, first only of volumetrically contaminated and then also of surface contaminated metal. Release of other (non-metal) contaminated materials is ongoing.

The reader is directed to chapters in this report on radiation detection, broad issues of regulating radioactivity and radiation and our critiques of computer codes and ALARA to understand why "meeting the standards" does not necessarily ensure radiation protection.

DOE: Radioactive Recycling Contract followed by Bans on Radioactive Metal Recycling

In August 1997, the Department of Energy (DOE) entered into a noncompetitive contract with British Nuclear Fuels Ltd. (BNFL) at Oak Ridge, Tennessee to decommission three massive buildings formerly used to enrich uranium for atomic weapons and nuclear reactors. DOE gave BNFL incentives to process and sell more than 127,000 tons of radioactively contaminated nickel, aluminum, copper and steel to commercial recyclers who provide metals for consumer products such as tableware, frying pans, orthodontic braces, furniture, batteries and automobiles. Consumer products made with metal that is contaminated by long-lasting radioactivity from DOE activities will not be labeled to alert producers or consumers that they are contaminated.

According to the DOE Inspector General Audit Report (DOE/IG-0481) on the BNFL contract, 6.6 million pounds of metal had been released for recycling from the site as of May 2000. Inaccurate surveys, inadequately supervised surveyors and selective verification have resulted in an "increased risk to the public that contaminated metals were released from the site." Ineffective management has led to cost overruns and put the successful completion of the project in doubt.

Environmental groups (NIRS, NRDC, OREPA) and PACE, the DOE workers union, sued DOE over the contract because it allowed radioactive metal to be circulated into open commerce with no environmental impact statement or assessment. The court found that, "through use of the NRC's offices, DOE and BNFL placed the public at unlawful and unexamined risk," acknowledging and sharing "the many concerns raised by the intervenors."[1] The potential for environmental harm is great, especially given the unprecedented amount of hazardous materials which [DOE and BNFL] seek to release.

After continued public, union and metal industry opposition, in 2000 the Secretary of Energy took action, halting the release of metal for commercial recycling into consumer goods and the marketplace and clarifying improved record keeping and procedures at all DOE sites. (Press releases and memos to DOE offices from the Secretary are Appendices C, D and E.)

In January 2000, a moratorium was placed on the release for commercial recycling of all surface contaminated metal. In July 2000 the ban was expanded to suspend the release for commercial recycling of any potentially contaminated metal (with surface or volumetric radioactive contamination) from any radiological control area. The DOE continued its efforts to release other radioactive materials, however, including concrete from its sites. (ex: DOE at Argonne and in Idaho developed a protocol for release and reuse of radioactive concrete.) Although the impression was given to the public that no contaminated metal would ever get out, the metal was stored at the sites with the expectation by the field offices that the suspension would be lifted or could be circumvented.

Efforts to codify and to overturn metal recycle ban fail—DOE proposes then cancels rule change; initiates and puts PEIS on hold

In late 2000, there was a proposed revision to DOE's internal *Order 5400.5*, *Radiation Protection of the Public and Environment*, that was purported to make the moratorium and suspension permanent—that is to ban the release of any potentially contaminated radioactive metal into commercial recycling. The language for the proposed change was opened to public comment, but because it did not effectively achieve the stated goal (make the metal release bans permanent), it was soundly rebuked by the public, unions and the metal industry. The field offices of DOE were reportedly critical as well, at least in part because of the requirements for tracking and record-keeping. So the proposed 2000 revision to DOE *Order 5400.5* was not adopted. Instead, a Programmatic Environmental Impact Statement (PEIS) was proposed by DOE in 2001. Public hearings were held and comments received. The public called for making the bans on radioactive metal release permanent and for expanding them to cover nonmetal materials, wastes, and property including but not limited to concrete, asphalt, wood, plastic, soil, chemicals. (See Appendix K.) There are strong concerns in the public and environmental sectors that completion of the PEIS process, now on hold, might result in the reversal of the bans on radioactive metal recycling.

In addition, in the intervening years since the 2001 PEIS was initiated, there have been attempts by DOE to circumvent the metal recycling moratorium and suspension. One such instance occurred in November 2001 when the Acting Director of the Office of Science, the Acting Deputy Administrator for Defense Programs and the Assistant Secretary for Environmental Management circulated a memo quietly, internally within DOE at the Field Manager level, proposed action to "…modify DOE's current suspension on the unrestricted release for recycling of scrap metals from radiological areas in order to permit the recycling of those metals…" It was a secretly prepared proposal during the public PEIS process and a clear violation of the spirit of the ban. The item was dropped from the agenda when public and industry forces cried foul.

There are many definitions of radiological areas in the DOE orders, guidance and regulations. The 2000 bans prevent any metal from radiological areas from entering commercial recycling. The November 2001 effort involved possible changes in some of those areas.

In August 2006, DOE proposed to adopt portions of DOE *Order 5400.5* into its 10 CFR 835 regulations. Adopted June 8, 2007, this appears to open more loopholes in DOE's ability release property for unrestricted use, this time allowing possible hotspots.

Regulatory Guide 1.86

Regulatory Guide 1.86 (Appendix O) was Atomic Energy Commission guidance published in 1974 for terminating nuclear reactor licenses. It was never intended to define a level for the free release of radioactivity to the public, but after Congress revoked the NRC's Below Regulatory Concern (BRC) policies in 1992, both DOE and NRC appear to have expanded its use as guidance for free release, decommissioning and deregulation of nuclear materials and properties.

The DOE adopted the fundamental approach of the Reg Guide and later promulgated its *Order 5400.5* incorporating Reg Guide 1.86 into it. According to EPA comparisons the doses from the Reg Guide 1.86 concentrations would be higher in some cases than the

---

[1] Statement of Dan Guttman (PACE and intervenor attorney) to the National Academies of Science, National Research Council, Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission - Licensed Facilities, March 27, 2001. (accessible at http://www.nirs.org/radwaste/recycling/nasguttmanradmetalsmarch26.htm)

BRC policies. These policies would have established a lower threshold below which radioactivity was considered unimportant, even while extensive research upholds the finding that there is no "safe" dose of radiation. The government agencies and industry were happy to have some release level to use in the wake of the Congressional action.

But since Regulatory Guide 1.86 only gave concentrations for surface contamination, it could not clearly and simply be used to release materials and property with radioactive contamination throughout- volumetrically contaminated, leading to the complicated process of establishing and authorizing release levels described below.

DOE Order 5400.5

Policies and procedures for the release of materials contaminated with residual radioactivity are promulgated in DOE *Order 5400.5*, where "residual radioactive material" means contaminated soils, radon decay products in air, external radiation and surface contamination.[2] It does not apply to volumetrically contaminated material, i.e. material that contains radionuclides in its matrix rather than just on the surface. Surface contaminant guidelines define both average and maximum allowable limits.[3] The projected doses resulting from the surface contamination guidelines are expected to be well below the primary dose standard, which is stated at a total of 100 millirems/year or up to 500 millirems/year on a temporary basis. These levels allow an effective doubling of (or up to 5 times more than) ongoing daily radiation exposure since the level is over and above naturally occurring background that has been assessed as anywhere from 100–360 millirems a year. Natural background at 100 millirems is projected by NRC to result in a background rate of 1 fatal cancer in every 286 people.[4]

The implementation of this policy is complex since day-by-day decisions of what does or does not meet the standard often require unique justifications for those decisions. The order defines a process of "authorized release" of residual radioactive material by workers and contractors at DOE sites, and elsewhere. On a case-by-case basis, limits for unrestricted release can be developed and material with contamination below these limits released. Authorized release limits can be developed at each site, using a prescribed approach, which is systematic, but leaves ample room for interpretation (see below). After development of the limits, they have to be approved by DOE before they can be implemented. The result, nonetheless, is a patchwork of site-specific and to some degree, release-specific authorizations.

Under IV-2.(d)(2), the Order states that "under normal circumstances expected at most properties, authorized limits for residual radioactive material are set equal to, or below guideline values. Exceptional conditions for which authorized limits might differ from guideline values are specified in paragraphs IV-5 and IV-7." The guidelines mentioned are the surface contamination guidelines referred to in the Handbook and the Protocol. It can thus be taken from the Order that for release limits to be greater than the surface contamination guidelines, there must be a good reason.

This "good reason" is the determination that the guidelines are "inappropriate," which by itself does not mean much. But the Order also states that any authorized limit has to provide that at the minimum, the basic dose limits of 100 and 500 mrem/yr are not exceeded (IV-5.a). The authorized limits also have to be consistent with other applicable Federal or State law. Note that these are yearly limits and are not intended to limit the total dose to the population over the duration of hazard.

Supplemental limits can be derived if previously authorized limits or guidelines are not appropriate. However, the Order states again that no matter the situation, the supplemental limits have to ensure that the basic dose limits will not be exceeded. In other words, both authorized and supplemental limits can be greater than the surface contamination guidelines if these are not "appropriate", but the resulting dose must still be below 100 mrem/y. In addition, the developed limits have to be put through the process of trade-offs called ALARA (As Low As Reasonable Achievable), which may (or may not) further lower the resulting dose. The 100 mrem/y is thus an upper bound. It must be noted that the intent of the Order is to supplement guidelines only where necessary (IV-7.c): "Every reasonable effort should be made to minimize the use of supplemental limits and exceptions."

A comment is in order about DOE's choice of terms. To call something an "authorized limit" asserts an authority that is looking out for others' welfare. In the case of DOE "authorized limits" under 5400.5, it is implied that someone does, in fact, figure out what the total dose from all DOE modes and sources for any given individual will be–whereas that is simply impos-

[2] DOE Order 5400.5 at IV-1.
[3] DOE Order 5400.5 at I-3: The primary dose limit for exposures of the public is 100 mrem/y; for limited periods of time and under unusual circumstances, a limit of 500 mrem/y can be used; and IV-6, figure IV-1 Surface contamination guidelines.
[4] US NRC Expanded Below Regulatory Concern Policy of 1990, excerpt in Appendix J.

sible. The language of control and release of radioactivity is potent, and often misleading.

Process to Develop Authorized Limits under DOE Order 5400.5

The Department issued a handbook to define the process of developing authorized release limits.[5] It applies to everything besides sites and structures that contain "residual radioactive material," a term defined as "Radioactive material that is in or on solid, liquid, or gaseous media, including soil, equipment, or structures, as a consequence of DOE activities." The handbook lays out a 10-step process for releasing material as follows:
Describe property. Determine whether it can be certified as "not contaminated." If it cannot, determine if contamination is detectable.
If it is detectable, determine whether "seemingly applicable release limits exist."
If they do, go to step 8. If not, develop release limits needed.
Develop release limits.
Compile and submit application for DOE Operations Office approval.
Document approved limits in public record.
Implement approved limits.
Conduct surveys/measurements.
Determine whether newly approved or pre-existing applicable limits are met.
If yes, release property. If not, determine whether supplemental limits should be developed, and, if so, go back to step 3.

There are some steps of this process that are not well-clarified. For step 1, there is no definition of when contamination is "detectable"—what instrumentation must be used, or what level above background will be considered detectable. (There is, however, description of what percent of the area of materials must be surveyed). It also isn't clear how the decision should be made whether release limits are applicable or whether there is any oversight for this determination. The document implies that release limits can continue to be adjusted with new dose assumptions if it is found that the material is not releasable under existing limits. However, there is no explanation of who will choose these assumptions or what requirements apply to them. It must also be remembered that at no time will a member of the public be notified of these additional doses, nor will any doses to the public be monitored in an ongoing or integrated way, so all compliance is assessed by extrapolation and modeling.

[5] DOE, *Draft Handbook for Controlling Release for Reuse or Recycle of Non-Real Property Containing Residual Radioactive Material*, DOE-HDBK-xxxx-97, 1997.

The release limits must be such that the case can be made (with computer models like RESRAD) that no member of the public receives more than a total of 100 (or up to 500) mrem/year from all sources, in addition to background radiation, which is the primary dose limit (*Order* DOE 5400.5, Sec. II.1.a). Since this is difficult to determine, there is a "presumption of compliance" when it can be shown that the dose from all DOE sources is less than 30 mrem/year. There is no detailed explanation of how this is to be done or which other DOE dose sources are to be included in the analysis.

In addition, like all institutions that expose workers and the public to radiation and radioactivity in the course of operation, DOE subscribes to a program known as ALARA (As Low As Reasonably Achievable). While "as low as" sounds reassuring to the lay public, "reasonably achievable" is a virtual blank check for the waste generator to factor its costs in the decisions about how stringent to be in making and applying the rules. In the case of DOE it must, again, be emphasized that the "right hand" and the "left hand" of rule-maker and ruled are, in fact the same hand.

The ALARA process itself involves comparison of several alternatives, including release, disposal, and storage. Multiple release alternatives including different release limits are included. Some of these release alternatives may be for "restricted release," although it is unclear how the future uses of the materials will be restricted. These alternatives are evaluated in terms of:

- Maximum dose to members of the public;
- Collective dose to the population;
- Doses to workers;
- Applicable alternative processes, such as alternative decontamination levels and methods;
- Doses for each alternative;
- Cost for each alternative;
- Examination of the changes in cost among alternatives; and
- Social and environmental effects (positive and negative) and non-radiological risks associated with each alternative.

While for individual members of the public both maximum and most-likely doses are to be evaluated, for collective dose only a most-likely dose scenario is to be evaluated.

There is no explanation of how the different evaluation criteria (cost, dose, social and environmental effects) are to be weighed against one another.

DOE has developed a computer model for metals that completes the ALARA process, including dose calculations using RESRAD-RECYLE and cost comparisons.[6] This program includes only 11 possible end products.[7]

There is a separate DOE document entitled "Protocol for Development of Authorized Release Limits for Concrete at U.S. Department of Energy Sites."[8] This document does not define how to determine whether existing release levels are appropriate. It does, however, specify the alternatives that should be considered in the ALARA analysis. It also provides "unit-dose factors" for several radionuclides for residential and occupational scenarios for disposal, reuse, and transportation alternatives in mrem/yr/pCi/m2, based on RESRAD. It also provides guidelines for transportation and decontamination costs to be included in cost analysis.

DOE Order 5820.2A, Radioactive Waste Management

Adopted in 1988, DOE internal *Order 5820.2A* incorporates the basic performance objectives of the Nuclear Regulatory Commission's "low-level" radioactive waste disposal rule promulgated at 10 CFR 61. While this Order pertains to "low-level" radioactive waste burial grounds on DOE sites, burial of radioactive waste on DOE nuclear weapons sites predates 1988. The incorporation of the NRC regulations enabled DOE to effectively "draw a line" and deal with post-1988 waste with the new policy, effectively "grandfathering" the pre-1988 burials. In addition, and discussed below, DOE did not incorporate the NRC standard as-is, instead applying its own variations.

During this timeframe (1988), the NRC was pursuing an across-the-boards policy to define a level of radioactivity that "didn't count"–that was "Below Regulatory Concern" (BRC). The NRC announced its first BRC policy in 1986, and expanded it in 1990. Appendix J is the NRC's fatal cancer risk table for various annual doses. When DOE adopted Internal *Order 5820.2A*, it incorporated the BRC concept. On page 15, "*Below Regulatory Concern"* is defined as *"a definable amount of low-level waste that can be deregulated with minimal risk to the public.*"

…and in Section III-7, adopted 09-26-88 on page 49:
(6) Waste containing amounts of radionuclides below regulatory concern, as defined by Federal regulations, may be disposed without regard to radioactivity content.

When Congress acted to repeal the NRC BRC policies in its Energy Policy Act of 1992, it apparently did not know that DOE had already adopted its own BRC policy. Nonetheless, the statement above (from page 49 of 5820.2A) refers to the very Federal regulations that Congress did revoke. Nonetheless, as shown below, a "BRC-like" across-the-boards release policy remained the goal of this DOE action, even in 1996 (see excerpts from the DOE implementation plan below). Further, in 1990 (although some records indicate 1993), 5820.2A was incorporated into DOE's *Order 5400.5*, its primary radiation guidance discussed above, which includes chapter 4, on releasing items with residual radioactive contamination to the public.

Defense Nuclear Safety Board Recommendation 94-2 Conformance with Safety Standards at Department of Energy "Low-Level" Nuclear Waste and Disposal Sites

The Defense Nuclear Facilities Safety Board issued a recommendation on Sept 8, 1994 with a letter from John Conway to then-DOE Secretary Hazel O'Leary (www.deprep.org/1994-2/ts94s08a.pdf) that contains sharp criticisms of the DOE approach to "low-level" waste and its adoption of 10CFR61 in *Order 5820.2A*:

In estimating the amount of radioactivity in radioactive waste burial grounds, current DOE guidance for performance assessments required by DOE *Order 5820.2A* allowed the evaluators to neglect waste disposed of prior to 1988. Further, it allowed use of individual reference dose criteria rather than assuming composite effects when more than one contiguous burial facility is present. Other factors also complicate site specific assessments. For example: (1) the US Ecology commercial "low-level" waste burial site is situated adjacent to a DOE burial site at Hanford; (2) some sites have multiple burial grounds, a situation not explicitly addressed by DOE *Order 5820.2A*, and (3) agreements have been established with State and Environmental Protection Agency authorities for closeout of some burial sites under the Resource Conservation Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act provisions.

---

[6] Development of DOE Complexwide Authorized Release Protocols for Radioactive Scrap Metals, S.Y. Chen, J. Amish, S. Kamboj, L.A. Nieves, L. Being, K. Trychta, Argonne National Laboratory; F. Gines, US. Department of Energy, Argonne Group; A. Bindokas, U.S. Department of Energy, Chicago Operations Office. Date unknown

[7] P2Pro(RSM): A Computerized Management Tool for Implementing DOE's Authorized Release Process for Radioactive Scrap Metals. J. Amish, S. Kamboj, L. Nieves,' and S.Y. Chen. ANL/EAD/TM-85 May, 1999. p. 37

[8] by J. Arnish, S. Kamboj, S.-Y. Chen, F.L. Parker,* A.M. Smith,* R.H. Meservey,* and J.L. Tripp*, Environmental Assessment Division, Argonne National Laboratory, ANL/EAD/TM-92. July, 2000

The objections raised in this letter are noteworthy. That reference dose criteria are being applied in a segmented, piecemeal way rather than in a more integrated, comprehensive manner is emblematic of the entire issue of how standards are used and abused in this system. When dose criteria are applied within a frame that is too small, multiple-additive, cumulative and synergistic impacts (See Appendix N) will be missed. As the Connway letter goes on to point out, the situation is complex, more resembling a patchwork quilt than a blank slate. Nor is there any truly credible system for summing all the potential for multiple exposures that are resulting from multiple DOE sites simultaneously releasing multiple waste streams, materials and properties.

Implementation Plan: Defense Nuclear Facilities Safety Board Recommendation 94-2 Conformance with Safety Standards at Department of Energy "Low-Level" Nuclear Waste and Disposal Sites REVISION-I April 1996

DOE responded to the issues raised in the Defense Nuclear Facilities Safety Board's Recommendation 94-2 with an "implementation plan" and a cover letter, signed by Secretary O'Leary and dated May 7, 1996; both are posted (as of 03-29-07) at: http://www.deprep.org/1996-2/Fs96y07b.pdf. This implementation plan, issued after Congress revoked the NRC BRC policies is noteworthy for its explicit goal of developing an across-the-board lower limit for radioactivity that must be treated as "radioactive"–in other words, DOE is seeking a DOE BRC policy.

DOE states in this plan on Pg II-3, in Table II-1 on line 3: ***A lower limit for radioactivity below which waste can be managed as other than LLW is needed.***

Managing waste "as other than LLW" ("low-level" radioactive waste) is a euphemistic way to call for a new "below regulatory concern" policy--an explicit call for removing control and releasing radioactivity.

Another entry from same table (II-1) states: *The DOE moratorium on off-site shipments of hazardous waste, WIPP delays, and problematic LLW forms (GTCC and special case) are contributing to storage problems.*

(GTCC is "Greater Than Class C") This statement is a direct admission that the lack of storage and disposal options is driving the deregulation and release activities. Further, this goal is explicitly stated on page II-5: *Establish limit of radioactivity for LLW, below which it need not be managed as LLW.*

Thus DOE was selectively adopting NRC policies to further implement deregulation and radioactive release.

Health Physics Society ANSI / HPS N-13.12-1999

While not directly cited by the DOE, ANSI N-13.12, is part of the regulatory "underpinning" in the radiation deregulatory scheme. The American National Standards Institute standard-setting process was used by the Health Physics Society in the wake of Congress' repeal of the BRC policies. The fact that the Health Physics Society, the professional organization for radiation supervisors at the DOE, and all other establishments that institutionally expose workers, and others, to radiation, would promulgate their own standard is indicative of the frustration that Congress caused in the worlds of radioactive waste generators.

HPS endorses a 1 mrem/year for releases of residual radioactivity in its document Clearance of Materials Having Surface or Internal Radioactivity, 1999 (reaffirmed 2001), is posted (as of 03-29-07) at: http://hps.org/documents/clearance_ps012-0.pdf . From pages 2 -- 3: *Clearance is the removal from further control, of any kind, of items or materials that may contain residual levels of radioactivity.*

The final clearance standard was approved in August 1999 as N13.12, Surface and Volume Radioactivity Standards for Clearance. This standard provides both the individual dose criterion of 1 mrem per year for clearance and derived screening levels for groups of similar radionuclides. The standard also allows for clearance, when justified on a case-by-case basis, at higher dose levels when it can be assured that exposures to multiple sources (including those not covered by the standard) will be maintained ALARA and will provide an adequate margin of safety below the public dose limit of 100 mrem/y (TEDE). It was recognized that there were several complex issues that would make it difficult to fully implement the clearance standard. As a result, some of these issues were defined to be beyond the scope of the standard, including: naturally occurring radioactive materials, radioactive materials in or on persons, release of a licensed or regulated site or facility for unrestricted use, radioactive materials on or in foodstuffs, release of land or soil intended for agricultural purposes, materials related to national security, and process gases or liquids.

The commentary here recognizing complexity in projecting outcomes reveals another interesting angle on releasing radioactivity: if deregulated radioactivity were to be consumed, and become an internal dose-emitter, it would no longer "count" toward the annual dose limit of 100 mrem / year – precisely when it would be most potent and contribute the greatest amount of dose to the "receptor" possible!

N-13-12-1999 applies to volumetrically contaminated material as well as surface contamination.

A National Academy of Sciences Committee reviewed the deregulation issue and concluded in its 2002 report, *The Disposition Dilemma: Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities*[9], that the documentation used in ANSI N-13.12 to project doses from volumetric radioactive contamination were not traceable and therefore could not be relied upon.

Because there is no government standard for releasing radioactive materials with volumetric contamination, there is pressure to adopt this ANSI document, despite its lack of traceability, reliability, and public input.

DOE G 450.1-5 (Guide, 05/27/2005, EH-4) Implementation Guide for Integrating Pollution Prevention into Environmental Management Systems

This Guide suggests non-mandatory approaches to integrating pollution prevention into Integrated Safety Management/Environmental Management Systems, and contains the disclaimer: *This Guide describes suggested non-mandatory approaches for meeting requirements. Guides are not requirements documents and are not construed as requirements in any audit or appraisal for compliance with the parent Policy, Order, Notice, or Manual.*

The guide is posted (as of 03-31-07) at:
http://www.directives.DOE.gov/pdfs/DOE/DOEtext/neword/450/g4501-5.htm

[9] The Disposition Dilemma: Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities, National Academy of Sciences © 2002, Board on Energy and Environmental Systems, Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission Licensees, March 2002, page. 93. (www.nap.edu/openbook.php?record_id=10326&page=93)

CHAPTER 7: HOW IT GETS OUT AND WHERE IT GOES

How is radioactive material managed in the DOE and NNSA nuclear weapons complex and how does it get out?

The military industrial nuclear complex generates radioactive, hazardous and mixed waste at every step of the atomic fuel chain. As at businesses, industries or households, waste routinely accumulates at weapons sites. The big difference is that these sites are using, processing and generating radioactive materials and wastes, which can cause health effects, including cancer, and genetic effects, such as birth defects. Policies geared to save money are driving the push to physically and legally transfer nuclear weapons-generated radioactivity from government control, and to deny their identification as radioactive. In other words, radioactive material is getting "out' and radioactivity that is "out" could go anywhere and be made into anything. We don't know exactly where and into what products because "getting out" fundamentally means that there is no longer any tracking. The material, wastes and property are disposed, reused or recycled as if not radioactive, with no credible restriction imposed or information provided.

Part of the original intent of this research was to track released radioactive materials from DOE into commerce. At some sites we were able to observe records with the initials of individuals who were responsible for letting various pieces of equipment go. We spoke with the broker contracted to take scrap from one site that treats DOE/NNSA (National Nuclear Security Administration) scrap as clean and thus sends it wherever scrap goes. We observed items cleared to be sold at open public auctions. We reviewed authorized release documents for volumetrically contaminated materials that were released from DOE to landfills or companies. But we were not able to observe and independently monitor contaminated materials such as plastic, wood, concrete, asphalt, soil or others as they are released for recycle and reuse, although this is understood to be happening. It will take more scrutiny, expertise, detection equipment, resources and lucky timing to identify which items are contaminated and to follow their pathways into commercial products.

The track is open and there is nothing stopping materials from getting into consumer goods, but we were not able to follow it fully in this project. The exception is for some metals, thanks to the Metal Industries Recycling Coalition (including the steel, copper, nickel and brass industries and some specialty metals), which is resisting any contamination in their supplies for economic, health and public relations reasons. Those industries are incurring expenses to monitor their processes and products, physically and legally, to keep nuclear contaminated metal out of them. Meanwhile the nuclear waste generators have purchased the same detection equipment used by the metal industry to assure their contamination is not detected. As metal costs are rising, DOE is reviving its ill-advised efforts to process and fabricate the metal allegedly for "restricted" release, opening the door to letting it out into everyday commerce.

International release

Since the metal market, as well as other materials markets, is international, we are seeking information on the position of metal industries in other countries. DOE has funded research at a Swedish radioactive metal recycler, Studsvik, which processes and releases metal from decommissioned German (and possibly other European) nuclear power reactors and facilities. There is radioactive metal recycling in Russia (Ecomet-S) near the Sosnovy Bor nuclear reactors and reportedly at Chernobyl in Ukraine. We are seeking documentation of DOE or NNSA funding of other radioactive release efforts internationally, not metal only.

How does it get out?

From review of practices at DOE sites that are closing and continuing operations, the paths out for wastes, materials and property are similar to each other and to those at other federal agencies that don't have radioactive contamination. The distinction is that DOE sites take steps to determine that the contamination is either not present or below self-chosen acceptable levels. The flow chart for making these decisions is included in the appendix. Once these "clearance" or "free release" or "authorized limits" determinations are made the waste, property and materials are released. Here are some of the ways it gets out.

What are the pathways to unrestricted public use of waste, material and property from the Department of Energy's nuclear weapons complex?

"Cleared" Department of Energy property can be:

Sold for Reuse or Donated

- At Auctions --Auctions are held for most DOE sites to get rid of excess property. They are held regularly for property from Los Alamos, NM and Oak

Ridge, TN--both operating facilities, and West Valley, NY, a closure facility, has held them. Thorough scanning is time-consuming so it is only done statistically and in conjunction with "institutional knowledge" about the likelihood the items ever came in contact with radioactivity. It is not likely that complete scanning is done of entire surfaces, in drawers of desks and nooks and crannies and hundreds of items are released for sale, from filing cabinets to pumps to large equipment to sinks, lamps, and furniture.

- Offered on Federal government exchange systems- There are federal exchanges within DOE for contaminated and "clean" property, wastes and materials. There are also exchanges with other, non-nuclear federal agencies. All government agencies can place property on federal exchanges making it available to others within their agency and or other federal agencies. Much was sold or donated from Rocky Flats during the closure process.
- Sold or Donated directly -- If property is not sold on the federal exchanges, it can be donated or sold to others. Glove boxes used for remote handling of radioactive materials at Rocky Flats went to schools and businesses. Trailers from Santa Susana in California went to schools, only to be found to contain asbestos and returned to DOE. Fire trucks from Fernald or Mound were donated to the local fire department.
- Leased or rented for unrestricted use to companies or other entities sometimes through the local Community Reuse Organizations.

These transfers can be:

- Direct i.e. equipment and building materials, such as the water tower from the Mound, Ohio site which went to a community for reuse and the soil from Los Alamos, New Mexico that went to a golf course in the area.
- Indirect via processors or brokers. At Oak Ridge there is an annual contract with a scrap broker that picks up scrap and combines it with all other scrap he collects. It is all mixed together and not considered contaminated. The contract is renewed regularly.

The materials, wastes and property can go to

- Municipal and other solid waste landfills onsite or offsite of DOE,
- Incinerators,
- Hazardous and mixed waste TSD (Treatment, Storage Disposal) facilities,
- Recycling into raw materials for consumer goods, building supplies, industrial and public works projects, etc. (No metal recycling due to the Secretarial bans but metal pipes or dismantled structures can go to scrap.)
- Waste brokers – for storage or shipment to processing, recycling, reuse, disposal or direct release,
- Processors of waste and materials that can treat or reassess and release,
- Schools, community organizations and nonprofit charities,
- The original source,
- Buildings and rooms can be leased or rented to businesses and other tenants,
- Other recipients.

A note on landfills:
Resource recovery (scavenging and organized recycling businesses) at local landfills could enable contaminated items to get out. To prevent this, Los Alamos reported that they send potentially contaminated metal to the larger Rio Rancho landfill near Albuquerque rather than the closer Los Alamos County landfill because the larger landfill takes more steps to prevent scavenging or deliberate resource recovery. Habitat for Humanity, however, does have access to the Rio Rancho landfill for supplies, but supposedly knows not to take DOE metal or materials. Housing developments are being built immediately adjacent to the Rio Rancho landfill. The Los Alamos County landfill has limited space remaining and encourages recycling of metal and concrete, having a facility adjacent to it for cement processing.

A note on incineration and thermal processes:
Incineration does not destroy radioactivity. If sent to an incinerator, radionuclides can be released and spread in the air, concentrate in the filters and ash and contaminate the incinerator. It facilitates internal ingestion and inhalation of radioactive materials. Tennessee has the most commercial and only DOE radioactive incinerators in the US, the others being Perma-Fix's near Hanford, Washington (not in use) and Gainesville, Florida. Tennessee licenses numerous commercial incineration and thermal processing facilities throughout the state that bring waste in to treat. Some atomic power reactors and other nuclear facilities burn some of their own radioactive and mixed waste on their sites (which is of concern) but do not take in other generators' waste as a business venture. [The NRC permission to burn radioactive wastes at licensed sites was approved in 1992 (almost immediately) after the Energy Policy Act reaffirmed states' rights over radioactive disposal and *off-site* radioactive air emissions.[1]]

[1] Energy Policy Act of 1992. Public Law 102-486, Section 2901. House Report 102-1018.

Commercial radioactive incinerator licenses in Tennessee include two at EnergySolutions, formerly Duratek, in Oak Ridge. Aerojet, in Jonesborough, supposedly has no license for incineration but it has "a condition on their processing license that authorizes oxidizing (incinerating) metallic uranium chips and grinding fines for disposal as dry solids."[2] Perma-Fix's DSSI in Kingston has run a mixed waste boiler for many years and was reported to have had a resin processing license in 1999. (1999 was the year we first obtained a list of TDEC radioactive processors—See Appendices A and B.) An incinerator proposed by RACE in Memphis (now Studsvik/RACE) was licensed by the state TDEC but halted by the local air authority in 2005. While not incineration per se, TDEC licenses at least two companies to process ion-exchange resins, some of which can be the hottest so-called "low-level" radioactive waste. Heavily loaded nuclear power reactor resins can give a lethal dose unshielded in 20 minutes. Studsvik has been 'thermally processing' resins since 1999 in Erwin. EnergySolutions bought up Duratek which had a resin processing license. ATG Catalytics had one in the 1990s but went bankrupt. Reports indicate that the first resin processing started in 1996 in Oak Ridge. DSSI was listed as processing resins in 1999 and RACE was reported to have a resin processing license in 2006 but the summary reports don't indicate specifics on the source of or radioactive concentration of the resins or whether the licenses are in use. Metal melters include EnergySolutions (formerly Duratek and still MSC), ToxCo (formerly American Ecology Recycle Center) and Aerojet. The only DOE incinerator in use in the country is at Oak Ridge.

Release via Processor or Broker

We provide a more detailed discussion of processors elsewhere in this report. In broad-brush, brokers collect from DOE and other customers. Some are specifically brokers for radioactive materials and wastes; some are general brokers who may not even suspect radioactivity. Processors are contractors or licensed facilities that may accept a so-called "low-level" radioactive waste or alternately a radioactive material under the terms of their license, and then subsequently declare the waste or material to be "cleared" after either simply another scan, or in some cases treatment that may lower the level of contamination on a portion of it to declare it "clean." An example is the Texas licensee, Waste Control Specialists, which advertises to DOE that they (apparently under Texas agreement-state authority) can clear DOE's nuclear waste, enabling DOE site operators to avoid the "authorized limits" process that would be necessary to release waste themselves.

Processors may grit or sand-blast, acid-etch, concentrate, heat-treat, cut, dilute, volume reduce, solidify, remove liquids or in some cases simply store the radioactive material. (See chart of Tennessee licenses for examples.) Some processors can let radioactive material out – so to a large degree, the DOE simply transfers the process of release to an agent. The results for the public are the same, since some processors are permitted to release their still-radioactive material.

Materials sometimes go back to the source

In some cases DOE sends materials back to the source that provided them in the first place. At Rocky Flats, activated granular carbon was used to filter plutonium and other radionuclides from solvents. After processing it, Rocky Flats DOE got permission from DOE headquarters[3] to return it to the Calgon Corporation in Kentucky for reactivation. Since Calgon is not licensed to handle radioactive material, DOE tried to remove most of the plutonium, americium and uranium, but needed approval since some remained. The plan to reactivate the carbon at the same facility that activates carbon for normal, every-day non-radioactive purposes was approved by DOE, the State of Kentucky and supposedly the company. It is unclear what the final disposition of the carbon was even though DOE did provide documentation of this "authorized release." An obvious concern is whether and how much plutonium and other radionuclides might have contaminated this unlicensed facility.

Overview of Wastes that Remain Under Radioactive Controls

When it doesn't get out, where does it belong? We summarize briefly how radioactive wastes are controlled when they remain identified as radioactive. Some radioactive waste stays on DOE sites in storage or disposal. It can also be sent offsite to other DOE sites or to NRC or Agreement-State- licensed commercial sites for processing, treatment and disposal. It is treated as high level, "low-level," transuranic or mixed radioactive waste. Even when under control, leakage and problems are rampant, calling into question the reliability of release decisions by the DOE.

[2] Email [Followup on Information Request] from TDEC Arnott to NIRS D'Arrigo Wed 2/28/2007 9:43 AM, "Aerojet does not have an incineration license, but does have a condition on their processing license that authorizes oxidizing (incinerating) metallic uranium chips and grinding fines for disposal as dry solids:" In response to inquiry posed when what appeared to be an incineration license was observed at the Johnson City TDEC office, near Aerojet DU processing facility.

[3] US DOE Memorandum October 28, 1993, from EM-331 Subject: Approval of Rocky Flats Office Proposal for Regeneration of Contaminated Granulated Activated Carbon, Approval signed 10-21-1993 by Tara O'Toole, Acting Assistant Secretary for Environment, Safety and Health, EH-1.

DOE's *Order 435.1, Radioactive Waste Management***,** identifies the options for disposal of so-called "low-level" radioactive wastes

--**onsite** at facilities that have onsite disposal cells (ex: Fernald), centralized at another DOE facility (the two options are Hanford, Washington or Nevada Test Site-NTS), or

--sent **offsite** for commercial disposal (ex; EnergySolutions in Utah) or storage (ex: Waste Control Specialists [WCS] in Texas) or

--sent for commercial **processing** (ex: EnergySolutions in Utah, WCS in Texas, Pacific EcoSolutions [PEcoS] in Washington, Alaron in Pennsylvania, Perma-Fix in Florida or Tennessee or any of the many other TDEC licensed processors in Tennessee). Some processors can now come to the waste and process or clear for release rather than shipping.

There are two **centralized mixed (hazardous and "low-level" radioactive) waste** disposal facilities designated by DOE

-- one at the Nevada Test Site

-- one at the Hanford site that currently takes mixed waste from Hanford only. A referendum overwhelmingly passed in 2004 in the State of Washington that called for clean-up at Hanford before more hazardous and mixed waste was brought in to the state.

Mixed waste sometimes goes **offsite** to **commercial mixed or hazardous waste processing** and/or disposal sites. Examples include radioactively contaminated oil going to Diversified Scientific Services, Inc. [DSSI or DSS] mixed waste boiler in Kingston, TN which generates energy. Los Alamos, Paducah and Oak Ridge have sent or considered sending mixed radioactive/hazardous waste to the **commercial hazardous waste disposal site**, Chemical Waste Management (CWM) hazardous waste landfill in Lewiston, NY. Los Alamos and West Valley have both used that site for radioactive or mixed wastes. The claim was made in Los Alamos that the background radioactivity at CWM is higher so more radioactivity can go there as designated as at or below background. Interestingly, the site is adjacent to the Niagara Falls Storage Site where K-65 ore is stored—some of the hottest radioactive uranium residues in the world. Both are adjacent to the Lewiston-Porter Kindergarten through Grade 12 schools.

DOE uses its internal orders and guidance to release radioactive waste to **solid waste facilities** such as BFI Pine Avenue Landfill, NY; BFI Conestoga Landfill, PA; Grows Landfill, PA and Carter's Valley Landfill, TN.[4] As indicated elsewhere, several Tennessee landfills, including North and South Shelby in Millington and Memphis, respectively, Middle Point in Murfreesboro near Nashville, Carter's Valley in Church Hill near northeast of Knoxville and Chestnut Hill landfill in Heiskell near Oak Ridge and Knoxville take radioactive "special" waste from DOE and/or commercial nuclear waste generators, via state licensed processors. DOE can use *Order 5400.5* and authorized limits to release directly to solid waste sites. In California, DOE attempted to dispose at solid waste sites but was stopped. They still send or attempt to send to California hazardous wastes sites, however.

Although the state-licensed C-746-U solid waste landfill on the Paducah, Kentucky site is not licensed for nuclear waste, DOE has adopted "authorized limits" permitting radioactive waste to be buried there.

Onsite Superfund or CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) burial areas are located at several facilities including Oak Ridge, TN; Fernald, OH; Hanford, WA; Idaho National Labs, ID for wastes from their sites only.

The **only operating radioactive incinerator in the DOE complex –the TSCA (Toxic Substances Control Act) incinerator** is at Oak Ridge, Tennessee.

The first geologic repository in the world opened for **defense transuranic (TRU)** and expanded quickly to take **mixed TRU** waste at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico.

High level radioactive waste must, by law, go to an NRC-licensed repository and none exists. The proposed repository at Yucca Mountain is deeply flawed legally, technically and politically.

Wastes under DOE control are getting out… through leaks, fires and natural forces including biological vectors (like the Hanford prairie dogs and other burrowers, migrating birds that stop at Oak Ridge's mercury or radioactive lakes, and other animals and plants).

Knowledge of DOE mismanaging the radioactive waste that is kept "*under control*" makes it difficult to trust that free release to *uncontrolled* destinations would be done responsibly and at the stated limits.

[4] "Authorized Release Overview: Obtaining DOE Authorized Release Limits for Property Containing Residual Radioactivity," power point presentation accessed 2/3/06 and 3/23/06 at http://www.bnl.gov/wmd/Linkable%20files/Power%20Point/Authorized%20Release%20Overview.ppt

Examples include:

- At Hanford, Washington and the Idaho National Laboratory, waste from reprocessing irradiated nuclear fuel from atomic weapons reactors, which will remain hazardously radioactive for millions of years, was poured into soil "cribs"[5] and into carbon steel tanks, not expected to remain intact nearly as long as the waste is hazardous. Not surprisingly, it is leaking out into the Columbia River watershed and the food-chain.

- At the Oak Ridge Reservation (ORR), radioactivity is routinely released into the air and water. The Tennessee Department of Environment and Conservation DOE-Oversight Division, Radiological Monitoring and Oversight Program First Quarter 2005 Report states that "Radioactive contaminants released on the ORR enter local streams where they are transported to the Clinch River, which is used as a source of raw water by local drinking water suppliers." Pages 8- 9 state: "Over one hundred miles of surface streams and significant (but unknown) quantities of groundwater in East Tennessee have been contaminated as a consequence of activities on the ORR. Process wastes contribute to this contamination, but the major portion of water pollutants on the ORR can be attributed to releases from antiquated and deteriorating waste disposal, transport, and storage facilities. Contaminants released from these facilities migrate to groundwater where they are discharged to local streams and are transported to the Clinch River and Watts Bar Reservoir." The downstream Watts Bar Reservoir has hundreds of curies of cesium-137, and mercury contamination located in underwater silt deposits. In the past, marina owners sued the DOE for contaminating the reservoir.

Many DOE sites and the places to which the DOE waste was sent have become Superfund sites—sites that pose so much danger that they must be cleaned up with government dollars with the intent of getting the potentially responsible parties to reimburse the government later once the cleanup is completed. EPA's Superfund website defines Superfund sites as sites "which are uncontrolled or abandoned places where hazardous waste is located, possibly affecting local ecosystems or people."[6]

[5] Crib: An underground structure designed to receive liquid waste that percolates into the soil directly or percolates into the soil after having traveled through a connected tile field. Defined at http://hanford-site.pnl.gov/envreport/2002/pdf/14295-2/14295210.pdf accessed 3-4-07.
[6] www.epa.gov/superfund accessed 4/20/07

Three case histories of places that ended up with DOE radioactive waste and became Superfund Sites (in Colorado, Ohio and Tennessee) are summarized in next chapter this report, **Where It Got Out in the Past**.

Redefining Waste Categories to Reduce or Remove Radioactive Controls: From High Level and TRU to "Low-Level" and From "Low-Level" to No Level

High-level radioactive wastes (irradiated fuel and the extractions from reprocessing that fuel) from DOE operations are required by federal law to go an NRC-licensed permanent repository. Despite a federal court determination that wastes from reprocessing irradiated fuel are "high-level" radioactive wastes [*NRDC v. Abraham*, 271 F.Supp.2d 1260, 1265 (D.Idaho 2003)], DOE used its political might in Congress to begin declassifying it, legislatively, as "Waste Incidental to Reprocessing" or "WIR." Driven in part by the ballooning costs of clean-up in the DOE nuclear weapons complex, some of the still-highly-radioactive reprocessing waste is destined to be grouted--mixed with concrete and left in place--at the Savannah River Site in South Carolina and at the Idaho National Labs, and left to leak into the aquifers and rivers. Hanford, Washington and West Valley, NY are similarly threatened. While renaming high level waste to a lower level is not exactly the same as the "clearance" or "free release" by DOE, these are both examples of "linguistic" detoxification, to reduce the costs but increase the hazards to our health and environment.

This trend to define away the radioactivity is not new. In the 1970s DOE raised the concentration level for "transuranic waste" or TRU waste from 10 to 100 nanoCuries per gram (1 nanoCurie equals 37 becquerels or radioactive emissions per second per gram). Transuranics are elements that are heavier than uranium, including plutonium, neptunium and americium, that are generally very long-lasting and that emit alpha particles, most hazardous when inhaled or ingested. Alphas can do five to twenty times or more damage than gamma rays to the cells they hit. Raising the amount of radioactivity from 10 to 100 nanoCuries per gram as the definition for "transuranic" waste saved DOE from having to clean-up many acres to square miles of land at Hanford, Washington and Savannah River Site, South Carolina, clearly saving money but raising risks.

So, DOE continues to work hard to change the classifications of radioactive waste to essentially 'not radioactive' to reduce disposal requirements and costs. Creative dose-based classifications of waste by DOE allow theoretical projections of its eventual leakage and exposure to determine how it is classified and managed.

How does DOE "clear" wastes, materials and properties for unrestricted release?

Unintentional or Accidental Releases from Uncontrolled, Non-radiological Areas

Some material, waste and property are directly released as regular trash or for reuse if it originates from a non-radiological area. Even if DOE had always pursued a goal to isolate and prevent the dispersal of radioactivity, it is safe to assume that over the decades, some amount of it would have spread around throughout the facilities and off the sites. It is not credible to assume that every non-radiological and non-controlled area is, in fact, clean (no DOE-generated radioactivity). Since detection is only done randomly in these areas, it is entirely possible that surface contamination, tracked or otherwise spread from other areas could get into the areas assumed clean and be released. These would be accidental or unintentional releases.

There is no dispute however that some materials and wastes that are known to be contaminated with DOE-generated radioactivity are deliberately released from DOE control.

Intentional Surface Contaminated Releases under DOE *Order 5400.5* from Controlled Areas

DOE *Internal Order 5400.5*, Radiation Protection of the Public and Environment, Chapter IV (releasing radioactive waste and materials from controls) was adopted in 1990 (or 1993), without public knowledge or input, evolving from DOE *Order 5820.2A*, Radioactive Waste Management. A provision of that Order allowed "Waste containing amounts of radionuclides below regulatory concern, as defined by Federal regulations, may be disposed without regard to radioactivity content."[7] There had been public opposition to this provision, but it was expanded into *Order 5400.5* Chapters II and IV providing criteria for releasing nuclear waste. According to DOE staff actively developing and implementing the release provisions, Chapter IV evolved from clean up experiences at FUSRAP (Formerly Utilized Site Remedial Action Plan) Manhattan Project sites and Surplus Facilities Management Program (SFMP) sites contaminated from the development and production of the first nuclear weapons. Many of those sites were identified, demolished and removed or cleaned for reuse in the 1980s.

DOE *Order 5400.5* (Appendix I) has a table of surface contamination levels for various categories of radionuclides. The table is a variation of the *1974 Atomic Energy Commission Regulatory Guide 1.86* (Appendix O) that was created to decommission reactors. *Reg Guide 1.86* was not intended to set contamination levels for items to be released into unregulated use and commerce. DOE has added and changed some of the contamination levels in that table and it is the basis for releasing surface contaminated radioactive materials, wastes and properties.

Intentional Volumetric Contaminated Releases under DOE *Order 5400.5* from Controlled Areas

Volumetrically contaminated materials, wastes and property are those that have radioactivity throughout their mass. They can include materials such as soil, activated metals and other wastes. There are no set concentrations that can be released. Instead, volumetric releases must be "authorized," by creating "Authorized Limits." Guidance and procedures were provided in the *November 17, 1995 DOE Memorandum from R.F. Pelletier, Office of Environmental Policy and Assistance, Air, Water and Radiation Division: EH-412: Wallo to Program Office, Field Offices and Other (DOE) Organizations, RE: Application of DOE 5400.5 requirements for release and control of property containing residual radioactive material*. Thus, **this memo** determines how DOE and, later, NNSA sites may release radioactive waste, material and property contaminated with nuclear weapons generated radioactivity.

If it is calculated that the volumetric contamination will give "individual doses to the public [that] are *less than 25 millirem in a year with a goal of a few millirem,"*[8] the waste can go to a solid waste landfill, as long as the groundwater is protected to state requirements and the landfill operator and state solid waste regulator agree.

If it gives a dose of a millirem or a few millirems per year, field offices can make the determination. If it would give higher doses, permission must be granted from the head of Environment Safety and Health EH-1, now HS-1, the head of the Office of Health, Safety and Security established August 30, 2006.

Using RESRAD Computer Code to permit radioactive releases to landfills and public

To assist DOE in claiming that groundwater would be protected, the DOE and NRC contracted the DOE Ar-

[7] DOE *Order 5820.2A Radioactive Waste Management* 9-26-88 Chapter III Low-Level Radioactive Waste Management, page III-7. Defines "Below Regulatory Concern" as "a definable amount of low-level waste that can be with deregulated minimal risk to the public."

[8] November 17, 1995 DOE Memorandum from R.F. Pelletier, Office of Environmental Policy and Assistance, Air, Water and Radiation Division: EH-412: Wallo: 2025864996 to Program Office, Field Offices and Other (DOE) Organizations, RE: Application of DOE 5400.5 requirements for release and control of property containing residual radioactive material, Page 7.

gonne National Laboratory to develop the RESRAD computer code. It provides a tool to claim doses are being calculated as acceptable and justify dumping nuclear waste in solid waste landfills.

The same doses estimates can be used to allow dumping radioactive waste in a state-licensed solid waste landfill that is on the DOE property. There is such a landfill at Paducah, Kentucky, which takes DOE radioactive waste although it is not licensed as a radioactive disposal site.

Internal DOE "Guidance" to Implement DOE *Order 5400.5:* November 1995 Memo[9] and 2002 Draft Guidance[10] are used to allow radioactive releases.

These are not laws or regulations approved through any public process. They are DOE staff guidance developed to assist the sites in clearing nuclear waste out economically.

The November 1995 memo explains how radioactive materials and property can be released into general commerce. First, the total exposures have to be estimated to be less than the 100 millirems/year individuals are allowed from all sources above background. Like the landfill releases, they should have a *goal* of a few millirems but can each give up to 25 millirems per year.

These "authorized limits" appear more and more like blank checks to let contaminated materials go because there is no process and no effort made to verify the exposures caused.

At Tennessee landfills which have been taking nuclear waste for over a decade, there appears to be no monitoring for radioactivity in the leachate.

Authorized Limits and Supplemental Limits

As described, DOE sites and headquarters can establish authorized limits for releasing radioactivity from DOE controls. The limits may be established for one situation, but can be used regularly or irregularly thereafter for additional releases that are determined to meet the criteria for that authorized limit. Since an authorized limit can be used over and over for different releases, and no overall assessment is needed, it is impossible to know the total amount of radioactivity released under each authorized limit. In addition, if the authorized limit becomes impractical, *supplemental* limits may be approved to allow more or different radioactive releases.

As part of this research effort we sought information on authorized limits and received some examples of approved and rejected requests for releases under authorized limits. What has not been provided, which the DOE Secretarial Memos from 2000 promised the public, is transparent public record-keeping for all releases. Thus, simultaneously with the release of this report, NIRS is filing a Freedom of Information Act request for all of DOE's approved and pending authorized and supplemental limits and an accounting of all of the radioactivity that has been released under these limits.

Another guidance document–this time a draft–establishes DOE's procedures for creating Authorized Limits and Supplemental Limits. ***Draft DOE Guide 441.1-XX*** requires a cost benefit analysis to be done *by the entity wishing to release the radioactive waste.* Again, doses can be as high as 25 millirems a year and should be coordinated with landfill operators and state regulators if going to landfills. If the doses from volumetric radioactive contamination are projected *by the entity wishing to release the radioactive waste* to be higher than a millirem a year then they must get DOE Headquarters approval.

If the materials, wastes and properties are surface contaminated only, they can be directly released from a radiological area if it they are believed to be at or below the levels listed in DOE *Order 5400.5* (which is based on the *1974 Atomic Energy Commission Reg Guide 1.86* contamination levels). The misuse of *Regulatory Guide 1.86* for free release and the inadequacy of detection procedures are discussed more later.

Records are supposed to be kept, but these are sometimes hard to find or interpret. More than once, the headquarters comments on requests for authorized limits appeared to be coaching the field officials in how to convey and defend the releases rather than reviewing them critically with the primary motive of protecting public health and safety.

The Authorized Limits and Supplemental Limits approved are not reported on a central database or in a systematic way for DOE Headquarters or the public to review as was mandated by the 2000 Secretarial Memos. We were able to obtain some reports on specific authorized limits through a Freedom of Information Act request and are initiating a follow-up request for all DOE, NNSA Headquarters and site Authorized and Supplemental Limits used, in use and under consideration.

[9] Ibid.
[10] DOE G 441.1-XX, XX-XX-02 Implementation Guide Control And Release Of Property With Residual Radioactive Material for use with DOE 5400.5, Radiation Protection of the Public and the Environment, May 1, 2002

Limitations: Types of Detection, Detection Levels, Procedures and Time Constraints

Even items that are scanned and declared "clean" may have residual radioactivity. Radioactive substances can be present below the levels of detection of the instruments used or simply not picked up due to timing, calibration and other errors. Further, many instruments can detect only specific types of radiation, for example gamma rays. Another type of radiation, such as alpha, may be present in large amounts but will not be detected if the wrong instrument is used. The amount of time given to scanning will impact the data. If done too fast the instrument may not register radioactivity that is there. If this happens, contamination, even in excess of "release levels," can escape.

Items that could be released include tools, vehicles, equipment, building materials, metals, plastics, concrete, asphalt, soil, chemicals, and even the buildings themselves that are at many sites now being leased for non-radiological purposes with no restrictions.

Possible Loopholes in Metal Recycling Ban

In 2000, the Secretary of Energy promised the American public that no metal from radiation areas (See box on right.) would be released *for recycling* into unrestricted commerce. Metal can go to unregulated landfills even though it is not supposed to go to commercial recyclers. As of early 2007, DOE is officially exploring "restricted" metal recycling raising immediate concerns about how it will remain restricted after the first restricted use, whether exemptions will be given and whether it will be used to circumvent the 2000 bans.

The movement between controlled and uncontrolled areas on DOE sites could also be a loophole for radioactive metal to get out.

Unfortunately in preventing metal recycling, no similar promises were made for other materials or property including soil, concrete, asphalt, chemicals, buildings, metal components of building such as piping, equipment and more. All non-metal materials can be deliberately released with some radioactive contamination into recycling.

In fact, DOE has been encouraging the release of various materials, wastes and property, through its pollution prevention or P2 programs, "Green Is Clean," and activities of the Oak Ridge-based Center for Excellence in Recycling.

As mentioned above, the release levels can be as high as those for large operating nuclear power reactors or entire decommissioned areas (25millirems/year).

Unfortunately it is difficult, expensive and time consuming to detect low levels of different kinds of radioactivity. Since there is no safe level, all contaminated materials and property could pose health risks.

DOE RADIATION AREAS

There are numerous types of areas at DOE sites that have radioactive materials or generate radiation. No metal can go to commercial recycling from these areas. Some of these are:

Controlled Area [(CA) any area where access is managed to limit individual exposure to radiation and/or radioactive materials < 100 mrem per year]

Radiologically Control Area [(RCA) Areas containing radioactive material areas or radiological areas < 5 mrem per hour at 30 cm]

Radioactive material area [Areas where radioactive materials are stored for long and short time periods, may be combined with RCA; various dose levels]

Radioactive material management area [(RMMA) Areas where non-radioactive material may become activated (from bombardment by radiation), such as all accelerator housings. These areas are RCAs. Various dose levels and dose rates.]

Radiation area [> 5 to 100 mR per hour at 30 cm, a 10 CFR 835 "Radiological Area"]

High radiation area [100 mR per hour-500R per hour at 1 meter, a 10 CFR 835 "Radiological Area"]

Very high radiation area [> 500 R per hour at 1 meter, No entry allowed. Typically not accessible, a 10 CFR 835 "Radiological Area"]

Personnel exclusion area [No entry allowed. Secured areas with the potential for abnormal ionizing radiation dose rates not controlled by engineered personnel protection systems (PPS)]

Contamination area [Regardless of dose rate, a 10 CFR 835 "Radiological Area"]

[http://www-group.slac.stanford.edu/esh/eshmanual/references/radTraining.pdf 21 December 2005 SLAC-I-760-0A05S-002-R000; Radiological Safety: Training Requirements for Unescorted Entry to Controlled Areas; reference accessed 3-3-07]

Recordkeeping: Mandated Reporting Not Taking Place; One of DOE's Broken Promises

Despite a commitment to the public from the DOE Secretary in 2000 that there would be publicly available recordkeeping, this has not happened—at headquarters or at some sites.

When NIRS requested the cumulative information on releases that have been made from each site, we were told by DOE officials that, as indicated in a 2000 Secretarial Memo, these were to be reported in the ASERS, Annual Site Environmental Reports. After reviewing all available ASERs for all years for all 7 DOE sites in this research, we found that this reporting is not taking place. It was mandated in 2000 but as of late 2006-early 2007 it was not being done. Guidance documents on how to comply with the reporting requirements were available but with the exception of West Valley, NY which simply reported no releases under authorized limits, we were unable to find the required reporting. Interestingly West Valley, like many DOE sites including Los Alamos and Oak Ridge, release large amounts of property through public auctions.

Although some sites do keep detailed records, they are not easily accessible or meaningful without direction from the entity responsible for them. This was the case in Ohio, where both Mound and Fernald are closing. The records were being shipped out of town to a federal repository and those that were available for review did not convey the amount of radioactivity released or its destination. Only the initials of the person releasing and the recipient were reported with no key as to who the initials represented.

The staff was very friendly, highly competent and helpful in finding and interpreting the sample information requested, but the information itself was not adequate to provide an understanding of the amount of contamination and its endpoint. Once the sites are closed there will be no staff to direct the interested public to specific clearance records. In addition, the records were in the process of being moved to a final location out of the area.

In reviewing the information, the only indication that contamination on released items was below the allowable release level was an instrument number and calibration date. Which instruments are used (which radioactivity to try to find) are determined by "institutional knowledge" of the area and an expectation of the type of contamination that is likely to be present. Amazingly, our researcher at Rocky Flats was told that there were areas of the site that need not be monitored for alpha contamination despite the fact that it was a plutonium facility that even burned plutonium, an alpha emitter.

Over-reliance on Institutional Knowledge

The head of the Tennessee Department of Environment and Conservation DOE Oversight Division expressed grave concerns about reliance on institutional knowledge at such old, enormous sites as Oak Ridge, TN. The first step in releasing radiological property is to determine if the property has known or potential contamination. This is done relying on institutional memory or knowledge about what might be contaminated and with what types of radioactivity. (The Radiological Release of Property flow diagram is provided in the Appendix F.) Another TDEC official expressed serious concern about the folly of relying on computer models to predict radioactive migration underground. He said the problem with computer models is the longer people spend on them, the more they believe they mean something. His opinion was that they cannot predict the underground migration patterns or timing. These are relied upon in Tennessee (by other TDEC divisions) to allow 'cleared" radioactive materials/wastes to be disposed of in solid waste landfills.

One of the troubling aspects of "clearance" is that the material is no longer recorded as, labeled or considered radioactive. The more important issue is not the mass of the material being released that is of concern, which the TDEC Solid Waste Division is supposed to keep track of for each landfill receiving deregulated or "special" radioactive waste. It is the radioactivity and the resulting undisclosed radiation exposures to unsuspecting individuals that is of real concern.

The regulations that govern the release of residual radioactivity are reviewed in greater detail elsewhere in this report but we offer an overview here to give some perspective on the loopholes that exist between regulations on paper and their implementation.

How Much Radiation Gets Out?

We don't know. Apparently DOE doesn't know. There is *no cumulative* tracking, measurement, quantification, record keeping or reporting *on all of the DOE's radioactive releases* in terms of volume, weight, type of material or radioactive amounts or concentrations. The releases are based on estimated concentrations and doses or surface contamination levels, not total radioactivity. There is no estimate or compilation of radioactivity or radionuclides released. There is generally no verification or confirmation that the release levels are being met or exceeded. This is especially difficult since it is a dose calculation that justifies some of the releases. In a few cases independent verification of surface contamination levels is possible but the expense is rarely incurred and the results are not made public.

How DOE decides what can get out

The Environmental Protection Agency (*40 CFR 190*) limits exposures to the public from each operating nuclear-fuel-chain facility to 25 millirems per year.

The Nuclear Regulatory Commission (*10 CFR 20 Subpart E*) allows closed, decommissioned nuclear sites to be released for unrestricted use if they are projected to expose members of the public to up to 25 millirems per year.

By comparison, the Department of Energy releases individual sections of property, portions of sites and portions of waste streams based on projections that each release could expose people to 25 millirems per year, and possibly higher.[11] This is using draft guidance that has never been promulgated into regulations, but it is the procedure DOE field offices use to implement *DOE's Internal Order 5400.5*. On November 17, 1995 an internal memo[12] about implementing *DOE 5400 .5* stated that it allows *each authorized limit or release to give up to 100 millirems per year to individual members of the public but encourages that they be less* than that since 100 millirems per year is the *total* dose above background a member of the public should receive, and people can get multiple exposures. The limits should be selected, it states, to ensure doses to individuals using the property under "actual" and "likely use" scenarios will be well below the primary dose limit and at a level that provides a reasonable expectation doses will be *less than the dose constraint of 25 millirem in a year, with a goal of a few millirem or less in a year.* In fact, if volumetric releases are calculated to be less than a millirem a year, the field can approve them. If they will be higher DOE Headquarters (EH-1, after 2006 HS-1) must approve them.

It is clearly inconsistent to allow an entire site to meet a radiation dose limit, but to allow each piece of a site in the form of released waste material, to meet the same limit.

DOE's Internal *Order 5400.5* incorporates with some variations, the *Atomic Energy Commission Regulatory Guide 1.86.*[13] That guide, (See Appendix I), provides surface contamination levels for releasing a reactor area from licensed control, *not levels for unregulated disposal, reuse or recycling into everyday commerce*. These levels, most of which were selected in 1974, "were never intended to be used as (a) release guideline for recycling purposes,"[14] according to John MacKinney of the EPA in 1993. Others have agreed since the *Reg Guide 1.86* levels were intended for clearing an area, not releasing materials that could be made into items with which the public comes into routine, intimate personal contact.

DOE has interpreted that it can simply clear items that have less radioactivity than the surface contamination levels in their Internal *Order 5400.5*. DOE has added and changed some surface contamination levels and is in process of changing some numbers currently.

Proposed Changes to Weaken 10 CFR 835 – Adopting Provisions of *Order 5400.5*

There is a current rulemaking[15] underway in which DOE has adopts part of its *Internal Order 5400.5* into the DOE "regulations" for worker protection from radiation, *10 CFR 835*. *10 CFR 835* is known to have been stricter than *5400.5*, but DOE is weakening it by incorporating *5400.5* into it. This appears to permit some hot spots of radioactivity in buildings that are leased by DOE or Community Reuse Groups at DOE sites to independent, non-nuclear businesses that unsuspectingly rent rooms and buildings that once housed DOE nuclear activities. These occupants may be exposed to that residual radioactive contamination. Another change in the regulations under *10 CFR 835* could be made in the definition of some controlled areas that have the potential to affect the bans on commercial recycling of metal in those areas.

If DOE wants to release materials, wastes, property that are volumetrically contaminated, that is, have radioactivity embedded within, an extrapolation must be

[11] *DOE G 441.1-XX, XX-XX-02 Implementation Guide Control and Release of Property With Residual Radioactive Material for use with DOE 5400.5, Radiation Protection of the Public and the Environment, May 1, 2002*)

[12] November 17, 1995 Memo to Field Program Offices of DOE From Air, Water and Radiation Division: EH-412: Wallo:2025864996 RE: Application of DOE 5400.5 requirements for release and control of property containing residual radioactive material. Response to Questions and Clarification of Requirements and Processes: DOE *Order 5400.5, Section II.5 and Chapter IV Implementation (Requirements Relating to Residual Radioactive Material*)

[13] US Atomic Energy Commission Regulatory Guide 1.86, Directorate of Regulatory Standards June 1974*, Termination of Operating Licenses for Nuclear Reactors.*

[14] MacKinney, John, U.S. Environmental Protection Agency Recycling of Radioactive Scrap Metal, presented at Radioactive Scrap Metal Conference, July, 1993, University of Tennessee

[15] 71 FR154: 45996, August 10, 2006 / Proposed Rules, Department of Energy 10 CFR Parts 820 and 835 Procedural Rules for DOE Nuclear Activities and Occupational Radiation Protection.; 72 FR 110: 31904 June 8, 2007 Final Rule; http://www.hss.energy.gov/HealthSafety/WSHP/radiation/rule.html

done from the surface contamination levels to allowable concentrations and doses. DOE hired Argonne to develop the RESRAD computer to project the doses people would receive from various levels of all the radionuclides and combinations of radionuclides. To make this calculation, many assumptions are made that cannot be guaranteed. Volumetric releases have required approval of EH-1, the top official in the DOE Office of Environment Safety and Health. Now that DOE has restructured that office it is part of the Office of Health, Safety and Security (HSS). ES-1, the top official in that office is responsible for approving or rejecting volumetric releases.

Because of public, local, state, other industry, worker and union opposition to radioactive recycling and release in the US, there is no legal, allowable release level. *DOE has created its own internal allowable levels* and procedures to release both volumetric and surface contaminated metals and other materials, wastes and property. Because of the insistence of the metal industry, along with public and local and state governmental concern, DOE has halted (as of this writing in April 2007) deliberate commercial recycling of potentially contaminated metal, defined as that present in control areas. (Some definitions of radiological and control areas are provided in the box p. 42.) The latest threat is DOE's request for Expressions of Interest for companies to process contaminated nickel and other metal from uranium enrichment for "restricted" use within DOE or the regulated nuclear industry.

Increasing amounts of allowable contamination; Some risk comparisons

DOE Internal *Order 5400.5* states: *"The basic public dose limits for exposure to residual radioactive material, in addition to natural occurring "background" exposures, are 100 mrem (1 mSv) effective dose equivalent in a year…"*

The Order further allows for "unusual circumstances" in which a site may request permission to temporarily allow doses up to 500 millirems a year.

The section of this report on radiation detection discusses the challenges of detection. The dangers of radiation exposure are covered in the section on Ionizing Radiation. It is worth noting here that in 1990 the federal government provided its own risk assessment for the chances of fatal cancer from radiation exposure. The NRC's Below Regulatory Concern Policy Statement radiation risk table (See Appendix J) projects the risk of fatal cancer from an ongoing exposure at various levels. NRC projected that exposure to 100 millirems a year over a lifetime (the same regulatory limit as DOE) will result in 3.5 fatal cancers per 1000 members of the public exposed, or 1 cancer death in every 286 people exposed. Compared to earlier public discussion (circa 1965) about whether it is ok for an industrial activity to result in "collateral damage" of 1 cancer in a million members of the public, the escalation of the Atomic Age has lowered the bar dramatically on a "bag limit" for the public. It becomes even more worrying when independent radiation experts find risk of fatal cancer from this level of radiation to be as much as 10 times higher than NRC's projection.

In fact a DOE staff-person, in advocating the now rejected changes to DOE internal *Order 5400.5* stated that technically, DOE can expose people to up to 500 millirems per year. Guidance–and there are volumes of it—require DOE headquarters' approval for volumetric releases, each greater than one or few millirems per year. But these are internal DOE decisions on allowable risks to the public and environment in addition to others already allowed by DOE and other nuclear facility operators. This risk has never been approved by any elected officials or public process—it is an internal assertion by DOE for its own guidance, with no enforcement possible by the public or physically possible. It has never been approved by the public, by law or regulatory process. In fact Congress has previously rejected the levels and the concept.

How State Licensing is Circumventing Federal Opposition to Nuclear Waste Release

DOE is taking advantage of the favorable attitude or lack of oversight in some states toward nuclear activities. Tennessee appears to be the leader. Tennessee's Department of Environment and Conservation (TDEC) has at least four Divisions with some connection to DOE and commercial nuclear power industry radioactivity: the Divisions of DOE Oversight, Radiological Health, Solid and Hazardous Waste Management and Air Pollution Control. The Radiological Health Division licenses processors that can survey and release nuclear waste. The Solid and Hazardous Waste Management Division allows this "special" waste to go into solid waste landfills. Radiological Health and Solid Waste have a Memorandum of Agreement (See Appendix H) streamlining the process of sending nuclear waste to solid waste landfills.

Tennessee appears to have the most nuclear waste processors of any state and is the most proactive. It expressly licenses profit-making companies to import nuclear power and weapons wastes from other states and countries to be re-characterized and released in the state. The Division of Radiological Health gives at least seven types of licenses to numerous companies to free release or for Bulk Survey For Release (BSFR). The nuclear waste is brought in and scanned or treated and surveyed to be released into the states' solid waste landfills or for reuse or recycling. (See Appendices A and B.)

Some of the processors could be releasing radioactive materials for recycling and reuse. The documentation of this is more difficult because companies do not willingly admit to accepting materials from DOE weapons sites, even if it is through a middleman such as a broker or processor. It is also possible that the recipients don't even know that their raw materials may have originated at a nuclear power or weapons site.

As far as deliberately determining an "acceptable" level of contamination, DOE is clearly biased and has a bad track record at protecting the public, workers and environment from its nuclear refuse. It is unsettling to be asked to trust the DOE, with its abysmal history of environmental neglect and contamination, to authorize releases. It is just as troubling to trust the State of Tennessee which actually licenses companies to import and release radioactive materials into the states' environment to make decisions about how much radioactivity to let out. Finally, it is worrisome to trust local community reuse organizations that could profit from releases and leasing of formerly utilized property to determine acceptable contamination levels.

CHAPTER 8: WHERE IT GOT OUT IN THE PAST AND IS CAUSING TROUBLE TODAY: 3 CASE HISTORIES

The Department of Energy expects the public to trust them regarding how much radioactive waste to let go. Based on past history this would seem ill-advised. DOE waste went to these three sites, all of which are now in either federal or state Superfund cleanup: Lowry Landfill in Colorado, Industrial Excess Landfill in Ohio; and a metal recycler with a landfill on site, Witherspoon, Inc. in Tennessee. In all cases there was public concern and outrage surrounding the contamination and cleanup, some of which continues to this day.

These sites suffer from leakage, incorrect monitoring and contamination assessment, secret agreements and other difficulties. DOE is listed as either a Responsible Party (RP) or a Potentially Responsible Party (PRP) for each site.

The thread that passes through all of these case studies is the lack of government oversight and responsibility. Once radioactively contaminated materials leave a weapons site, keeping track of where they go or trying to assess the risk they pose has proven too great for either the government or its contractors. These case studies clearly show this.

Those who cannot learn from history are doomed to repeat it. George Santayana

Lowry Landfill, Colorado

Rocky Flats, a Department of Energy weapons production facility, dumped at the Lowry site which started out as a bombing range and later became a landfill. Lowry had no provisions for radioactive or hazardous materials. While DOE claims that it dumped no radioactive materials at Lowry, the radionuclides present nearly always come from the DOE weapons complex. Due to poor management and resulting contamination, Lowry is now a federal Superfund site.

The Lowry site is located about 15 miles southeast of Denver, Colorado. It was a United States Air Force Bombing range until1964 when the United States ceded it to the City of Denver to be used as a landfill. Lowry Landfill accepted solid waste and industrial liquid waste in unlined waste pits or trenches with no measures to prevent seepage into surrounding soil. In 1984 Lowry was placed on the National Priorities List (NPL), becoming one of the nation's more expensive EPA Superfund sites.[1] In 1985 a barrier wall was constructed to keep onsite groundwater from moving offsite and a treatment plant was built to treat onsite groundwater. Recognized contaminants include several volatile organic compounds (VOCs) (www.scorecard.org) and radionuclides[2]. Data from 1991 show elevated levels of radionuclides in water at the site, including plutonium. These data were generated by responsible parties (RPs).

In the interim between the collection of 1991 data and the Responsible Parties' reevaluation of the site, several wells were capped or re-dug, including wells that indicated plutonium contamination. Additionally, several of the Responsible Parties were offered a "radiation premium" which they would buy into in trade for abrogation of responsibility for radioactive contamination at the site. A deal was cut between the City of Denver (which was partnered with Waste Management) and the Responsible Parties that was sealed from public view by a court decision[3]. The exact nature of the language of this agreement still eludes the public.

EPA Region 8 issued a Record of Decision in 1994 regarding the Lowry site that allowed groundwater to be pumped off the site as wastewater through the municipal water treatment facilities. The public became concerned that this water was not being completely filtered for radiation, resulting in potential exposures. In response, EPA issued a 1995 report explaining their 1994 Record of Decision (ROD) and the apparently conflicting radiation contamination numbers. EPA Region 8 was attempting to claim that testing at Lowry which found plutonium and other nuclides was faulty.[4]

But the company (Teledyne Isotopes) that did the original testing that found the plutonium, stood by their original tests that indicated plutonium, uranium and thorium were present[5].

Further, a Federal judge stated[6] that …on July 31, 2000, the EPA Ombudsman issued a report which concluded that the "weight of evidence supports" citizens' claims that "uncertainty" exists concerning radioactive

---

[1] http://www.epa.gov/region8/sf/sites/co/lowry_.html and Environmental Protection Agency OIG Audit Report: February 29, 2000 doc #1998-R8-000206-00007

[2] Radionuclide Work Group Meeting report, US EPA, Aurora, CO, March 29, 2001

[3] Welsome, Eileen, "The Lowdown on Lowry," a series in The *Westword*, Denver, Colorado, April 2001

[4] OIG Audit Report February 29, 2000, doc #1998-R8-000206-00007

[5] Letter from Teledyne Isotopes to Harding Lawson Associates, June 1, 1992

[6] case # 1997-SDW-7 Adrienne Anderson v. Metro Wastewater Reclamation District

contamination of the Lowry Landfill Superfund Site. As a result, the Ombudsman recommends "further sampling and the development of sampling protocols to address the issue of the presence of radioactive material at the Lowry Landfill Superfund Site."

The judge further found that the "discharge permit" which Metro Wastewater had fought to keep from being permitted as evidence in this lawsuit "includes plutonium and other radioactive material," making it clear that plutonium and other nuclides are indeed a concern at Lowry.

The Denver Metro wastewater treatment facility receives groundwater recovered from the Lowry site which has been treated (for VOCs, semi-VOCs and heavy metals) but not for plutonium. Metro then monitors this water for levels of various radionuclides. The Metro wastewater permit (permit #I-118) allows discharge of plutonium and other radionuclides to be released into the public sewage system which is then spread as sludge on farmland for edible crops.

While Rockwell International, a U.S. Department of Energy contractor that was responsible for oversight at Rocky Flats weapons complex, is listed as a Potentially Responsible Party, it claimed that the 55,630 gallons of waste it sent to Lowry was not radioactive. Considering the kinds of radionuclides found at Lowry, this claim appears to be untrue. Or perhaps Rocky Flats dumped additional wastes at Lowry that were radioactive, without any record. In either case, DOE's handling of radioactive wastes in this way was and is inappropriate and dangerous. It leaves very little trail, and subjects the surrounding community and anyone who eats the crops grown with water from the site to unknown exposure to radiation.

Rocky Flats contractor, Rockwell, remains a Potentially Responsible Party at the Lowry Superfund Site. The presence of radioactive isotopes at the Lowry site has never been adequately explained. Public inquiry on this matter has met with resistance, threats and personal recriminations leading to an ever-deepening suspicion and further obfuscation of the truth.

Industrial Excess Landfill, Uniontown, Ohio

The Industrial Excess Landfill (IEL) started as a sand and gravel mine. In 1966 it was converted to a landfill (old-style with no liners or engineering) that closed in 1980. The public, rubber industries, and hospitals, and others, dumped at the landfill, which is now a U.S. Environmental Protection Agency (EPA) Region 5 Superfund site. The U.S. Department of Energy is also suspected to have dumped at this site, which was not licensed or regulated for radioactivity. Local citizens actually saw a line-up of trucks with radiation symbols in the middle of night.[7] The plutonium (Pu) contamination at this site most likely came from DOE sites, but determining which DOE facility is responsible would be difficult (though the excess of Pu-238 indicates the Pu came from Mound Laboratory).

The EPA Superfund website (www.epa.gov/superfund) does not list radionuclides as a concern at IEL, yet radionuclides were detected in the groundwater. Rainfall is flushing the permeable glaciated, sand & gravel site at a flow rate of up to 6 feet per day as reported by the US Geological Survey. This raises extreme concern that IEL could potentially affect a sole source aquifer that goes into 13 counties and is used by 600,000 people.[8] Numerous radionuclides have been discovered at the site, including plutonium.

Plutonium was reported detected in the ground water at the IEL site in several wells, both on and offsite in 1992/93, 2000 and 2001. U.S. EPA has described them as "potential detections." In 2000 two wells were reportedly found to be contaminated with plutonium and an additional three wells in 2001[9]. The levels of plutonium reported were above cleanup, health-based legal limits established at other DOE sites such as Rocky Flats in Colorado. For comparison, the limit for ground and surface water cleanup at Rocky Flats is 0.15 pCi/L for plutonium set out in the "Final Rocky Flats Cleanup Agreement."[10]

The testing of groundwater at IEL was sporadic and core samples of soils were never taken. Top radiation scientists have weighed in on this case with concerns that the testing methods used at IEL were suspect in several ways. For example, according to several experts in and out of government, tests for plutonium in water were improperly performed at IEL. Further, U.S. EPA used a method of screening for contamination known as Finished Drinking Water 900, which is meant for use on clean, finished public water systems and not raw, untreated dump water at a Superfund site. Experts at DOE have raised serious questions regarding the collection and handling of the samples including "field filtering" the 1992/93 samples by EPA, and lack of field preservation of the 2000/01 samples, stating

[7] Reported by Dr Marvin Resnikoff, Radioactive Waste Management Associates.
[8] Schwartz, G.M. Buried Secrets, Cleveland Free Times Volume 14, Issue 25; http://www.freetimes.com/story/4185
[9] Data summary sheets of IEL pollutants prepared by contractors for Potentially Responsible Parties and reviewed and validated by EPA's National Air and Radiation Environmental Laboratory released by EPA Region V, covering the periods May 2001 and November 2000.
[10] Op. cit. 8.

that failure to immediately preserve the samples could set up conditions for potentially most of the plutonium to be lost, and thus go undetected. The sensitivity of the actual testing has also been called into question.[11]

Independent experts have been forbidden site entrance and samples for proper testing, and many of the wells that showed plutonium or other radionuclide contamination have since been capped.[12]

Overarching issues:

1. Citizens around IEL have the following concerns: Improper monitoring which cannot show the totality or the magnitude of on- or off-site contamination,
2. Stonewalling access to IEL test wells for independent monitoring & failure to conduct core samples.
3. General improper collection and testing methods used according to several experts.
4. 33 monitoring wells were permanently sealed, preventing crucial testing from being conducted of those wells in the future, including wells that showed possible detections of plutonium as high as the Nevada Test Site.
5. No real cleanup of this 30 acre site in the middle of a community of approximately 30,000 people.
6. Testing methods used at IEL were the example used by EPA for all other sites suspected of containing radiation around the country.[13] A policy change is needed to ensure that the U.S. EPA Finished Drinking Water Method is NOT used on raw, untreated dumpsite water. EPA needs to use methods with better sensitivity and mass spectroscopy. The Finished Drinking Water Method may mask or miss leaking of man-made radiation from a site, yielding dangerously misleading test results about contamination. As a result, a true picture of contamination may never be known and polluters would be able to walk away from dirty sites which are clean on paper, but could easily pose a great risk to unsuspecting communities.

Recommendations:

NIRS recommends that properly trained, independent experts are allowed onsite at IEL to measure radionuclide concentration in the remaining wells and holes. NIRS also recommends opening the capped wells or installing new test wells at the same locations and depths and measuring again. Cores samples (soils) should be taken near the "plutonium eggs." Independent measurements and monitoring must be done both on and offsite to assess the type of contamination, the distance traveled and the danger it poses. Any testing should be on the unfiltered site water with mass spectroscopy, with samples being properly preserved upon collection in the field. Samples should be big enough to get a good measure. The source of the plutonium on site should be determined and proper cleanup should be undertaken with proper and full citizen input.

As of June, 2005, EPA was still in discussion with the PRPs for clean up compensation. Clean-up at the site will occur only after these discussions reach agreement.

"How can we trust the government to build more nuclear plants when the evidence shows we can't properly and honestly deal with the radioactive waste that has already been generated?"[14]

Witherspoon Radioactive Metal Recycling

In 1948, a metal recycling company opened in Knoxville, near Oak Ridge, Tennessee. The facility recycled radioactive metal from the Oak Ridge nuclear facilities. In 1981, the US Nuclear Regulatory Commission realized that 200,000 pounds of radioactive scrap metal, containing 1,760 grams of Special Nuclear Material (concentrated uranium 235) were missing.

Investigation of the matter revealed that while the material had been accounted as present at Witherspoon, NRC had no record of Form NRC-741, Nuclear Materials Transaction Report, which should have documented when the material came to the Witherspoon Facility. The contaminated metal apparently came from Babcock and Wilcox (B&W), a Department of Energy Contractor, in 1968 or 1969. B&W records document this transaction. Up until 1981 paper work submitted by Witherspoon claimed the contaminated scrap was still at the site. It now appears it may have actually left the site in 1969 or 1970[15], though it is still not clear where the material went. Confounding this mystery is a 1971 fire that destroyed the company's files, including all paper records of where this scrap went.

The metal could have gone to Knoxville Iron Company (KIC), which has since gone out of business. According to their then-president and a former general manager, they had an Atomic Energy Commission (AEC)

[11] Ibid.
[12] Ibid.
[13] Cleveland Free Times "Buried Secrets" Volume 14, Issue 25

[14] Chris Borello. In Schwartz, G.M. Buried Secrets, Cleveland Free Times Volume 14, Issue 25; http://www.freetimes.com/story/4185
[15] NRC Report # 70-992/81-01

license to smelt contaminated metal, but they let it lapse in 1970. KIC got most of their contaminated scrap (90%) from Witherspoon.

KIC also did not have any records and the only person who would know of such shipments was deceased. A search of the records of the Nuclear Regulatory Commission's Office of Nuclear Materials Security and Safeguards revealed Knoxville Iron Company *never* had a Special Nuclear Materials license, the proper AEC license for handling nuclear materials[16].

However, the radioactive scrap could also have gone to Wolverine Metal Company in Detroit, Michigan, which recycles metal. They did have an NRC license, but in 1978 it was terminated at the request of the company. NRC site inspection claims that "the site and remaining buildings …were decontaminated to a residual radiation level consistent with current NRC guidelines."[17] Both Wolverine and KIC are listed among many commercial companies that performed nuclear weapons work,[18] and were on but have been removed from the FUSRAP (DOE Formerly Utilized Site Remedial Action Program) list.

Apparently Witherspoon also smelted contaminated scrap and had a state license to do so beginning in 1968[19]. However it appears Witherspoon lacked an equivalent license from the US Atomic Energy Commission (AEC). They needed both. In 1970, Witherspoon requested a smelting license from AEC but a search of the records reveals no positive response subsequent to this request[20].

NRC cited the following violations: 1) failure to complete and distribute forms reflecting transfer of licensed materials 2) submissions of incorrect forms indicating this material was still on the Witherspoon site 3) transferring scrap to a non-licensee[21]. The Tennessee Department of Environment and Conservation found numerous violations since 1967 yet Witherspoon's state license to handle contaminated scrap remained unaffected[22]. Additionally, Witherspoon was cited for violating AEC/NRC regulations at least three times between 1970 and 1979 and also failed to pay a license renewal fee at least once[23].

In July 2002 the Subcommittee on Oversight and Investigations of the US House Energy and Commerce Committee noted in Order 90-3443 that Witherspoon is a Superfund Site grossly contaminated with radioactivity and other contaminants. The order states "DOE is listed as a potential responsible party under state Superfund regulations because a major portion of the contaminants of concern at the Witherspoon sites came from material purchased from a DOE contractor." At the time of this order, DOE was in the process of addressing site contamination and interim measures have been taken to seal off the site as well as remove some of the contaminated material. The destination for contaminated materials is not mentioned[24].

Unfortunately, testing wells at Witherspoon were vandalized; ruining potential sample collection and testing equipment went missing. Drilling and trenching tests largely found no contamination[25]. Lacking information on the testing methodology used, it is impossible to assess the validity of this data. A negative finding means little in a context where data collection was disrupted and there is no understanding of how the conclusion was derived.

NIRS spoke with an on-site manager at TDEC in Knoxville[26] and was informed that most of the radioactively contaminated waste (a good deal of it metal and soil) being cleaned up at Witherspoon is being shipped to a landfill at Oak Ridge National Lab where some of the waste came from originally. He then said that material that fell under the NRC criteria for free release would go to a regular landfill or metal recyclers. The limit varies according to radionuclide, for instance if U-238 contamination is below 35 pCi/gm activity level it would be considered free release. The official stressed that most of the material does not fit this criteria and was uncertain whether any had actually been shipped under this criteria. In a follow-up phone call, he was asked to provide documentation of the free release criteria. The office stated that the criteria were contained in a final rule that was published in the Federal Register, and said he would provide it; but has not

---

16 NRC Report # 70-992/81-01

17 Report # 999-90003/94005(DRSS)

18 Eisler, Peter, *USA Today* 09/21/00- UPdated 08:52 AM ET http://www.usatoday.com/news/poison/022.htm; http://www.usatoday.com/news/poison/023.htm, http://nucnews.net/nucnews/2000nn/0009nn/000921nn.htm accessed 4/20/07

19 History of the Witherspoon Problem, http://web.utk.edu/~nolt/envrepts/WSPOON.htm

20 letter from Witherspoon to AEC dated May 1970

21 NRC Report # 70-992/81-01

22 History of the Witherspoon Problem, http://web.utk.edu/~nolt/envrepts/WSPOON.htm

23 letters from AEC/NRC to Witherspoon: May 1970, September 1970, August 1972, June 1977

24 testimony of Mr. John Owsley, Tennessee Department of Energy and Conservation [TDEC], July 19, 2002 reprinted in "A Review of DOE's Accelerated Cleanup Program and State-Based Compliance Agreement," Subcommittee on Oversight and Investigations

25 History of the Witherspoon Problem, Updated 7/31/02, http://web.utk.edu/~nolt/envrepts/WSPOON.htm

26 Communication by Cindy Folkers, NIRS, on October 24, 2006.

to date. NIRS has not been able to find it either. He also added that trash that is not contaminated to begin with goes back to the Witherspoon Companies.

Although the original Witherspoon Company is closed the previous owners have opened and are operating other companies, including a metal recycling facility. Company names include David Witherspoon, Inc. and Volunteer Equipment & Supply, Inc. both at 1630 Maryville Pike in Knoxville (one of the same addresses as the original Witherspoon companies). Per phone communication on October 30, 2006, Volunteer Equipment & Supply, Inc. says it does not take scrap with radioactive contamination (it is unclear how the company knows the scrap material is not contaminated).

One troubling circumstance lingers among the all of the other difficulties surrounding Witherspoon. If a clearance or "free release" level actually exists for this site, anything below this level could be considered uncontaminated when in fact, residual contamination below this level may be present. This linguistic decontamination (calling contaminated scrap uncontaminated) results in a situation where, when one asks the cleanup parties if radioactive material goes to unprotected, unmonitored dumps or recyclers, their answer could be "no", but it wouldn't be completely correct. It is not possible from the evidence available to know whether this is happening as of this point.

There is also no indication at this stage in the research that a free release level is approved for Witherspoon at the levels indicated above in either the regulations or other agency policies.

CHAPTER 9: PROCESSORS OF RADIOACTIVE WASTE AND MATERIALS

One of the ways that radioactive waste gets out of the control and responsibility of the Department of Energy (DOE) and its National Nuclear Security Administration (NNSA) is via Nuclear Regulatory Commission (NRC) and Agreement-State-licensed processors and brokers.

These companies are licensed by NRC or Agreement States[1] to receive, handle, manage, store, treat, dispose or otherwise process source, byproduct and special nuclear materials[2]. Processing of nuclear and mixed waste is often carried out to reduce volumes, to stabilize or to destroy chemical components that might accelerate leakage from burial grounds. Processing, including incineration, does not destroy the radioactivity. It may move the radioactivity from one portion of the waste to another or convert it from one chemical or physical form to another, but the radioactivity remains until it undergoes its own natural, characteristic decay (generally 10 to 20 half-lives). Processors themselves generate radioactive waste, routine radioactive emissions into air and water, and worker exposures. Processing is of concern because it incompletely removes man-made radioactivity and can lead to subsequent sale of the contaminated material into commercial recycling or to disposal at solid or hazardous waste facilities not intended to isolate Atomic-Energy-Act generated nuclear materials[3].

In Tennessee, a state leading the country in licensing nuclear waste processors, the Tennessee Department of Environment and Conservation (TDEC) is the Agreement State agency with the responsibility and authority to regulate and provide permits or licenses for handling of radioactive material. TDEC has several divisions that involve licensing or oversight of nuclear power, weapons and other man-made radioactivity including the Divisions of Radiological Health (RH), Solid and Hazardous Waste Management (or Division of Solid Waste) (SW) and Department of Energy Oversight (DOEO). The Air Pollution Control Division can have a role as do four local air authorities.

Tennessee has been an Agreement State with the Nuclear Regulatory Commission since 1965, meaning that the state has the authority to license activities involving byproduct materials, source materials, and special nuclear materials in quantities not sufficient to form a critical mass. The Tennessee Department of Environment and Conservation's Division of Radiological Health has over 600 licensees, tens of which are for processing and some for release of radioactive materials, sites or wastes from regulatory control. The state also licenses over 150 transporters—"license-for-delivery" licenses[4].

As the nuclear industry makes great efforts to expand, growing numbers of old, highly contaminated nuclear power and weapons facilities are closing, reducing size, dismantling and decommissioning. Massive amounts of resources have been irreversibly contaminated and essentially sacrificed to the nuclear decisions of bygone eras. Companies that are moving out of the nuclear business are seeking to be excused of all liability (e.g., closing nuclear power reactors) and to incur minimal expenses for waste disposal. Sending all the contaminated materials to licensed waste disposal can seem exorbitantly expensive when compared to hiring an entity to survey and determine it can be sent to regular trash dumps or even sold to be reused in the open marketplace. In a federal legislative provision to encourage normal (not radioactive) recycling, recyclers were relieved of Superfund liability whereas the danger of a waste site being declared a Superfund site could render all who dumped there "Potentially Responsible Parties" or PRPs. The promised exclusion for radioactive recy-

[1] Agreement States have the authority to license activities involving byproduct materials, source materials, and special nuclear materials in quantities not sufficient to form a critical mass. Essentially they license most commercial nuclear facilities except reactors. There are 34 Agreement States [AL * AR * AZ * CA * CO * FL * GA * IA * IL * KS * KY * LA * MA * MD * ME * MN * MS * NC * ND * NE * NH * NM * NV * NY * OH * OK * OR * RI * SC * TN * TX * UT * WA * WI] as of April 2007, with 3 [PA * VA * NJ] in process of becoming Agreement States. Information on them and most of the agreements can be found on the NRC website: http://nrc-stp.ornl.gov/

[2] As defined in the Atomic Energy Act in Section 11(e) 1 and 2 as byproduct materials. In 2006 additional definitions were added for 11 (e) 3 and 4 by Congress. In early 2007 the Nuclear Regulatory Commission is completing its final regulation to update and assert regulatory control over these additional, newly identified byproduct materials.

[3] What is referred to here is the history of keeping nuclear power and weapons wastes at facilities intended to isolate or limit their release to the environment and public rather than sending to facilities without that intent or design. Some of those facilities may have taken naturally occurring radioactive materials before because they were never regulated under the Atomic Energy Act as requiring governmental control.

[4] As of 2006 according to email messages from Charlie Arnott, Tennessee Department of Environment and Conservation, Division of Radiological Health, to Diane D'Arrigo

cling was not included despite bipartisan commitments. Thus processors are being hired to take the waste and treat, manage, dispose or release it under their own license and authority. DOE uses this “service” as well.

In the U.S., there has been clear public opposition to deregulating long-lasting, man-made nuclear waste. There has also been inept federal agency hiring of a contractor with clear conflicts of interest to provide technical support for deregulation rules while at the same time involved in a major contract profiting from release levels[5]. Federal agencies such as the NRC and EPA have not been able to set publicly acceptable clearance levels for man-made radioactivity. As we report throughout this study, DOE is implementing self-determined internal orders and guidance developed against and out-of-view of public will and scrutiny. DOE continues to pursue other ways to release or clear its contamination that circumvent public knowledge and opposition by local and state governments, workers, unions, affected industries and Congress. NRC is using various surreptitious methods, alternatives and license provisions that do not require public notice to help the nuclear waste generators release their contaminated wastes without public knowledge. Old guidance from the Atomic Energy Commission (Reg. Guide 1.86) is misused by federal and state agencies to justify releasing surface-contaminated materials, wastes and property. The public naively trusts its governmental agencies to prevent nuclear dispersal but those agencies are acting as strong proponents of releasing nuclear waste--essentially violating the public trust--and misrepresenting the U.S. public on this point when participating with international nuclear bodies, establishments and bureaucracies.

State-licensed Radioactive Waste Processors, part of International Nuclear Corporations

Since at least the 1980s, with almost no public knowledge, Tennessee has been blazing the way for nuclear processors. Some of the processors started up as small companies run by former DOE workers or contractors who stepped out on their own. The corporate structures, owners and license holders are constantly changing but the trend is for more and more radioactive processing facilities and consolidation in the hands of fewer large companies.

Hake in Memphis, Scientific Ecology Group (SEG) in Oak Ridge and Diversified Scientific Services Inc. (DSSI) in Kingston were some of the first, all of which have since been purchased by other companies. Hake and SEG were bought by Duratek (as were other waste companies in Tennessee). They are now owned by Utah-based EnergySolutions which also owns Manufacturing Sciences Corporation and recently bought British Nuclear Group (which included BNFL which has participated in some of the large nuclear power and weapons decommissioning projects). DSSI or DSS is owned by Perma-Fix Environmental Services (which is in the process of purchasing a commercial nuclear incinerator outside of Tennessee[6]). All of these continue to process radioactive and/or mixed waste imported into Tennessee. An offshoot of Hake, RACE (Radiological Assistance, Consulting and Engineering), in Memphis, processes large bulky components from nuclear facilities, among other functions. In 2006 the company was purchased by Studsvik which is one of the only companies in the world known to recycle radioactive metal from nuclear power reactors and other facilities into the open metal market. They do this in Sweden, but the metal market is international. In Erwin, Tennessee they process radioactive ion exchange resins, some of the hottest “low-level” radioactive generated by the US nuclear power industry[7].

EnergySolutions also has a permit to process very radioactively-hot ion exchange resins, a license which was originally with SEG and companies with which it partnered or merged. Thus, some local Tennessee nuclear processors have become simply pieces of large international nuclear corporations whose bottom line far outweighs health, safety and local concerns about occupational and public radiation exposures.

TDEC’s Division of Radiological Health has 14 Fee Categories for licenses[8] including a General License and numbered Fee Categories 1 through 13. There are categories for receipt, possession, processing, disposal of various amounts and types of radioactivity and use

[5] SAIC Science Applications International Corp was hired by DOE as part of the team to dismantle and recycle a large portion of theK-25 Oak Ridge Site for $278 million. At the same time they were developing the NRC’s NUREG 1640, technical basis for recycling radioactive metal and concrete. They were let go by NRC when this was made public and the NRC lawsuit against SAIC for compromising the NRC rulemaking is still in court as of early 2007. Meanwhile, DOE again hired SAIC to carry out their Programmatic Environmental Impact Statement on Radioactive Recycling and had to let them go due to the same conflicts of interest.

[6] Perma-Fix as of June 2007 owns the Washington and Florida incinerators and other TN processors. The only incinerators we identified were in TN, WA and FL. The scope of this project was not extensive research into the incineration portion of the processing so we welcome information to update this review.

[7] “Hottest” here means concentrated, intensely radioactive, able to give a lethal dose in less than an hour unshielded depending how loaded with radioactivity from the core and irradiated fuel pool of reactors the resins and filters are.

[8] Tennessee SRPAR (State Regulations for Protection Against Radiation) 1200-2-10-.31 Fees for Licenses. January 2006 revised.

of devices that generate radiation. The specifics of the licensed activity are in the license itself. Release of nuclear waste and materials as if not radioactive is licensed as Bulk Survey For Release or BSFR license provisions. Bulk Survey For Release is (as of 2006) in Fee Category 11 (d) and is always accompanied by another Fee Category 11 license.

According to a 2001 TDEC White Paper[9] (see Appendix J), requests for sending some radioactive materials to Class D landfills, regulated by TDEC Division of Solid and Hazardous Waste Management, began going to TDEC Division of Radiological Health in the early 1990s. In the late 1990s more and more proposals were coming in and were getting backlogged. Consequently, the Radiological Health and Solid Waste Divisions streamlined the process for permitting radioactive wastes into Tennessee solid waste landfills. They created a systematic way to accelerate the determinations.

To speed up approvals of deregulated radioactive disposal in landfills, a hypothetical, "worst-case" scenario was set up using the RESRAD Computer Code (RESidual RADioactivity code developed by Argonne National Labs for DOE and NRC) to justify the dumping. Any waste stream that was less contaminated than the amounts in the scenario, or could be shown to be equivalent, could go if some conditions were met.

Some documents observed in TDEC files appeared to permit releases in the "few millirem per year range." Releases to the state-licensed landfill on the Oak Ridge property can be higher.

TDEC inspects licensees and determines they are in compliance, but the compliance data are not available to the public. TDEC inspects licensees' programs for release methods and procedures, not the actual releases. TDEC Radiological Health (as of 2003) did not keep records of what went out. The companies keep the records and they can destroy them when the licenses are closed or terminated. Records of measurements and calculations are maintained until license terminates-then are destroyed.

TDEC records were reviewed in 2003 and 2004 and with information gathered from 1999 until 2007. In approving the streamlined releases, no requirement appears to have been made to evaluate for the synergistic effects of radioactivity and hazardous chemicals that could be in the landfills.

Tennessee made this determination to accept additional exposure to members of the public even though it is not practical to enforce or limit the exposures. Our research did not reveal exactly how this decision was made or any requirements for monitoring or efforts to verify or enforce the exposure limits.

The state streamlined procedures for sending nuclear waste to landfills purport to limit the nuclear waste to no more than 5% of each approved landfill.

The state requires "quarterly summaries of all shipments" including the mass, average concentration and maximum concentration of each radionuclide shipped[10]. These are documents that should be made public and reviewed to see if the reporting is taking place and how it is evaluated by the state, the waste site operator and all the nuclear generators and processors that dump at each site.

Tennessee Solid Waste Landfills Permitted to Take Nuclear Waste

At least five solid waste landfills in Tennessee have been approved to take deregulated nuclear waste from TDEC-licensed processors. These are the BFI Middle Point landfill in Murfreesboro in Rutherford County near Nashville, BFI Carter's Valley or Carter Valley landfill in Church Hill near Kingsport in Hawkins County. BFI South Shelby landfill in Memphis and BFI North Shelby landfill in Millington both in Shelby County. The Chestnut Ridge Landfill and Recycling Center in Heiskell, Anderson County, [11] owned by Waste Management Inc. of Tennessee also takes released radioactive waste.

NIRS collected information on some of the companies that have and had TDEC licenses in 1999 and in 2006 to receive and process nuclear waste and materials, including releasing, storing, incinerating, compacting and other actions. We reviewed some specific files in 2003, 2004 and 2005. We also requested information in 2006 and 2007 directly from TDEC staff, who were very knowledgeable and responsive. Unfortunately, the

[9] "Evaluation and Acceptance of Licensee Requests for the Disposal of Materials with Extremely Low Levels of Contamination in Class D Landfills," White Paper, Tennessee Department of Environment and Conservation Division of Radiological Health, undated but signed by 10 TDEC RH directors and managers between October and December 2001. (See Appendix J for actual copy.)

[10] Op. cit. footnote #9

[11] The Chestnut Ridge Landfill and Recycling Center in Heiskell is a different facility than the DOE burial area with a similar name also in Anderson County but on DOE land. The DOE-owned and operated, state licensed hazardous waste burial area is the Chestnut Ridge Hydrogeologic Regime comprised of East Chestnut Ridge Waste Pile, Chestnut Ridge Sediment Disposal Basin, Chestnut Ridge Security Pits and Kerr Hollow Quarry on the Oak Ridge Y-12 National Security Complex co-operated with the Bechtel Jacobs Company LLC.

information from the Radiological Health Division can only be obtained directly from knowledgeable staff because it is not published and the records are so enormous that guidance is necessary to find where desired information might be within the licensee files.

There are about a dozen major companies with processing licenses, but it is not clear this is a complete list. In addition, companies often buy each other, go bankrupt, have their licenses transferred to others or otherwise change identities over time.

As mentioned above, some of the landfills to which Tennessee nuclear waste processors could send waste are Carter's Valley BFI in Church Hill, TN, from what was Duratek Bear Creek Metal Melt Facility at the time of records review and is (in 2006) licensed as Duratek but owned by EnergySolutions. Duratek at Oak Ridge was also reported to be able to send to the Heiskell WM Chestnut Ridge Landfill and Recycling Center. ATG was approved to send nuclear waste to the Middle Point landfill run by BFI in Murfreesboro not far from Nashville. American Ecology Recycle Center (now ToxCo) also was allowed to send to Middle Point. Hundreds of thousands of tons were still going to Middle Point as of early 2007. Licensed processors have been bought by other companies but the landfill arrangements apparently continue.

We were told that TDEC does not "track" Reg Guide 1.86 or releases of **surface contaminated waste** to landfills but they do track the number of volumetric releases to landfills. In some cases the EPA COMPLY computer code was used to determine potential doses but the RESRAD code has since been adopted for the more systematic releases. This could mean more radioactive waste goes to landfills than calculated by TDEC.

Memphis-based RACE had a license (license #R 24003 which became R 79273 RACE LLC) to super-compact and "free release." The North Shelby landfill was approved to receive waste from that processor. As mentioned, the company has now become Studsvik RACE.

We provide two charts of the major processing activities licensed by TDEC Radiological Health Division and a list of processors holding some of those licenses in 1999 and in 2006. (See App. A and B.) Several licenses types expressly permit the clearing or release of radioactive materials. The lists may not be complete but they certainly reveal a growing industry in nuclear waste management, processing and deregulation.

Processing can be done in various categories or combinations of categories. There is variability and judgment (by TDEC Radiological Health Division and the licensee) used to determine which categories cover the different activities the companies carry out.

The TDEC licensed nuclear processing activities listed in 1999 are:

-Receipt of Waste Material
-Packaging for Transfer to Licensed Parties
-Preparation of Waste for Processing
-Treatment of Waste Materials
-Compaction
-Metal Melt Operations
-Resin Processing
-Wet Waste Processing
-Mechanical and Chemical Decontamination
-Onsite Decontamination and Waste Disposal
-Temporary Jobsite Decon and Disposal
-*Decontamination for Free Release*
-*Survey for Free Release Reg Guide 1.86*
-*Volumetric Free Release*
-*Free Release of Lead*
-*Free Release of Soil and Other Bulk Materials*
-*Free Release of Equipment*
-*Free Release of Concrete and Asphalt*
-Nuclear Laundry
-Machining of Shield Block
-Incineration
-Container Maintenance
-Store and Sort
-Shredding
-License Product Material Processors and Producers
-Encapsulation of Sources

Seven of these allow the companies to make determinations to deregulate or free release nuclear materials or waste as if not radioactive. These are: *Decontamination for Free Release, Survey for Free Release Reg Guide 1.86, Volumetric Free Release, Free Release of Lead, Free Release of Soil and Other Bulk Materials, Free Release of Equipment, Free Release of Concrete and Asphalt.* From there they can go to approved landfills or anywhere else including recycling (except for *Volumetric Free Release* requiring landfill disposal).

Clearance, Release, Bulk Survey For Release (BSFR)

As previously stated, since at least the early 1990s, companies in Tennessee have been licensed to make the decision themselves on what is radioactive and what can be considered "clean." As identified above, there are at least seven types of Free Release or "Bulk Survey For Release" (BSFR) licenses, which, as of 2006, are held by a small and changing number of companies. Some of these companies can make the decision that their own waste is releasable as not radioactive—some can do this for other companies or the DOE. One of the services they provide is to deregulate or clear radioactive waste for their customers. BSFR, or Bulk Survey For Release, is a mechanism for deregulating nuclear wastes. The specific criteria for each company to make radioactive release decisions are in their individual licenses at the regional TDEC office and at the Nashville headquarters office.

There is "reciprocity" between some Agreement states for some licensing, meaning that a company licensed to perform an activity in its home state might be able to do so in other states without the residents of that state even knowing about it. It is not clear how this reciprocity applies to companies with licenses to deregulate nuclear waste, but presumably a nuclear generator in Tennessee or another state could hire the TDEC-licensed company to come in and survey their site or materials and declare them acceptable for "free release," even if that state did not allow such a determination. It is also possible for companies licensed elsewhere to come to Tennessee and carry out their licensed activities in Tennessee.

According to the 2001 TDEC White Paper[12] (see Appendix J), approved by the Division of Radiological Health director, deputy director, health-physics consultant and key managers, increasing numbers of requests to dispose of low-concentration radioactive wastes in the state's Class D solid waste landfills were causing backlogs. To speed up approvals of deregulated disposal in landfills, a hypothetical ("worst-case") scenario was set up and any waste stream that was less contaminated was allowed to be released if some conditions were met. Use of the RESRAD computer code was approved to calculate that doses to the public from each request for sending volumetrically contaminated nuclear waste to landfills. Each request could cause doses up to and including 1 millirem per year for 20 years (for resident-farmer agricultural scenario) and for 30 years for the less restrictive worker scenario. So at this juncture, the State of Tennessee made or reaffirmed a decision to allow its residents to be exposed, unknowingly, involuntarily to additional man-made radioactivity from nuclear waste. TDEC was affirming that an additional millirem a year to Tennesseans for every accepted release to state-approved landfills was permissible. They made this decision while knowing there would be more than one waste stream, since the backlog of requests motivated the accelerated process for approvals.

Tennessee made this determination to accept additional radiation exposure to members of the public even though it is impossible to physically measure one or any millirems. Thus it is not practical to verify, enforce or limit the exposures. For a fee, nuclear waste can be more economically buried in potentially leaking solid waste landfills. The burden is borne by local residents and taxpayers because the added radioactivity potentially increases the risks posed from leakage into ground, surface and drinking water, from use of the landfill gas if radioactive gasses form and from synergistic effects with hazardous or other chemicals in the landfill. Our research did not reveal any requirements for monitoring to actually verify or enforce the exposure limits were not being exceeded. This is due to the inability to physically measure exposure. Doses are calculated based on assumptions and using computer codes. (See radiation chapters.)

RESRAD

The RESRAD computer code, which had been designated as an acceptable tool to justify sending the nuclear waste to solid waste landfills for DOE and NRC, was approved for use in the state. RESRAD was originally developed for DOE by DOE at Argonne National Laboratory to implement DOE's own free release of volumetrically contaminated nuclear wastes, materials and property under DOE Internal *Order 5400.5*. The NRC also supported the development of the code to justify releasing contaminated property from licensee liability in its regulations 10 CFR 20, especially the License Termination Rule, Subpart E and 10 CFR 20.2002 Alternative Methods of Disposal. So Tennessee decided to permit its licensees to apply the code to nuclear waste brought in from DOE or NRC and Agreement State licensed generators. The generators pay the processors (and the processors pay TDEC for the licenses) to take their waste and the processors utilize a computer code to deregulate the waste and send it to regular trash landfills in Tennessee.

The RESRAD code does not incorporate or factor in the synergistic effects of radioactivity and other environmental stressors such as chemicals into its projected doses. It is common knowledge, but not part of the so-called acceptable risk calculation, that health effects are greater than additive for exposures to chemicals and radiation together. In addition, chemicals in a landfill can accelerate migration of the contents of landfills including radioactivity.

The RESRAD computer code was designed to project the doses members of the public or workers might receive in the future from abandonment of some set amount of radioactive materials today. Although claims are made that code has been validated, which means proven to give the correct projections when compared to real world situations, our researchers were unable to

[12] Ibid.

identify any validation for the RESRAD code for landfills. The RESRAD Recycle code for recycling radioactive metal into consumer goods was put through a DOE-funded validation exercise (at Studsvik in Sweden) but it was not convincing and focused on worker doses, not doses to people in daily contact with items made from radioactive metal. Regarding the RESRAD code used to determine doses from landfills, no proof that it was even in the ballpark could be found. In addition, projecting leakage of any materials from landfills is highly speculative.

According to landfill groundwater expert, Dr. G Fred Lee[13], "There is no reliable way to properly predict when high density polyethylene liners in an MSW [Municipal Solid Waste] landfill or Class C landfill are going to fail. They are going to fail. There is no question they will fail. The issue about that is not if but WHEN and that is unknown. It relates to the fact that there are a whole host of reasons they fail including free radical attack. It can take hundreds of years but that is extrapolating beyond any reasonable approach." He did not believe RESRAD or any code can reliably predict when any doses would be delivered.

In addition, the RESRAD computer code relies on a secret base code. The underlying equations for the various assumptions are not revealed publicly even though the code was developed primarily with U.S. tax dollars and is used to justify release of corporate and government nuclear waste generators from liability for the radioactivity they produce.

The claims are often made that the RESRAD code has been benchmarked (compared with other comparable codes), validated (shown to have the correct calculations) and verified (shown to be accurate based on real-life comparisons). There are several RESRAD codes and the one used for landfills has not been validated, to the best of our ability to ascertain. We researched and inquired directly with the authors but got no information on validation of the code used for landfill dose calculations. The RESRAD website[14] indicates that metal recycling code RESRAD RECYCLE was validated but we would urge caution on accepting that assertion as there appear to be flaws and invalid comparisons in that validation effort.

Other States

Although Tennessee appears to be the leader in importing, processing and releasing nuclear waste, other states are beginning to follow suit. (See the Low Level Radioactive Waste Forum's Broker/Processor list at http://www.bpdirectory.com/)

When the federal policies were adopted by NRC that would have removed control over radioactive waste, materials, emissions and practices (NRC's 1986 and 1990 BRC policies), states began passing laws and regulations to require continued licensed control. Over a dozen states took action. (See p. 23 **Timeline: Efforts to Remove Control Over Radioactive Waste**.) When Congress overturned the BRC policies, states incorrectly thought the policies were stopped.

Among states requiring stricter than federal control over nuclear wastes, Texas has provisions which allow release of only short-lasting radionuclides. Longer-lasting radionuclides require licensed control.

A West Texas company, Waste Control Specialists (WCS) has state licenses for hazardous waste storage, treatment and disposal and for storage and treatment, not disposal, of radioactive waste. The company promotes, among its "services," the ability to circumvent the DOE's "Authorized Limits" process for release of nuclear materials, wastes and properties from DOE sites. DOE site managers can pay WCS to take their nuclear waste rather than going through the hassle of evaluating and recording their own decision to release it. Waste sent to WCS in Texas, will be accepted as radioactive but then WCS can re-characterize it (using Reg Guide 1.86 which only applies to surface contaminated waste) or it can process and then reassess the contamination. If determined to have low enough radioactive contamination, mixed waste could be released or disposed at the WCS site, and radioactive waste without hazardous components could be disposed as if it is solid waste. WCS is near Andrews TX, just across the New Mexico state line from the proposed LES uranium enrichment facility. WCS is applying for a nuclear waste disposal license from the State of Texas but as of April 2007 was still the application process.

---

[13] G Fred Lee statement to Diane D'Arrigo on Monday February 26, 2007; From his website, www.gfredlee.com: "Dr. G Fred Lee has a PhD in environmental engineering from Harvard University. A major area of his specialization there was aquatic chemistry, which focused on the transport, fate, transformation, and control of chemical constituents in aquatic (surface and groundwater) and terrestrial systems, as well as in waste management facilities. For 30 years he held graduate-level faculty positions, teaching and conducting research in departments of civil and environmental engineering at several major US universities… During that time he conducted more than $5 million in research and published approximately 500 professional papers and reports based on his investigations. In 1989, he relinquished his position as Distinguished Professor of Civil and Environmental Engineering to expand his part-time consulting into a full-time endeavor."

[14] http://web.ead.anl.gov/resrad/documents/

Pennsylvania, which is not an Agreement State yet but is on its way, appears to have violated its own state law prohibiting nuclear waste in any location other than those specifically licensed for radioactive material. The Pennsylvania Department of Environmental Protection set permissible contamination levels for all of its solid waste facilities (landfills, treatment facilities, recycling centers) de-facto allowing radioactive materials in as long as they are not detected above those levels.

In addition, Alaron[15], a nuclear waste processor in Wampum, Pennsylvania, licensed by the NRC, processes DOE waste from Ohio and Kentucky.

Washington: In the State of Washington, PEcoS (formerly ATG and purchased by Perma-Fix in 2007), near Hanford, is licensed to incinerate and do other processing. Separately, Hanford has sent hazardous, suspect radioactive, contaminated metal to a regular metal processor resulting in alleged worker contamination and serious injury, suffering and discrimination. Litigation is underway.

New York: NYS Department of Environmental Conservation allows DOE mixed radioactive and hazardous waste to be dumped at the Chemical Waste Management hazardous waste site in Lewiston, NY and DOE has listed the Pine Avenue landfill as an option for some nuclear waste.[16] Oak Ridge and Los Alamos have sent waste to CWM.

Transport regulation exemptions = defacto allowed radioactivity to solid waste facilities

Deregulation of nuclear materials due to the 2004 Department of Transportation (DOT) and NRC transport regulations could increase the amount of radioactive materials entering solid waste facilities.

Unofficially, but routinely, DOT and NRC exemption levels for radioactive transport have been used as levels for exemption of radioactive waste from regulatory control for access to landfills and other solid waste facilities. That means if radionuclides are exempt from transport regulation, solid waste sites often accept them, perhaps not realizing radioactivity is present.

NIRS and four other organizations sued DOT and NRC for adopting weaker exemption levels (for a majority of radionuclides) in transport partly because they could be used as new levels for release and partly because they increase public and transporter health and economic risks. In late 2006, the courts dropped the suits on jurisdictional and standing grounds without addressing the merits. So the international transport recommendations, dubbed TSR-1 or STR-1 by the United Nations transport agencies, developed by nuclear advocates, went into effect in the U.S. in October 2004. The International Atomic Energy Agency used its UN role to aid the intentional deregulation of nuclear waste, allowing more to be shipped without labeling or tracking. DOT and NRC deny this is a step to remove control over nuclear wastes, but some brokers use these levels to dispose of customers' nuclear waste as regular trash.

Incineration and Heat Treatment of Radioactive and Mixed Wastes

Tennessee is one of the few states to license the commercial incineration and thermal treatment of nuclear waste. It is the only state in which DOE is burning radioactive waste.

Among the Tennessee companies that have licenses or license conditions or other permission to incinerate or heat treat radioactive waste is Studsvik/RACE, which has a TDEC license for an incinerator in Memphis, but was prevented from operating the incinerator by the local government air authority and community opposition. In early 2007, Studsvik withdrew its incinerator application for Erwin, Tennessee due to community opposition. In Erwin, Studsvik now proposes to expand its existing thermal process for ion exchange resins and other radioactive wastes from nuclear power reactors. The process called THermal Organic Reduction (THOR) process, is a "pyrolysis/steam reforming technology" which started up in about 1999. The ion exchange resins "treated" are among the radioactively hottest so-called "low-level" radioactive waste. They become loaded with plutonium, cesium, strontium, iodines—all the same radionuclides that are considered "high-level" waste if they stay in the fuel rods but which become "low-level" once they leak out. The resins are used at reactors to filter the cooling water in the reactor core and fuel pool to remove the radionuclides that leak out of the fuel rods. According to the Government Accounting Office GAO-RCED98-40R Radioactive Waste: Answers to Questions… May 22, 1998 pp.50-52 Class C "low-level" radioactive waste (which includes heavily loaded resins) can give a lethal dose, if unshielded, in less than an hour (20 minutes for doses of 500 rads per hour). Wastes at Studsvik can have surface doses of up to 400 rads per hour[17].

[15] http://www.alaron-nuclear.com/main.html

[16] DOE Power Point on Implementing Authorized Limits 2005.

[17] Studsvik Processing Facility Update, J. Bradley Mason, Thomas W. Oliver, G. Mike Hill, Peter F. Davin, Mark R. Ping presented at DOE Waste Management 2003 WM'03 Conference, February 23-27, 2003, Tucson, AZ. p. 1 paragraph 2. Studsvik, Inc. 151 T.C. Runnion Road Erwin, TN 37650 (423) 735-6300 Phone (423) 743-0794 Fax mail@studsvik-inc.com.

EnergySolutions (formerly Duratek, GTS Duratek, SEG and Westinghouse in Oak Ridge and formerly Hake in Memphis) has two licenses for operating radioactive incinerators at its Oak Ridge Bear Creek Road facility. It also has been melting metal, including depleted uranium, for many years. According to TDEC, EnergySolutions also has a license for resin processing. Prior companies developed the Q-CEP process for heat treating radioactive resins but technical and financial difficulties beset those processors around 2000-2001. EnergySolutions bought several processors including ones that had done work on US nuclear power reactor decommissioning. Unanswered questions remain as to how much of decommissioned nuclear reactors and other nuclear fuel chain facilities have been disposed as regular trash in TN and other states including NY.

Aerojet, in Jonesborough, TN, which processes depleted uranium, has a condition of its license that "authorizes oxidizing (incinerating) metallic uranium chips and grinding fines for disposal as dry solids." [18]

DSS, DSSI or Diversified Scientific Services, Inc. in Kingston, TN (a wholly owned subsidiary of Perma-Fix Environmental Services of Oak Ridge, TN), operates a boiler in Kingston for mixed waste but is not listed as having a permit or license to incinerate radioactive materials. According to the TDEC fact-sheet on DSSI, it can "combust blended liquid waste fuels containing hazardous and low level radioactive constituents while continuously controlling system emissions within established RCRA, Clean Air Act, and radioactive materials license limits."[19]

As mentioned elsewhere, Washington, licensed Pacific Eco Solutions or PEcoS to incinerate waste but it is not doing so as of early 2007. PEcoS is owned, as of 2007, by Perma-Fix, which also owns DSSI and East Tennessee Materials & Energy Corporation in Tennessee (which operates from the K-25 portion of the DOE Oak Ridge site).

Oak Ridge, TN is the home to the only DOE radioactive incinerator operating in the country, the TSCA (Toxic Substances Control Act) incinerator which can burn mixed waste from Oak Ridge and other DOE sites.

[18] C. Arnott, TDEC, to D'Arrigo NIRS email 2/28/2007.

[19] http://www.state.tn.us/environment/swm/ppo/dssifactsheet.pdf accessed 4-10-07 fact sheet
Diversified Scientific Services, Inc. direct fired fuel boiler system

Efforts by industries and DOE to build new radioactive incinerators have been repeatedly defeated across the country over the years (including in NY, PA, and ID). As with all processing methods (other than transmutation which is not a process in practical use), heat does not destroy the radioactivity. The chemical bonds may break and chemical structures and phases change but the radioactive isotopes remain just as long as if not heated. So the process has the very large danger of dispersing radioactivity into the air (where it can be taken internally directly by inhalation or indirectly by getting into the water and food chain where it can be concentrated and ingested), concentrate in ash, filters or other solid remaining after the thermal process and contaminating the incinerator or processor.

Licenses for Free Release and Bulk Survey For Release--BSFR

As described above, a group of "processes" that are of special concern are those that allow re-characterizing the radioactive waste to make a determination that it is below some threshold of contamination followed by its release as if not radioactive. Some processors treat the waste in various ways such as acid etching or grit blasting to remove surface contamination and then declare the material "clean" enough to recycle into commerce or dispose as regular trash. Some have permits to bring waste to their own sites or to carry out the determination at the customers' sites.

There is an arrangement between the TDEC Divisions of Radiological Health and Solid Waste whereby Radiological-licensed processors can send some of their waste to regular landfills in the state. In some cases the TDEC Department of Solid Waste does calculations using the RESRAD Computer code to predict that the doses from these landfills from the nuclear materials being disposed there will be "acceptable."

It is unclear under what authority TDEC approves this radioactive release, since Congress revoked the NRC's policies that intended to do it.

Since some of the BSFR licenses allow for unrestricted free release, in addition to going to landfills, some radioactive wastes, materials and property could get into commercial recycling and reuse. Equipment, asphalt, concrete, soil, plastics, wood, glass, paper and metal (except if it is from DOE-controlled areas) and other materials could get out this way. Closer tracking of these paths is needed to identify the destinations.

Tennessee licensees

According to TDEC, in December 2006 with follow-up in February 2007, RACE, Duratek Services, Studsvik, Diversified Scientific Services, East Tennessee Materials and Energy, IMPACT Services, ToxCo, and Philotechnics were licensed to receive radioactive waste material. Others who have licenses include Nuclear Fuel Services in Erwin, Tennessee, MSC or Manufacturing Sciences Corporation (which was bought by Duratek so is now part of EnergySolutions), Aerojet, UniTech (formerly KER Services) with a radioactive laundry license, Alstom Power (formerly Combustion in Chattanooga), Shaw Environmental (formerly IT Corporation). In 2006 EnergySolutions purchased Duratek and its previously-purchased processing and disposal companies but the license names had not changed as of the information request.

All of those licensed to receive radioactive waste materials--RACE, Duratek Services--now EnergySolutions, Studsvik, IMPACt Services, ToxCo, and Philotechnics (although Philotechnics does not have BSFR licenses in 2007)--have licenses for Bulk Survey For Release. The websites of these companies give estimates of the amounts and types of waste they have "free released" for customers.

All of these companies also are licensed for
Preparation of Waste for Processing
Treatment of Waste Materials
Wet Waste Processing
Onsite Decontamination and Waste Disposal
Store and Sort

Some of the major processors in TN include:

1) Studsvik/RACE in Memphis and Studsvik in Erwin. RACE got an incinerator permit from the state TDEC but the local air authority for Memphis prevented it from being used for a few years. Then Studsvik bought RACE and tried to get a similar incinerator license for Erwin, TN. Community opposition halted it. As mentioned under Incineration and Heat Treatment above, Studsvik is already processing some of the hottest so-called "low-level' radioactive waste in the country with nearly no public knowledge of the activity. They plan to expand that process.

RACE, prior to its takeover or merger with Studsvik, was handling heavy equipment decontamination, sectioning or large components and grit blasting to clean surfaces. They reportedly can do resin processing, among many "services," as of 2006.

2) EnergySolutions, the Utah-based, rapidly-expanding nuclear disposal company, bought numerous nuclear companies in Tennessee and elsewhere including Duratek which had taken over Hake in Memphis, licensed to decommission nuclear reactors and to accept metal sheets, plexiglass, wood and large components for processing and release. Duratek (which had been GTS Duratek), Scientific Ecology Group (SEG) and some metal and ion exchange resin melting companies in the Oak Ridge area, has licenses to run two radioactive waste incinerators, a metal smelter, several BSFR Bulk Survey For Release permits, and more. They also own MSC (Manufacturing Sciences Corporation) which processed and released some radioactive metal from the large ($278 million "fixed price") DOE-BNFL/ SAIC/et al contract to clean up three huge uranium enrichment buildings at the K-25 area of Oak Ridge, Tennessee. They run burial grounds at Barnwell (SC), Oak Ridge (TN) and Tooele County (UT) and are bidding on DOE (GNEP) reprocessing proposals.

3) ToxCo, in Oak Ridge, is a DOE Basic Ordering Agreements (BOA) company pre-approved to do processing work fast. Both ToxCo and Duratek/ EnergySolutions have metal melt licenses but state they do not free release metal.

4) IMPACt Services is a TDEC licensed processor at K-25 on DOE's Oak Ridge property. Among its services, it can "clear" or release volumetrically-contaminated materials.

5) Philotechnics has creatively implemented clearance and release procedures to maximize the amount of material "cleared" from radiological controls, saving customers money--likely meaning more unregulated radioactivity.

Circumventing DOE's Radioactive Metal Recycling Ban

In 1997 the huge, controversial DOE contract with BNFL, MSC, SAIC et al 3-building contract allowing radioactive metal recycling went into effect at Oak Ridge K-25. Some radioactive metal was released into commercial recycling but in 2000 that was halted. Before the radioactive nickel from the K-25 cleanup could be released, public, worker and metal industry opposition prevailed and the Secretary of DOE placed bans (moratorium and suspension) on commercial recycling of potentially radioactive metal from DOE. This resulted in prevention of much nuclear contamination of the metal supply. The Community Reuse Organizations at Paducah (PACRO, Paducah Area Community Reuse Organization) and Oak Ridge (CROET Community Reuse Organization of East Tennessee) have been strong advocates of selling the surplus contaminated metal. These groups identify and sublease DOE property and equipment and hope to benefit from the sale and reuse of the contaminated metal at both sites. They have advocated overturning the bans on commercial metal recycling.

The TDEC-licensed processors had been taking DOE radioactive materials, processing them and hoping to sell them for profit into the open recycling market. Some of the companies are still there –they and others in Oak Ridge and Paducah have participated in meetings regarding DOE's early 2007 requests for expressions of interest in "restricted recycling" of radioactive metal.
Entities within DOE have also been attempting to get around the metal recycling bans. In apparent violation of the spirit of the ban, DOE at Paducah put out a Request for Proposals to develop concepts and procedures for releasing the metal.

In 2003-2005, the University of Kentucky (KRCEE)[20] received and DOE funded carried out contracts to pursue development of processes that would lead to or be prototypes for releasing the radioactive metals despite the bans. Several DOE-funded research projects were carried out to facilitate radioactive metal processing and recycling.

DOE made an earlier attempt to bypass the suspension and moratorium on radioactive nickel. In November to December 2001, the DOE field offices were scheduled to discuss making provisions to release metal despite the bans and ongoing Environmental Impact Statement process. The metal industry and public objected strenuously and that plan was halted.

In August 2006, DOE proposed in the *Federal Register* to adopt some of the provisions of its internal *Order 5400.5* into its worker radiation exposure regulations, 10 CFR 835 (FR Aug 2006 comment deadline October 2007) This move, adopted, in June 2007 could allow radioactive contamination in the buildings that DOE leases to the local community reuse groups at its sites, which they subsequently lease to industry and other users that may not have anything to do with radioactive processes. They could be used for food storage or day care or any business. Ads marketing the spaces abound. But because of the proposed change in the regulations, a loophole could open allowing more contamination than permitted before, without warning.

There is some question too as to whether the change redefines radiation and control areas, thus affecting the areas that were previously banned from releasing metal for commercial recycling.

The changes in 10 CFR 835 are claimed by its perpetrators at DOE to be benign but they allow hot spots and DOE *Order 5400.5* contamination and procedures that were not allowed previously.

It is important to note that the opposition of the metal industries in the US and UK[21] have been important in preventing generic release of contaminated metal into the open metal marketplace in these countries. Other recycling industries are not as organized thus releases could be occurring from DOE under 5400.5 and authorized limits. The commercial nuclear industry can be releasing to metal and other materials markets using the surface contamination guidance (Reg Guide 1.86) or through license provisions from NRC possibly for volumetric releases.

As of May 2007, DOE has released a request for Expressions of Interest from companies to process the radioactive metal accumulated at both the Oak Ridge and Paducah enrichment facilities for supposed "restricted" recycling and reuse, but it appears the restriction will only be on the first reuse, from whence the metal could be free released. If the internal nuclear market is not big enough to support the processing of the metal and use within DOE and NRC restricted areas, there will clearly be pressure to exempt and release it into the marketplace. Previous study of this prospect had not been promising but as metal prices rise, concern about health effects appears to drop. As of publication of this report, this is the biggest loophole we face for DOE to release radioactively contaminated metal. As mentioned throughout, the possibility of other radioactive materials being "cleared" and released from both the DOE and commercial nuclear waste generators is an active concern.

[20] From the KRCEE website http://www.uky.edu/krcee/proj3.htm: purification and recovery of radiologically contaminated metals; project manager Lindell Ormsbee, Director, Kentucky Research Consortium for Energy and Environment, University of Kentucky ; PRINCIPAL INVESTIGATOR David Silverstein, Assistant Professor, University of Kentucky - Paducah Campus
From the KRCEE website http://www.uky.edu/krcee/proj10.htm: Purification and Recovery of Radiologically Contaminated Metals 3; project manager Steve Hampson, Assistant Director, Kentucky Research Consortium for Energy and Environment, University of Kentucky principal investigators Eric Grulke, Ph.D., Professor University of Kentucky College of Engineering Dr. Tony Zhai, Ph.D., Professor University of Kentucky College of Engineering

[21] http://www.nuclearpolicy.info/publications/scrapmetal.php Report on Radioactive Scrap Metal by NFLA, British Metals industry zero tolerance policy toward radioactive metal in their facilities

CHAPTER 10: WHAT WE DID, WHAT WE LEARNED, WHAT TO DO NEXT

In our effort to determine how nuclear waste gets out of control and where it goes, we surveyed various DOE entities, workers and former workers, community and environmental advocates, some state agencies and some of the potential recipients. More time and personnel would be needed to comprehensively complete the research we initiated and, over time, we plan to continue to pursue some of these avenues.

Much of the information we gleaned came from DOE headquarters and site visits, partial responses to our Freedom of Information Act (FOIA) requests and document research.

Interviews, document searches

NIRS met with headquarters personnel and visited Los Alamos, Oak Ridge, Rocky Flats, Mound, Fernald, the Ohio Field Office, and attended some West Valley public meetings, in order to understand the legal, regulatory and practical methods for characterizing and releasing radioactive materials from the complex. We asked for copies of the governing regulations and guidance and for actual demonstrations of procedures. At some sites we observed the detection instruments used and the records of releases. At another site we observed cleared items ready for public auction. We heard various perspectives on the reliability of institutional and historical knowledge as applied to determinations for release from radiological controls. We discussed how and by whom the decisions are made to use independent verification—the expense and benefit. No place has routine independent verification. Those that choose to employ it do so for specific parts of various projects--never routinely for all site releases. It is used for increased public confidence in portions of some high profile or precedent-setting cleanup efforts.

Failure to fulfill public reporting requirement

In 2000 the DOE Secretarial orders banning commercial recycling of all potentially radioactive metal also committed to the public that DOE would make all information about releases public. Guidance was included in the Energy Secretary's January 19, 2001 memo (2001-001288), directing DOE Department Heads to clearly define contamination areas, release criteria, measurement and survey protocols, and independent verification programs. The directive required all DOE sites to "(b)etter inform and involve the public and improve DOE reporting on releases…" Documentation on releases was to be made available to the public and to those receiving the property. This information was to be included in Annual Sites' Environmental Reports (ASERs) and a system was to be developed to track releases by category. We investigated, requested and reviewed all available ASERs and other information and found that, seven years after it was made, this commitment to the public still has not been fulfilled. There is guidance provided to field offices from headquarters on how to report in the ASERs but no meaningful reporting has been done. There is no database to inform DOE Headquarters and no records of any efforts to create the promised reporting system.

Slow and incomplete responses to FOIAs

Over the past ten years, NIRS and other organizations have filed through the Freedom of Information Act (FOIA) for information on radioactive release decisions from both the Department of Energy and the Nuclear Regulatory Commission, which has a related role. Most of the responses to FOIAs submitted to DOE Headquarters have taken years (from over one to over four years) to receive response and many responses were incomplete.

Hard to know what consumer products are made with nuclear waste

Some of the most common questions members of the public have are "What objects are made with radioactively contaminated materials?" "Do I need to take a Geiger counter or detector when I go shopping?" "How can I avoid potentially contaminated items?"

The system in place by DOE and NRC makes answering these questions very difficult because there is no public reporting of companies and facilities that receive the material. It is possible that some are aware that they are taking potentially radioactive materials but there is also a possibility that they have no knowledge. This is especially possible the more steps there are between the nuclear waste generators and the industries that use the materials to make items or the companies that sell items to the public. When brokers accumulate and transfer materials from many sites, including some nuclear sites, to scrap yards or other centralized locations for recycling they are not necessarily required to report the source of all the materials they are supplying. The steel and most metal recyclers do their best to monitor incoming loads to prevent any radioactive materials from entering their facilities, but they can only monitor for gamma radiation, not alpha or beta, due to practical physical, technical, economic and time constraints. Other types of recyclers likely have not invested in detection equipment to prevent incoming nuclear contaminated materials.

In general, from our visits and the information we did receive, we were able to gain a general understanding of DOE's overall framework for the release of radioactive materials, which are governed largely by draft guidance documents (many listed in the References and Appendices). Those documents are based on assumptions of "acceptable" doses, which in fact have never been deemed acceptable by the public in a democratic, open and informed way. The release guidance can get complicated and largely appears to be neither verifiable nor enforceable unless the violations are extreme and detailed knowledge of the release pathways is already known. The records were not easily, routinely available at all locations. Obviously, when sites close there will be loss of institutional knowledge. At those locations, with some exceptions, the records, information and knowledgeable personnel are gone, but radioactivity can remain. Public input is rarely sought before DOE headquarters or sites make release decisions or policies. When the decisions involve release to the open market, getting local input is not sufficient since the recipients of the doses are from the more general population and future generations, if the radioactivity is long-lasting.

Some sites (such as Mound) had clear (although constantly changing) written release procedures which they readily shared upon our request. This was complicated by the various levels (DOE HQ, DOE Field Offices, DOE at each site, NNSA at some sites, contractor and subcontractor) and constantly-changing procedure manuals at each level. Despite constant updates, the suspension and moratorium on metal recycling reportedly had not been incorporated into the procedures, but we were informed verbally that they were being honored and implemented. There were possible loopholes in the ban that might not seem obvious. For example, although metal is prohibited from going into commercial recycling, metal parts from disassembling buildings supposedly are not subject to the bans. Large metal objects could be reused unrestricted, thus subsequently they could enter the metal recycling market. Despite various loopholes in the ban, we got the *sense* it was being respected by most with whom we met.

Other sites were much more evasive when it came to providing written documentation and procedures. Basic site governance information has not been provided from Los Alamos and Oak Ridge. Oak Ridge required that all information we requested on our visit be provided by FOIA. Generally, the Oak Ridge FOIA office had been very efficient but requests under this research project have been circuited through DOE headquarters and thus far not provided. Los Alamos personnel were very open and informative but the point of contact was resistant to providing follow up information, deferring to NNSA.

We did receive a partial response to our FOIA on what is being released to where. Some examples were given of authorized releases of volumetric radioactive materials considered by DOE Headquarters. They were instructive on the internal processes that are in place to evaluate releases. From the examples provided, DOE headquarters appears to play more of a role in assisting local sites on preparing defensible data to allow releases than preventing releases or unnecessary public exposures. The default for local requests for some authorized volumetric radioactive releases is that they can proceed (in 40 days) if DOE headquarters does not object within a given time period (within 20 days). The final destination was not always clear for the approved releases.

One of the important pieces of missing information from our requests to DOE is regarding The Center for Excellence in Recycling (formerly Radioactive Metal Recycling, now Materials Recycling) based at Oak Ridge Tennessee, and reportedly funded through the Oak Ridge portion of the DOE budget. Staff from the Center met with us and provided historical information on the releases of "slightly" radioactive materials from DOE sites over the years but none of the requested current information, budget information or follow up on the reported information was provided. All of our Oak Ridge DOE contacts required that we submit a FOIA for any information from them, but none has arrived nearly a year after the request was submitted. This Center is pivotal in assisting all of the DOE sites in releasing and trading potentially contaminated materials. The Center promotes commercial recycling despite the public opposition to polluting recycling streams with man-made radioactivity from nuclear weapons production. It is connected with the Pollution Prevention (P-2) and "Green is Clean" programs which cover both radioactive and non-radioactive materials and recycling but which facilitate radioactive release or clearance to unrestricted, uncontrolled destinations.

After four years, we did receive some FOIA information on the failure of DOE to identify a first or second Conflict of Interest in their hiring of SAIC (Science Applications International Corporation): first to make money on recycling radioactive metal at the K-25

Oak Ridge decommissioning contract, while at the same time developing the allowable release levels for radioactive metal that could have applied to that project, and second to carry out the DOE Programmatic Environmental Impact Statement (PEIS) on Radioactive Metal Disposition despite their vested interest in the outcome. Since then they have been removed from a couple of these projects and the PEIS is on hold. But DOE continues to refuse to allow public review of the comments received on the scoping or the work done thus far on the PEIS issue.

A sampling of what we learned:

The Ohio and Tennessee sites have been playing key supporting roles for radioactive recycling and release over the years.

Copper from Fernald was recycled into commerce after processing at a Tennessee Department of Environment and Conservation (TDEC) licensed company (ATG) on the Oak Ridge DOE reservation. The companies on that site have come and gone, changed names and owners, but there is usually some commercial radioactive processing operation at the East Tennessee Technology Park (ETTP).

Oak Ridge is home to the Center for Excellence in [Radioactive] Recycling. Of course recycling is normally very positive environmentally, but when it includes radioactively contaminated materials the benefits are destroyed. The Center has a history of working to provide artificial incentives to recycle radioactively contaminated materials, thus circulating small but still-potentially dangerous sources of radiation throughout the environment, marketplace and recycling world.

The entire Rocky Flats site is being released from radioactive control and open as a wildlife area to the public with no warning that long-lasting radioactivity remains. State legislation that would have notified visitors did not pass the Colorado legislature.

Fernald is also being converted to a wildlife refuge but an important distinction is that radioactive waste remains buried in a tumulus at the site so there will be some level of institutional control as opposed to complete abandonment. In addition, there will be a visitor center explaining the history of the site, so there is some chance of warning visitors. Fernald officials allowed us to inspect some materials that were to be released for unrestricted use but they were in the vicinity of radioactive waste supposedly ready for shipping that was hot enough that we could not take readings on the "cleared" items.

Los Alamos is in the process of releasing much land for unrestricted use—giving or selling it to the City of Los Alamos, and private, public and Tribal recipients. We requested but did not receive a map of all areas being released. [Good maps, of the Technical Areas, but not designating release areas per se, can be viewed at the Los Alamos Study Group website, http://lasg.org/maps/pages/contents/TAmainmap.htm]

We learned a lot about the procedures for actually dismantling and clearing out areas that had been used for decades for various activities. Some mixed waste from a cleanup project went to the Chemical Waste Management hazardous waste site in Lewiston, New York supposedly because background levels there are higher than the radioactive contamination of the material. Thus it was shipped across the country to a site not licensed for radioactive disposal next to the Lewiston-Porter schools. At Los Alamos, despite growing public concern about leakage from the site, it appeared that there was accessible onsite disposal for nuclear waste and thus a lower motivation to deliberately release the waste into commerce and recycling. There are regular auctions of materials from the site into the open market, and these items are cleared as at other DOE sites based on institutional knowledge and instruments set at the "acceptable" contamination release levels. Soil from Los Alamos was used on a golf course. Buildings, land, rubble, are "cleared" based on state limits for hazardous contamination and DOE levels for radioactive contamination. Some DOE waste is dumped at the local Los Alamos landfill in town, some at the larger landfill near Albuquerque and some is released for reuse or recycling or used onsite.

Preventing nuclear waste from getting Out-of-Control:

We reaffirmed our knowledge that more work needs to be done to track, identify and stop DOE's radioactive releases. Coordinated pressure is needed to shifting DOE's overall goal to that of preventing radioactive releases and exposures. Until the goal is shifted to isolate the radioactivity, the public must become ever more vigilant.

First steps include demanding the promised reporting about DOE radioactive releases…authorized and supplemental limits at each site and overall.

Despite much effort, the public's main questions about where the contamination is going remain largely unanswered.

As long as DOE and other nuclear waste generators can slip their contamination out–letting it get Out of

Control–On Purpose – there is really no limit to the amount of additional radiation exposure members of the public could receive in many relatively small but technically unmeasured doses.

We list below the specific ways we see DOE and other agencies could remove controls over nuclear waste and encourage those concerned to help track and provide input to the decision makers.

Maintain and expand DOE's radioactive metal recycling ban

Dramatic, coordinated, sustained action will be needed if the public hopes to maintain the ban on commercial recycling of nuclear weapons-generated radioactive metal and especially to expand that ban to prevent non-metal radioactive materials from being released.

Prevent contaminated property, equipment and materials from getting out of control

Greater vigilance is needed by the public at DOE sites. Radioactively contaminated land, property and buildings are released for unrestricted use at several DOE sites.

Streamlined release of contaminated materials and equipment are now being facilitated with finalizing of the multi-agency MARSAME procedures. Those technically inclined are needed to help watchdog our federal agencies' coordinated joint efforts to remove radioactive controls.

DOE Expressions of Interest[1] for "Restricted" Recycling of Radioactive Metal: Foot in the Door for Unrestricted Release

Maintaining the prohibition on metal recycling could be challenging if metal prices continue to rise. There have been repeated efforts within and outside of DOE to overturn the bans on commercial recycling of radioactive metal. If DOE gets away with investment in supposedly "restricted" metal recycling, the metal could easily be diverted to unrestricted use on second use or through exemptions if the market for contaminated metal is not large enough to justify the costs of processing it. Beyond tracking the industry responses to DOE's Expressions of Interest on "Restricted" Metal Recycling, and DOE's next steps, the concerned public could take the opportunity until June 8, 2007 to express its interests to DOE in the radioactive metal processing and "recycling" proposal, the responding companies and to decision makers. [2]

Expanded FOIA Request to DOE/NNSA on Authorized and Supplemental Limits for Radioactive Releases

NIRS is submitting a new comprehensive FOIA to DOE and NNSA along with the release of this report, in another attempt to identify, quantify and publicize the amount of nuclear weapons-generated radioactivity being released and its destinations. (See App. L.)

Watchdog DOE implementation of weaker standards for leasing used buildings, releasing radioactive materials

Close tracking is needed to identify the weakening of DOE's occupational exposure regulations (10 CFR 835 Occupational Radiation Protection[3]) which could affect
(1) non-nuclear workers or the public in leased buildings formerly used by DOE and
(2) the movement of potentially contaminated metal between radiation areas and between radiation and non-radiation areas of DOE and contractor sites.

DOE also intends to adopt 10 CFR 834, Radiation Protection of the Public and the Environment, which could incorporate radioactive releases into DOE regulations.

Agreement State Agency facilitation of removing radioactive controls

Demand State Accountability—Demand Enforcement of Laws requiring regulatory control over nuclear waste.

(1) Learn more about Tennessee and other Agreement states especially YOUR state's actions that prevent or encourage removing nuclear waste from control. Identify and track Agreement state-licensed processors to determine how much radioactivity they are

---

[11] Solicitation Number: DE-EI30-07CC40008; Title: Disposition of Nickel -- Expressions of Interest; accessed 5/8/07; https://e-center.doe.gov/iips/busopor.nsf/8373d2fc6d83b6668525645200 7963f5/7081dbcff9a957ea85257299006a7055?OpenDocument

[2] The solicitation requests interested companies that want to "clean" and reuse the metal within the nuclear complex to respond by close of business 4:30 p.m. EDT on **June 8, 2007** to Gene Chou, U.S. Department of Energy, Office of Disposal Operations (EM-12)/Cloverleaf Building, 19901 Germantown Road, Germantown, Maryland 20874-1290, by mail, express service delivery, or electronically to **gene.chou@em.doe.gov**; phone: 301-903-7159; fax: 301-903-1431.[2] Send your input and let your elected officials know what you think.

[3] **45996 Federal Register** / Vol. 71, No. 154 / Thursday, August 10, 2006 / Proposed Rules

bringing into the state and letting go into regular or hazardous waste landfills or into commercial recycling. Find out what processors are doing and what they are releasing to landfills and to commercial recycling. This report focused largely on Tennessee but other states need to be investigated.

(2) Follow up is needed in Tennessee to determine whether the public wants to remain a nuclear waste destination for much of the nuclear power and weapons fuel chain and what authority justifies the additional radiation doses to people now and in the future. Answers are needed to questions including: Under what authority is nuclear waste removed from control in this state? How much radioactive waste is coming in; where is it coming from; what is happening to it; where is the radioactivity going; how much radioactivity being dispersed into the state's landfills and natural resources? Who guarantees compliance with landfill regulations and quarterly reporting for landfill disposal and other expressed provisions for special (radioactive) waste release and disposal? What efforts are being made to verify the claims about safety? What public education, regulatory and legislative efforts are needed to resume controlling, rather than releasing, radioactive waste in the state?

(3) Comment to TDEC by June 1, 2007 or call for a true public comment period on its licensing of nuclear processors to do Bulk Survey For Release (BSFR) of radioactive materials. Tennessee (TDEC) has been letting nuclear waste go to unregulated destinations for years and is now taking comments from those that release and those that accept the waste, but the public has not been notified or asked to comment. The TDEC comment period on BSFR is underway as this report goes to press, so why not let them know what you think? Once the public learns about the importation and routine deregulation and release of nuclear waste in Tennessee, they might want to have a say.

Identify the Position of Recyclers and other Potential Recipients of Out-of-Control Radioactive Waste

Let's track what recyclers, brokers and waste site operators are doing to keep radioactive wastes and materials out of their facilities and products.

The metals industries oppose nuclear waste getting out of control and into their facilities. Some landfill companies seem to accept, if not welcome, "special" waste. Some do not. What are the positions of other potential recipient industries on acceptance of and incorporation of radioactive materials into recycling or reuse of concrete, plastics, wood, paper, soil, chemicals, asphalt, equipment, components of dismantled buildings? Some hazardous waste sites seem willing to take the radioactive materials; some might not always. Do renters of "cleared" buildings know the previous uses of those buildings? And that they might have hot spots?

Assessment needs to be done of the stances of potential recipients of released or cleared nuclear waste. This will help consumers know the paths of least resistance for nuclear waste to better determine where it is going.

NRC and EPA could resume radioactive waste Out-of-Control rulemakings:

In the Timeline Chapter of this report the Nuclear Regulatory Commission and the Environmental Protection Agency are listed as having on hold potential rules to generically deregulate nuclear waste and to permit it to go to facilities without licenses or controls for radioactivity. The deferred rulemakings could reopen if pressure prevents release of nuclear materials and wastes via alternative pathways including processors and unlicensed disposal sites. If license extensions continue to be granted and new nuclear reactors are planned, more waste will be generated with nowhere to go thus exacerbating the problems. Thus the vigilant public must keep an eye on those EPA and NRC.

Track and publicize NRC's many options deregulating nuclear waste:

NRC could adopt the exemption levels from its 10 CFR 71 Radioactive Transport regulations into its 10 CFR 20 Radiation Protection regulations as the nuclear industry has requested. Increased radioactivity was exempted by NRC and DOT in the 2004 transport regulations. to comply with the United Nations International Atomic Energy Agency exemption levels developed to facilitate nuclear reactor decommissioning). The radiation standards have allowable contamination levels for air, water and sewage. The nuclear industry wants clear relief from liability for contaminated solids as well. Congress and the public revoked the efforts to codify such exemptions in the past, but the pressure from waste generators never stops.

NRC is continuing to let nuclear waste Out of Control through case-by-case deregulation under its 10 CFR 20.2002 rule on alternative methods of disposal which allows radioactive waste burial onsite at reactors and disposal at unlicensed facilities. Tracking each proposal is important but not easy.

NRC amended the licenses it gives to allow some waste to be deregulated. This is hardest to track because the approval is embedded in the license so is implemented routinely with no notice.

Join International Allies in Rejecting International Radiation Recommendations

Let NRC know your thoughts as they move to adopt the ICRP 2007 recommendations of the International Commission on Radiological Protection, which reportedly include absolutely unacceptable provisions for deregulating nuclear waste. The international nuclear groups such as ICRP, IAEA and Euratom are nuclear promoters whose members stand to gain economically if their waste can be let out of control. They claim some radiation levels are trivial so recommend removing controls. They are not independent and NRC uses their recommendations to overcome US opposition to unsavory radiation rules. Watch out for and help challenge the US adoption of the ICRP 2007 recommendations, instead demanding greater protection and a goal of preventing unnecessary radiation exposures.

QUESTIONS POSED AT SITE VISITS

We asked similar questions in FOIAs to DOE and at the site visits. In general we sought to learn about releases at each site. We asked the following questions and received various combinations of answers at each site.

1) What is the DOE's national policy on releasing or clearing potentially radioactive material or slightly contaminated radioactive material from DOE and contractor/subcontractor regulatory control?

2) A) What are field, site, DOE, contractor/subcontractor, NNSA policies on releasing or clearing potentially radioactive material or slightly contaminated radioactive material from DOE, NNSA and contractor/ subcontractor regulatory control?

B) Please provide the Policy, Procedures and Specific destinations for all types of waste and materials (see list below) and identify the location and type of records for surveys of 'released' materials.

Soil
Buildings- reuse
Buildings- demolition waste
Concrete
Asphalt
Metal – Surface Contaminated
Volumetric Contaminated
(how much and where stored?)
Equipment
Plastics
Chemicals
Wood
Other

C) Are the moratorium and suspension on release of radioactive and potentially radioactive metals from January and June 2000 still in effect? If so how much of a burden has this been for the site and why? Where stored? How much?

If metals are released for disposal where do they go?
What levels?
What instruments, procedures?
Detection limits of survey and measurement equipment?
How determined?
By whom? Generally and specifically?
Who decides what is released?
What is information is used to make the decision?
Where does the released material go?
How much has gone?
Records? Where? Arrange to see.

D) What is required to move material from DOE and contractor/subcontractor property to a destination that is not under DOE/contractor/subcontractor control? What is required to move potentially radioactive materials from radiological control areas to non-radiological control areas?
E) What inventories are kept for metal releases and for non-metal releases? Where and when may we review those inventories?

QUESTIONS POSED AT SITE VISITS (continued)

3) Responsible Parties for Authorized Levels and for Releases/Clearance

A) Federally: Is EH-1 still the responsible party authorizing volumetric releases?
(If not, who is or what procedure replaced that designation?)
What records are there of releases approved by EH-1 or designee?

[[This has changed since 2006 when there was reorganization of DOE. Now it is HS-1, the Chief Health Safety and Security Officer for the Office of Health, Safety and Security, who is responsible for approving or denying release of volumetrically contaminated radioactive materials that will give doses higher than in the millirem/year range.]]

B) Site Specific: Who is responsible at each site for releases? What records are there of releases both surface and volumetric?

4) How does DOE distinguish between radioactive and non-radioactively contaminated materials?

A) What are the rules, regulations, policies, procedures and practices for making the determinations?

B) What equipment and procedures are used?

C) What is the level of detection that the equipment and procedures are capable of detecting? Capable of measuring? Confidence levels?

D) Who does the independent monitoring of the process? What do they actually observe (percent of releases, which procedures, etc)?

E) Is a 3rd party independent observer required for all releases? Where and when may we observe the records of the 3rd party independent observer?

F) Where and when may we observe the release process? Where and when may we observe the oversight procedures of the independent 3rd party?

5) Authorized Limits or Authorized Levels

A) What federal--across the complex--authorized levels are there for surface and volumetric radioactivity? [e.g., DOE order 5400? Reg. Guide 1.86? draft implementation guides? others?]
B) What site-specific authorized levels are there?
C) How were they set?
D) What levels are currently being set?
E) Are they set for each portion of a cleanup or other activity or for the whole site generally?
F) Are they different for release to landfill disposal (not regulated for nuclear materials) and for recycling?

6) What measurements are done?
What instruments?
What procedures?
By whom?
Record keeping?
Where are the records? (Who to contact to review them)
May we observe the process?

1999 Tennessee Department of Environment and Conservation Radioactive Waste Processor Licenses (across top) and Licensees (below) (p. 1 of 3)	Receipt of Radioactive Waste Material	Packaging for Transfer to Licensed Parties	Preparation of Waste for Processing	Treatment of Waste Materials	Compaction	Metal Melt Operations	Resin Processing	Wet Waste Processing	Mechanical and Chemical Decontamination	Onsite Decontamination and Waste Disposal	Temporary Jobsite Decon and Waste Disposal	**Decontamination for Free Release**	**Survey for Free Release Reg Guide 1.86**	**Volumetric Free Release**	**Free Release of Lead**	**Free Release of Soil and Other Bulk Materials**	**Free Release of Equipment**	**Free Release of Licensee Concrete and Asphalt**	Nuclear Laundry	Machining of Shield Block	Incineration	Container Maintenance	Store and Sort	Shredding	License Product Material Processors and Producers	Encapsulation of Sources
East TN Materials and Energy R-01088 Oak Ridge	X	X	X	X													X									
ATG Catalytics, LLC R-73020 Kingston	X		X				X	X					X			#1										
GTS Duratek, Inc. R-73006 Oak Ridge	X	X						X				X			X			X		X		X	X			X
GTS Duratek, Inc. R-73018 Oak Ridge		X									X															
GTS Duratek, Inc. R-73015 Oak Ridge	X		X			X						X		X	X											
GTS Duratek, Inc. R-73013 Oak Ridge	X		X				X	X													X					
GTS Duratek, Inc. R-73008 Oak Ridge	X	X	X		X		X		X			X	X		X			X								
Manufacturing Sciences, R-01078 Oak Ridge	X		X									X		X											X	

1999 Tennessee Department of Environment and Conservation Radioactive Waste Processor Licenses (across top) and Licensees (below) (p. 2 of 3)	Receipt of Waste Material	Packaging for Transfer to Licensed Parties	Preparation of Waste for Processing	Treatment of Waste Materials	Compaction	Metal Melt Operations	Resin Processing	Wet Waste Processing	Mechanical and Chemical Decontamination	Onsite Decontamination and Waste Disposal	Temporary Jobsite Decon and Waste Disposal	**Decontamination for Free Release**	**Survey for Free Release Reg Guide 1.86**	**Volumetric Free Release**	**Free Release of Lead**	**Free Release of Soil and Other Bulk Materials**	**Free Release of Equipment**	**Free Release of Licensee Concrete and Asphalt**	Nuclear Laundry	Machining of Shield Block	Incineration	Container Maintenance	Store and Sort	Shredding	License Product Material Processors and Producers	Encapsulation of Sources
Manufacturing Sciences, S-01046 Oak Ridge	X		X										X	X											X	
Frank Hake & Associates R-79171 Memphis, TN	X		X	X	X			X	X				X			#1	X									
American Ecology Recycle Center R-01037 Oak Ridge	X	X	X		X			X	X			X	X	X		#1	X		X					X		X
American Ecology Recycle Center R-01086 Oak Ridge													X				X									
DSSI R-73014 Kingston	X		X	X	X		X	X	X			X												X		
Nuclear Fuel Services R-86010 Erwin TN											X															
Nuclear Fuel Services R-86001 Erwin TN	X																								X	
Nuclear Fuel Services R-86007 Erwin TN										X																

1999 Tennessee Department of Environment and Conservation Radioactive Waste Processor Licenses (across top) and Licensees (below) (p. 3 of 3)	Receipt of Waste Material	Packaging for Transfer to Licensed Parties	Preparation of Waste for Processing	Treatment of Waste Materials	Compaction	Metal Melt Operations	Resin Processing	Wet Waste Processing	Mechanical and Chemical Decontamination	Onsite Decontamination and Waste Disposal	Temporary Jobsite Decon and Disposal	**Decontamination for Free Release**	**Survey for Free Release Reg Guide 1.86**	**Volumetric Free Release**	**Free Release of Lead**	**Free Release of Soil and Other Bulk Materials**	**Free Release of Equipment**	**Free Release of Concrete and Asphalt**	Nuclear Laundry	Machining of Shield Block	Incineration	Container Maintenance	Store and Sort	Shredding	License Product Material Processors and Producers	Encapsulation of Sources
IT Corporation R-47152 Knoxville		X									X															
STS, Inc. R-47167 Knoxville		X									X															
KER R-01086 (blurry original) (?R-01066 or 01088) Oak Ridge	#2																		X							
Bionomics R-73021 Kingston		X																								
Philotechnics R-01084 Oak Ridge		X																								
Aerojet S-90009 Jonesboro									X			X	X												X	
Combustion R-33133 Chattanooga									X			X					X									
Studsvik R-S1001 Erwin	X	X					X	X																		

Footnote #1 – Disposal to landfill

Footnote #2 – KER receives contaminated clothing and preventive equipment

2006 Tennessee Department of Environment and Conservation Radioactive Waste Processor Licenses (across top) and Licensees (below) (p. 1 of 2)	Receipt of Waste Material	Packaging for Transfer to Licensed Parties	Preparation of Waste for Processing	Treatment of Waste Materials	Compaction	Metal Melt Operations	Resin Processing	Wet Waste Processing	Mechanical and Chemical Decontamination	Onsite Decontamination and Waste Disposal	Temporary Jobsite Decon and Disposal	**Decontamination for Free Release**	**Survey for Free Release Reg Guide 1.86**	**Volumetric Free Release**	**Free Release of Lead**	**Free Release of Soil and Other Bulk Materials**	**Free Release of Equipment**	**Free Release of Concrete and Asphalt**	Nuclear Laundry	Machining of Shield Block	Incineration	Container Maintenance	Store and Sort	Shredding	License Product Material Processors and Producers	Encapsulation of Sources
East TN Materials and Energy (owned by PermaFix)Oak Ridge	X	X	X	X				X		X													X			
ATG Catalytics, LLC Kingston-bankrupt R73020 under TDEC; R-73024 transfer to Impact																										
GTS Duratek, Inc. Oak Ridge + Hake Memphis both bought by EnergySolutions	X	X	X	X	X	X	X	X	X	X	X	X	X	#1	X		X	X		X	X	X	X	X		X
Manufacturing Sciences (MSC) Oak Ridge bought by EnergySolutions S-01046																										
RACE (R-79171) Memphis issued to Studsvik, Studsvik/RACE	X	X	X	X			X	X	X	X	X	X	X	#1		X	X	X			X	X	X	X		X
American Ecology Recycle Center AERC license transferred to ToxCo Oak Ridge	X	X	X	X	X	X		X	X	X		X	X	#1	X	X	X	X		X		X				
DSSI (owned by PermaFix)Kingston	X		X	X				X		X													X			
Nuclear Fuel Services Erwin TN S-86001, R-86002,R-86007,R-86008	#3									#3															#3	

2006 Tennessee Department of Environment and Conservation Radioactive Waste Processor Licenses (across top) and Licensees (below) (p. 2 of 2)	Receipt of Waste Material	Packaging for Transfer to Licensed Parties	Preparation of Waste for Processing	Treatment of Waste Materials	Compaction	Metal Melt Operations	Resin Processing	Wet Waste Processing	Mechanical and Chemical Decontamination	Onsite Decontamination and Waste Disposal	Temporary Jobsite Decon and Disposal	**Decontamination for Free Release**	**Survey for Free Release Reg Guide 1.86**	**Volumetric Free Release**	**Free Release of Lead**	**Free Release of Soil and Other Bulk Materials**	**Free Release of Equipment**	**Free Release of Concrete and Asphalt**	Nuclear Laundry	Machining of Shield Block	Incineration	Container Maintenance	Store and Sort	Shredding	License Product Material Processors and Producers	Encapsulation of Sources
IT Corporation became Shaw Env'tal, R01060, R47055, R47152, R73026																										
STS, Inc. Knoxville																										
KER transfer to Unitech Services, Oak Ridge	#2																		X							
Bionomics Kingston		X																								X
Philotechnics Oak Ridge	X	X	X	X				X	X	X		?	?				?					X	X			
Aerojet Jonesboro						X															#4					
Combustion, Chattanooga R33001 transferred to Alstom Power R33113 terminated																										
Studsvik Erwin	X	X	X	X			X	X		X		X	X				X					X	X			
IMPACt Services	X	X	X	X				X	X	X		X	X	#1		X	X	X					X			
ToxCo	X	X	X	X	X	X		X	X	X		X	X	#1	X	X	X	X		X			X			

Footnote #1 released to approved landfill only

Footnote #2 receives contaminated clothing and preventive equipment

Footnote #3 NFS has some of the same licenses as in 1999 but they were not reported in these categories in 2006

Footnote #4 "Aerojet does not have an incineration license, but does have a condition on their processing license that authorizes oxidizing (incinerating) metallic uranium chips and grinding fines for disposal as dry solids" email C Arnott to D D'Arrigo 2/28/2007.

Appendix C

FOR IMMEDIATE RELEASE
January 12, 2000

NEWS MEDIA CONTACT:
Stu Nagurka, 202/586-4940

Energy Secretary Richardson Blocks Nickel Recycling at Oak Ridge

Secretary Supports NRC Establishment of National Standards

Energy Secretary Bill Richardson announced today that he is blocking the release into commerce of volumetrically contaminated nickel from Department of Energy (DOE) facilities in Oak Ridge, Tennessee. The action will allow time for the evaluation of alternatives by DOE and for the Nuclear Regulatory Commission (NRC) to make a decision on national treatment standards. The Secretary also is directing expansion of the decision into a new, department-wide policy that would prevent the release of all volumetrically contaminated metals pending the NRC's decision and DOE's determination whether to release any such metals.

"The department will modify its contract with British Nuclear Fuels Inc. (BNFL) to prohibit release of the Oak Ridge nickel into the marketplace," said Secretary Richardson. "We are also establishing a new policy prohibiting the release of all volumetrically contaminated metals at other DOE facilities. This will give the Nuclear Regulatory Commission time to develop national standards for volumetrically contaminated materials, and allow the public an opportunity to weigh in on the development of a national policy. It also will allow DOE to examine alternatives to free release."

Volumetrically contaminated means contamination is present throughout the mass of the metal. While this decision covers some 6,000 tons of contaminated nickel at Oak Ridge, the new national policy will impact approximately 10,000 tons of additional volumetrically contaminated metal at DOE sites.

BNFL, a DOE contractor, is in the process of cleaning up several buildings at the former Oak Ridge uranium enrichment plant, and is removing equipment containing large amounts of nickel. Under the original contract, BNFL had the option of melting and decontaminating the nickel before releasing the material under a State of Tennessee license.

- DOE -

R-00-008

DOE NEWS

NEWS MEDIA CONTACTS:
Dolline Hatchett, 202/586-5806
Matt Nerzig, 202/586-4940

FOR IMMEDIATE RELEASE
July 13, 2000

Secretary Richardson Suspends Release of Materials from DOE Facilities

Secretary of Energy Bill Richardson today suspended the release of potentially contaminated scrap metals for recycling from Department of Energy (DOE) nuclear facilities. The suspension is part of a new policy aimed at ensuring contaminated materials are not recycled into consumer products and at improving the department's management of scrap materials at its nuclear weapons production sites.

"I am making this decision to ensure American consumers that scrap metal released from Energy Department facilities for recycling contains no detectable contamination from departmental activities," said Secretary Richardson. "The suspension will remain in effect until our sites can confirm that they meet this new more rigorous standard."

DOE's existing standards result in radiation exposure that is already far below what is allowed by federal policy. Detection equipment currently available will enable the department to do even better.

The department also is initiating a feasibility study on the possibility of recycling steel from decommissioned facilities into waste containers or other items needed by DOE. A preliminary review completed last May concluded that the concept merits a more detailed study.

"I am challenging the department's managers to think creatively and come up with incentives to promote internal reuse and recycling," said Secretary Richardson.

Richardson also announced other steps to improve record keeping and reporting as well as acceleration of the department's program to collect some types of commercially owned, radioactive sources that are no longer in use. Sealed radioactive sources are used in a variety of measurement, calibration and other activities. These sources can pose significant risks to steelworkers or the public if abandoned or illegally disposed. DOE has responsibility under the Low-Level Waste Policy Act of 1985 to dispose of them properly.

-DOE-

R-00-182

The Secretary of Energy
Washington, DC 20585

July 13, 2000

MEMORANDUM FOR HEADS OF DEPARTMENTAL ELEMENTS

FROM: BILL RICHARDSON

SUBJECT: Release of Surplus and Scrap Materials

The Department of Energy's (DOE) management of surplus and scrap materials has evolved over many years. Effective management of these materials has become more complicated over the past decade because the Department has begun generating them in larger quantities as it closes many facilities and expands its environmental management activities. Moreover, since much of this material was once used in nuclear operations, our management of it must continue to take into account safety and security issues, but we also want to address recently voiced public concerns that are not faced by most other Federal Agencies or by private industry.

For several months, we have been actively reviewing ways to improve our management of materials which might be released from departmental control. My goal has been to identify ways to better ensure protection of public health and the environment, openness and public trust, and fiscal responsibility.

I thank the Reuse and Recycling Task Force I established last winter for their contribution to the Department's review. While the work of the task force is now complete, many of its members will be involved over the coming months further developing and implementing changes to our policies and procedures.

On January 12, 2000, I placed a moratorium on the Department's release of volumetrically contaminated metals pending a decision by the Nuclear Regulatory Commission (NRC) whether to establish national standards. The NRC continues to review the issue, and the moratorium remains in effect.

Today, I am hereby directing further action in four areas: improvement of the Department's release criteria and monitoring practices; expansion of efforts to promote reuse and recycling within the complex of DOE facilities; improvement of the Department's management of information about material inventories and releases; and the accelerated recovery of sealed sources. Also, I am suspending the unrestricted release for recycling of scrap metals from radiation areas within DOE facilities. This suspension will remain in effect until improvements in our release criteria and information management have been developed and implemented as described below.

Our existing release criteria, described in DOE Order 5400.5, limit the potential for radiation exposure to the public to levels well below applicable requirements. Our experience using these criteria, however, demonstrates that even this very low potential exposure is not fully acceptable to the public. Our experience with existing criteria also shows that most scrap metal released is either not contaminated at all or has residual levels of surface contamination well below the current DOE standard.

Henceforth, the Department will not allow the release of scrap metals for recycling if contamination from DOE operations is detected using appropriate, commercially available monitoring equipment and approved procedures. To implement this decision, I am directing the Assistant Secretary for Environment, Safety and Health, with appropriate resource support, to revise DOE directives and associated guidance documents applicable to scrap metal releases through a public process, as described below, by December 31, 2000.

The Department will publish proposed changes to DOE directives and guidance for at least sixty days of public review and comment. The changes will describe conditions whereby the Department uses appropriate, commercially available technology and the most appropriate monitoring and decontamination procedures to ensure that no detectable contamination from DOE operations remains on any scrap metal released into commerce for recycling from any portion of our facilities. The revised DOE directive will establish a review cycle to develop future updates to guidance consistent with lessons learned, advances in monitoring or decontamination technology and procedures, and new information such as any future rulemaking activity by the NRC.

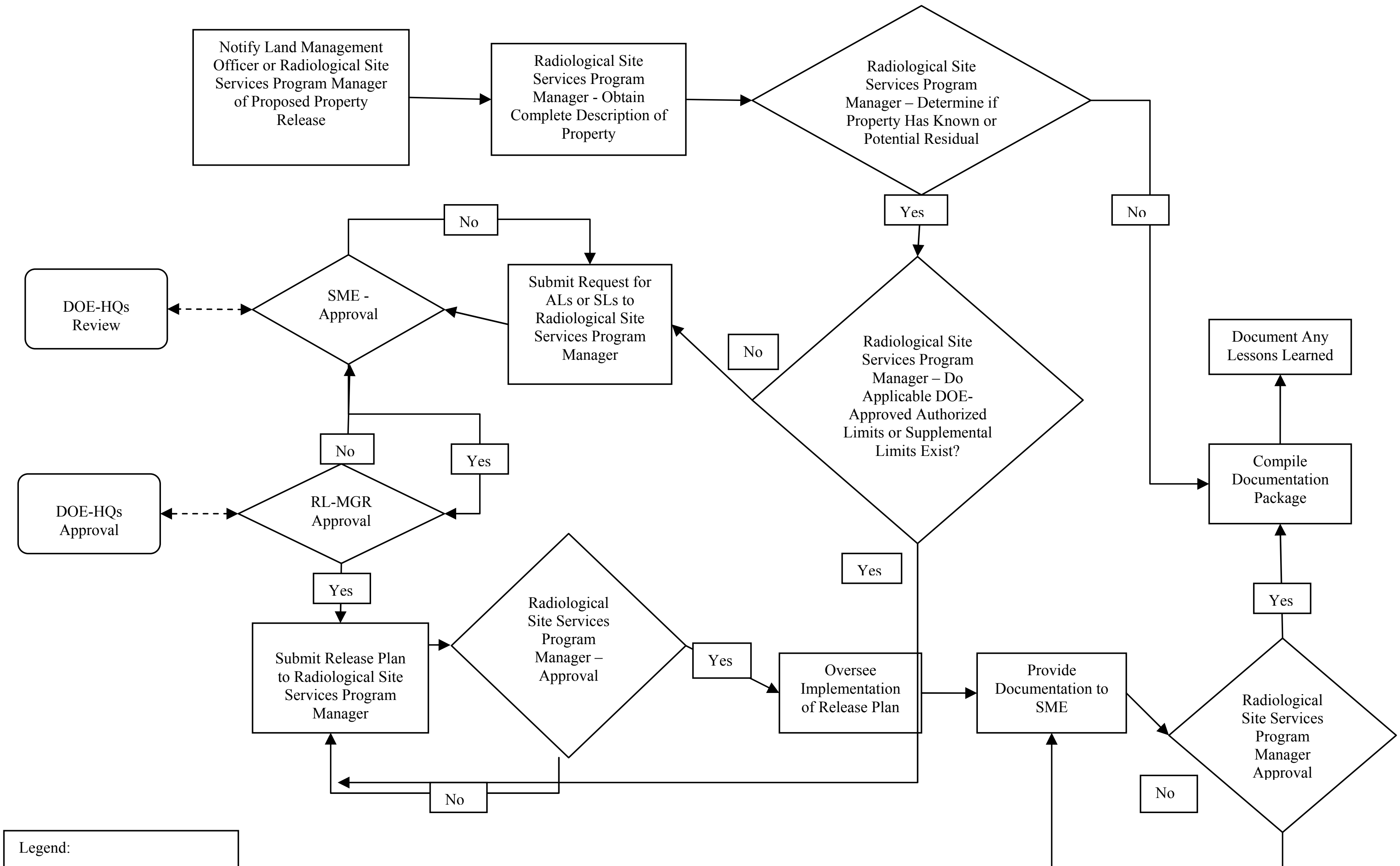
Changes will also be made to DOE's requirements and guidance to improve the collection, maintenance, and reporting of information associated with releases of surplus equipment, scrap metals, and other excess personal property. We need better records on inventories of these materials; contamination, security, and other concerns associated with them; and the basis for decisions authorizing their release. This information needs to be maintained in a way that makes it easily accessible to the public (consistent with classification and other security requirements) and readily available to meet the needs of project and program managers.

Once the revised directives and guidance are in place, the Department will require each DOE site to have local public participation before the site may resume the unrestricted release for recycling of scrap metals from radiation areas. These public participation requirements must address each of the above mentioned elements associated with release criteria and information management. In addition, the Department will require individual sites to certify, through the responsible Program Secretarial Officer (PSO), that they have met all requirements of the revised order before the release of scrap metal from radiation areas for recycling can resume. In addition, each affected PSO will implement an independent verification program to ensure that site activities continue to comply with the new requirements.

While updated release criteria and record keeping procedures are being developed and implemented, the Department will undertake several activities to promote internal reuse and recycling. All DOE programs and sites should expand their efforts to reuse and recycle materials within the Department. I direct the Assistant Secretary for Energy Efficiency and Renewable Energy to lead completion of a feasibility study on the potential use of a dedicated mill to recycle steel for reuse within the DOE complex. The study is to be completed within ninety days, after which I will receive the study's recommendations and determine if the Department will pursue the project further. Also, I direct the Chief Financial Officer to develop a set of proposed actions that will institutionalize incentives for internal reuse and recycling when such activities are cost-effective and protective of workers, the public, and the environment. The Chief Financial Officer will forward these recommended actions to me within 120 days for approval.

Finally, I direct the Assistant Secretary for Environmental Management to accelerate the Department's program to recover radioactive sources. The goal should be to recover over the next four years the backlog of commercial sources for which the Department has authority.

Radiological Release of Property



Legend:

SME – Subject Mater Expert
AL – Authorized Limits
SL – Supplemental Limits

White Paper

Evaluation and Acceptance of Licensee Requests for the Disposal of Materials with Extremely Low Levels of Contamination in Class D Landfills.

Background Information

Starting in the early 1990s the Division of Radiological Health received several requests to authorize the disposal of materials with extremely low levels of radioactive materials in a few of the class D landfills in the State of Tennessee. These proposals argued that the levels of contamination, while detectable, posed no hazard by being disposed of in this manner. These proposals were supported using a computer software evaluation package called RESRAD. RESRAD was developed by Argonne National Labs to evaluate future doses from residual radiation left in place after decommissioning. Evaluations using RESRAD are conservative for almost all possible scenarios and radionuclides. These proposals were each evaluated on a case-by-case basis and most were approved.

By the mid 1990s, many waste streams were being requested, and approvals became extremely backlogged. Several licensees asked if an evaluation could be made for a worst case waste stream and that any waste stream which was less contaminated than this hypothetical waste stream could be disposed of at the landfills without having to be specifically approved. This was accepted under the following conditions. The worst case waste stream and the actual waste had to be compared on an isotope by isotope basis, and the disposal could only take place at the landfill for which the evaluation was conducted.

Division Policy

Currently the Division has several facilities approved to do this type of analysis and disposal. Each licensee has its own individual license condition for this disposal but they all meet certain criteria. Currently all these evaluations meet these conditions:

1) The resident farmer scenario, using the NRC's PG8-08 inputs and the RESRAD[1,2] computer code for evaluation, must not show a dose greater than 1 mrem/yr after the first 20 years. (A landfill is required by law to be maintained for 30 years post closure.)

---

[1] All references to the RESRAD computer code should be understood to include any comparable method, however, other methods may have to be evaluated by the Division as part of its overall review of the request.

[2] New proposals using RESRAD should use the NRC approved version 6.0 or any later version approved by NRC.

2) The worker scenario, using the NRC's PG8-08 inputs and the RESRAD computer code for evaluation, should not show a dose greater than 1 mrem/yr for the first 30 years.

3) The resident farmer scenario must assume that the cap is removed from the site.

4) While a particular waste stream is typically a small percentage of the material going to a particular landfill, in the model it must assume that it is 10% of the total waste stream.

5) Approval is only for the landfill for which the evaluation has been made.

6) Isotopes that are not available in RESRAD due to a short half-life must be compared to radionuclides that are available and this comparison must be supported by similar chemical and radiological characteristics.

7) If approval is made isotope by isotope based on a single isotope resulting in a 1 mrem/yr maximum exposure. For waste streams containing more than one isotope a sum of the fractions[3] can be used to show that any conveyance going to the landfill will not exceed 1 mrem/yr.

8) If more than one licensee is going to any one landfill the total shipments to a landfill under these license conditions will not exceed 5% of all the material going to that landfill. If requests for shipment exceed 5%, all licensees shipping to that landfill will have their mass limits for that landfill reduced so that the total will not exceed 5%. This reduction will be done based on the modeled dose contribution from each licensee.

9) All licensees with amendments of this type will be required to submit quarterly summaries of all shipments. These summaries will include, but are not limited to, the total mass shipped, the average concentration per nuclide shipped, and the maximum concentration of each nuclide shipped.

The intent of this policy is to provide for the health and safety of the citizens of Tennessee. Such policies must evolve with increased technical understanding of long term affects. Accordingly, the Division reserves the right to re-evaluate this policy at any time and for any reason.

---

[3] Sum of the Fractions – If Isotopes A, B and C are present at concentrations conA, conB, and conC and their limits are limA, limB, and limC respectively then the following must be true.

$$\frac{conA}{\lim A}+\frac{conB}{\lim B}+\frac{conC}{\lim C}\leq 1$$

I have read the attached document. Any comments I have are attached on a separate sheet.

10/19/01	10/19/01
Eddie Nanney — Date Director, TN - Division of Radiological Health	Ruben Crosslin — Date Technical Services Program Manager, TN - Division of Radiological Health
10/22/01	11/19/01
Debra Shults — Date Deputy Director, TN - Division of Radiological Health	Allen Grewe — Date Memphis EAC Manager, TN – Division of Radiological Health
10/19/01	11/26/01
Joelle Key — Date Health Physics Consultant, TN - Division of Radiological Health	Billy Freeman — Date Knoxville EAC Manager, TN – Division of Radiological Health
10/22/01	12-23-01
Johnny Graves — Date Licensing Program Manager, TN - Division of Radiological Health	John Pelitte — Date Chattanooga EAC Manager, TN – Division of Radiological Health
10/19/01	10/19/01
Roger Fenner — Date Inspection and Enforcement Program Manager, TN - Division of Radiological Health	Anthony Hogan — Date Nashville EAC Manager, TN – Division of Radiological Health

Appendix H

Department of Environment and Conservation

Solid Waste Permit Status at Radiological Facilities

MEMORANDUM OF AGREEMENT

This memorandum of agreement (MOA) is entered into by the Division of Radiological Health (DRH) and the Division of Solid Waste Management (DSWM). Certain radiological waste processing facilities that are licensed by the DRH, including those that handle bulk survey for release (BSFR) material, also have solid waste management activities as part of their operations. The DSWM has made a determination that these facilities are not processing solid waste subject to a permit-by-rule, but are generating solid waste during the process of handling BSFR waste material. This MOA is an agreement between DSWM and DRH acknowledging that the DRH licensing program provides appropriate oversight for the Department of Environment and Conservation. It is understood that any questions arising to DRH regarding solid waste management at these facilities will be referred to DSWM.

Per this agreement, the DSWM shall not require a permit-by-rule for these facilities. DSWM shall instead regulate the solid waste generated from these facilities by use of the special waste approval process. All special wastes approved from facilities with a DRH waste processing license shall meet the following conditions for disposal:

1. The waste shall be immediately disposed of at the landfill working face and then immediately covered. The waste shall not be salvaged or recycled.

2. Disposal facilities that receive special wastes from facilities with DRH waste processing licenses shall install, calibrate, maintain, inspect and test periodically radiological sensing equipment at the facility scales. Records that verify these calibration requirements have been met annually shall be kept at the scale house and made available to DSWM personnel upon request and during inspections. A written protocol for responding to alarms triggered by this special waste shall be maintained at the landfill facility.

3. The generator shall provide an annual report to the Division of Solid Waste Management. This report must include the total quantity of special waste under this approval that was delivered to and disposed at Class I landfills in Tennessee.

This agreement is entered into by DRH and DSWM in a cooperative effort to increase the timeliness of service delivery, enhance overall customer service, and realize greater departmental efficiency.

_[Signature on File]_____	_[Signature on File]_____	__09/12/06_____
Mike Apple	Eddie Nanney	Date
Director, DSWM	Director, DRH	

policy/notebook/pn126
Original: September 2006

Appendix I

DOE Surface Contamination Release Levels

From DOE Internal Order 5400.5 change 2, consistent with Atomic Energy Commission Regulatory Guide 1.86 (1974), and pg. 12 of November 17, 1995 Department of Energy, Office of the Assistant Secretary for Environment, Safety and Health, Office of Environment Memo, "Response to Questions and Clarification of Requirements and Processes: DOE 5400.5, Section II.5 and Chapter IV Implementation (Requirements Relating to Residual Radioactive Material)"

Table 1. Surface Activity Guidelines Allowable Total Residual Surface Activity (dpm/100 cm^2)[4]

Radionuclides[5]	**Average**[6/7]	**Maximum**[9/8]	**Removable**[9/9]
Group 1 - Transuranics, I-125, I-129, Ac-227,Ra -226, Ra-228, Th-228, Th-230, Pa-231	100	300	20
Group 2 - Th-natural, Sr-90, I-126, I-131, I-133, Ra-223,Ra-224, U-232, Th-232	1000	3000	200
Group 3 - U-natural, U-235, U-238, and associated decay products, alpha emitters	5000	15000	1000
Group 4 - Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous[10] fission) except Sr-90 and others noted above	5000	15000	1000
Tritium (applicable to surface and subsurface)[11]	N/A	N/A	10000

---

[4] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[5] Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

[6] Measurements of average contamination should not be averaged over an area of more than 1 m2 . For objects of smaller surface area, the average should be derived for each such object.

[7] The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

[8] The maximum contamination level applies to an area of not more than 100 cm^2 .

[9] The amount of removable material per 100 cm2 of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

[10] This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

[11] Property recently exposed or decontaminated, should have measurements (smears) at regular time intervals to ensure that there is not a build-up of contamination over time. Because tritium typically penetrates material it contacts, the surface guidelines in group 4 are not applicable to tritium. The Department has reviewed the analysis conducted by the DOE Tritium Surface Contamination Limits Committee ("Recommended Tritium Surface Contamination Release Guides," February 1991), and has assessed potential doses associated with the release of property containing residual tritium. The Department recommends the use of the stated guideline as an interim value for removable tritium. Measurements demonstrating compliance of the removable fraction of tritium on surfaces with this guideline are acceptable to ensure that non-removable fractions and residual tritium in mass will not cause exposures that exceed DOE dose limits and constraints.

Appendix J
From NRC's Below Regulatory Concern Policy

Table 1

Incremental Annual Dose*	Hypothetical Incremental Annual Risk**	Hypothetical Lifetime Risk From Continuing Annual Dose**
100mrem (1.0 mSv)	5x10-5	3.5x10-3
10 mrem (0.1 mSv)	5 x 10-6	3.5 x 10-4
1 mrem (0.01 mSv)	5 x 10-7	3.5 x 10-5
0.1 mrem (0.001 mSv)	5 x 10-8	3.5 x 10-6

* The expression of dose refers to the Total Effective Dose Equivalent. This term is the sum of the deep [whole body] dose equivalent for sources external to the body and the committed effective [whole body] dose equivalent for sources internal to the body.

** Risk coefficient of 5 x 10-4 per rem (5 x 10-2 per Sv) for low linear energy transfer radiation has been conservatively based on the results reported in UNSCEAR 1988 (Footnote 2) and BEIR V (see also NUREG/CR-4214, Rev. 1).

The above is excerpted from the NRC's Below Regulatory Concern Policy, dated at Rockville, Maryland, June 22nd, 1990.

Appendix K

Public Concerns on

US Department of Energy

Notice of Intent to

Prepare a Programmatic Environmental Impact Statement on the

Disposition of Radioactive Scrap Metals

A comprehensive, permanent ban should be placed on release for recycling, regular (unregulated) disposal and reuse of all radioactive wastes and materials, including potentially contaminated metals and materials from all DOE sites and activities.

1. **(A) DOE should <u>maintain and make permanent</u>, its 'moratorium' on the release and recycling of radioactive "volumetrically" contaminated metal**. The moratorium went into effect in January 2000. "Volumetric" contamination means the radioactivity is within/throughout the metal. It includes but is not limited to the nickel powder from uranium enrichment facilities.

   (B) DOE should <u>expand</u> the 'moratorium' on "volumetrically" contaminated metals <u>to cover all potentially contaminated materials and wastes in addition to metals.</u>

2. **(A) DOE should <u>maintain, expand and make permanent, its 'suspension'</u> on the recycling of "surface" contaminated radioactive metal from 'radiological control' areas of DOE sites.** The July 2000 suspension was put in place to prevent potentially contaminated surface metals from being sent to recyclers. LOOPHOLES: It allows the metals to be disposed at regular landfills, incinerators, or to be reused as if they were not contaminated, even if they are. It does not prevent potentially contaminated metals from being moved to non-control areas and later recycled. "Surface" contaminated means the radioactivity is on the surface of the metal but supposedly not within. When it gets melted for recycling, however, the radioactivity blends in and the final products will be volumetrically contaminated. The implication is that surface contamination can be removed, but it cannot be fully removed.

   (B) DOE should expand its suspension on recycling of surface contaminated radioactive metal <u>to also prevent disposal and reuse</u>—that is to prevent potentially contaminated metal from being treated like regular garbage and sent to landfills, incinerators, etc. or reused as if it is not radioactive. When the suspension was put in place in July 2000, the then-DOE Secretary told the public no contaminated metal would get into regular daily items. But, DOE's current implementation of the suspension allows contaminated metals to leave DOE sites from non-radiological control areas, which have varying definitions, and where wastes and materials could be contaminated.

(C) No potentially contaminated metal: volumetric, surface contaminated or both, should be released from regulated control, whether it is <u>from radiological control areas or elsewhere in the DOE complex</u>. Contamination and contaminated materials may be present outside of currently designated radiological control areas. There are several definitions of control areas, providing a loophole for recycling of contaminated metals.

3. **DOE should stop allowing other radioactive waste and materials out as regular trash or for reuse and recycling into everyday household items and raw materials.** The prohibitions on metal release should be expanded to prevent any radioactive wastes and materials out as regular trash, hazardous-only waste (if it is mixed hazardous and radioactive) or for reuse and recycling in everyday commerce.

   Ex: Radioactive soil, concrete, asphalt, wood, plastics, chemicals and other materials are currently allowed to be dispersed into general commerce if they meet DOE's internal "authorization limits," which are self-imposed and fulfilled by DOE.

4. **Call for replacing DOE's "authorized limits" for release of radioactively contaminated materials with a clear, simple prohibition on release/recycle/reuse of radioactive wastes and contaminated materials.**

5. DOE should revise its authorizations (in DOE Internal Order 5400.5) to prohibit any radioactivity from DOE activities being released into commerce or regular trash.

6. **Restricted Release**- Although restricted release for use within the DOE complex might sound like a logical possibility for contaminated materials, they should not be 'released' at all. If they are no longer regulated, but used within the DOE complex, they could subsequently be released out of the DOE complex. Restricted release is a middle step to allowing release into the regular marketplace. Regulated reuse within the DOE complex without release from control might make sense, as long as continued to be treated as radioactive

7. Once radioactive materials are released from the DOE complex, there is no limit on what can be made with them- frying pans, belt buckles, playgrounds, garden-fill, zippers, braces, hip-replacement joints and more. It can be used for anything. There can be multiple exposures from many different deregulated waste streams.

8. The burden of proof that materials are clean of DOE contamination, thus permitted to leave DOE Complex and purview must lie with the DOE and the generator of the material**. Full monitoring at the lowest achievable levels of detection for every isotope must be required to allow release of materials.** Monitoring to determine the amount and type of contamination is difficult, expensive and nearly impossible to carry out for all the wastes and materials DOE wants to release/recycle. Full monitoring and labeling would make it too expensive to release the materials.

9. **Scope must be expanded to cover all releases (all of DOE Order 5400.5)** not just surface contaminated metals in radiation control areas.

10. **Deliberate dispersal of nuclear wastes now held at atomic facilities will unnecessarily spread radioactivity into communities**. Background radiation already causes unavoidable exposures, so why add preventable doses from "recycled" nuclear waste to it?

11. We cannot trust unverified computer models, developed at DOE and NRC expense, with highly questionable assumptions to predict levels, doses and risks from an unlimited array of sources.

12. **Multiple exposures:** We could be exposed to radiation from many different contaminated consumer products, building materials, etc. The risks add up and are multiplied when we are exposed to more radiation and other carcinogens in our lives.

13. **"Released" waste is not tracked to recyclers to manufacturers to consumers and so on.** Metal and other recyclers now have detection equipment at their facilities to prevent most nuclear wastes from getting in, but they can miss some radioactivity and should not be expected be the watchdogs of the nuclear establishment. DOE waste contaminated sites in Knoxville and east TN when it was sent to facilities not licensed to deal with radioactive metals and wastes.

14. **Some in the nuclear industry want a standard, any standard, to legalize processing or directly dumping waste into the marketplace**. Since any standard set is unlikely to be enforced, in the long run, it essentially legalizes a potentially unlimited amount of nuclear waste being incorporated into our homes, vehicles, workplaces. We call for a prohibition on nuclear materials into commerce.

15. **DOE can’t be trusted to release any levels of contamination, nor can they be trusted to honestly carry out the EIS process.** A contractor (SAIC) with conflicts of interest, making money on releasing metals was originally hired, but now let go, to do the PEIS.

Appendix L

FOIA to DOE and NNSA on "Authorized Limits" and "Supplemental Limits"
July, 2007

Abel Lopez
Director FOIA/PA Division, ME-73
US Department of Energy
1000 Independence Avenue NW
Washington, DC 20585
Fax 202 586 0575

Dear Mr. Lopez:

I am writing, under the Freedom of Information Act of 1966 (Title 5 of the United States Code, section 552), to request that you send me the information listed below from DOE's files.

"Authorized Limits" and "Supplemental Limits" appear to be very important mechanisms for potentially radioactive and known radioactive materials to be released to unregulated destinations and uses including commercial recycling and regular trash dumps. Some are approved nationally by DOE (and possibly NNSA) headquarters and some are approved at each site in the US and at some international sites over which DOE has authority or provides guidance or funding.

This Freedom of Information Request is for information on ALL the approved and pending "**Authorized Limits**" and **"Supplemental Limits"** for release of both volumetric and surface contaminated radioactive and potentially radioactive property/properties, materials and wastes.

Since the concept of **Authorized Limits** to permit radioactive releases appears to have been adopted into DOE's Orders and Guidance in the 1990s and record keeping is required, we are requesting information on all Authorized Limits and Supplemental Limits approved and under consideration from inception until the time this FOIA request is fulfilled.

REQUESTING:

1) Please provide ALL Authorized Limits and Supplemental Limits approved and under consideration

(A) **nationally** by DOE and NNSA;

(B) **by facility**, at each and every DOE, NNSA, contractor and subcontractor **site, field office** and all other applicable sites;

(C) **internationally** by DOE, NNSA or their contractors and subcontractors and international partners from **international locations over which DOE or NNSA have authority or provide guidance or funding**.

This includes **Authorized Limits** and **Supplemental Limits** for both **volumetric** and **surface contamination** for all radioactive and potentially radioactive wastes/materials/property(ies). It includes mixed radioactive and hazardous wastes and materials. This includes ALL approved and pending **Authorized and Supplemental Limits**.

2) Approved and Pending Authorized and Supplemental Limits
Please designate which Authorized and Supplemental Limits

(A) have been approved and have been used?
(B) have been approved and are being used?
(C) are being considered for approval?

This includes reporting the **Authorized and Supplemental Limits** and identifying the responsible parties requesting and approving the **Authorized and Supplemental Limits** as well as complete descriptions and quantification of the materials/wastes/property(ies) to which each **Authorized and Supplemental Limit** applies.

3) Characterization and Quantification.
What materials, wastes, and property/properties have been released under the **Authorized and Supplemental Limits**? What went where? Specifically:

(A) Please provide the **type of materials**, wastes and property/ies, **descriptions** and **volume/weight/amount/area** of materials, wastes, property(ies) released and permitted to be released.

(B) Please provide the **amount of radioactivity including curies or becquerels** of each radionuclide released and permitted to be released for each **Authorized and Supplemental Limit** for each shipment or parcel of materials/wastes/property(ies) released.

4) Destinations.
Where were the materials, wastes, and property/properties sent?

(A) Please provide the name, address, type of establishment and contact information for the recipient of the wastes/materials/property(ies). This includes all contracts, amendments, conditions and agreements regarding the wastes/materials/property(ies).

(B) Please provide documentation of **the intended, expected, required uses and disposition** of the materials/wastes/property(ies) including whether the releases are to/for restricted or "unrestricted" use, reuse, recycle, disposal or disposition.

(C) Please include documentation, notification or designation of "restricted," and unrestricted use, disposal, reuse and recycling. This includes documentation of whether and how the recipients are/were notified of the source of the materials, wastes, and property/properties provided or sent (whether for restricted or unrestricted use, reuse, recycle, disposal or disposition)? Provide documentation of procedures to keep secondary and subsequent uses "restricted."

(D) Enforcing "restrictions." If the recipient destinations are facilities licensed and/or regulated for radioactive materials/wastes/property(ies), please provide **documentation of the license or regulatory authority and how it will be asserted over the materials/wastes/property(ies) being transferred.** Please provide documentation of the restrictions and mechanisms for enforcement if the release is for use, disposal, reuse, recycling or disposition.

5) Recordkeeping.

(A) Please provide the location and procedures for public notification and input.

(B) Please provide all notices to the public for each **Authorized** and **Supplemental Limit** considered and for each **Authorized and Supplemental Limit** approved.

(C) Please provide the public records of the releases. This includes records of each of the **Authorized and Supplemental Limits** and the documentation for each of the releases.

6) Conclusion/Summary

To summarize, we are asking how much radioactivity the DOE and NNSA have released from nuclear controls. The information being sought is reporting on all Authorized and Supplemental Limits approved and under consideration. Who requested and who approved them? For what kinds of radioactive and potentially radioactive wastes/materials/property(ies)? Where are the records of the Authorized and Supplemental Limits and the releases under them? Where did the released material/waste/property go? How is it being used now? How much material/waste/property has been released? How much and what DOE and NNSA-generated radioactivity has been released under these approved authorized limits? Where did it go? How is it being tracked, verified and validated? How will restricted secondary and subsequent uses be enforced? This applies to DOE and NNSA domestic and international activities.

Appendix M

CONCENTRATED BENEFIT over DIFFUSE INJURY
by John W. Gofman, M.D., Ph.D., and Egan O'Connor, November 1993

The law of Concentrated Benefit over Diffuse Injury can be stated as follows:

A small, determined group, working energetically for its own narrow interests, can almost always impose an injustice upon a vastly larger group, provided that the larger group believes that the injury is "hypothetical," or distant-in-the-future, or real-but-small relative to the real-and-large cost of preventing it.

---

1 • The Surprising Aspect of This Law

Many scholars have written about this extremely important axiom before -- it is not original with us. The fact that narrow special interests are always at work for their own benefit *at the expense of others* is not at all surprising, given human nature. And it is not surprising that the beneficiaries select what appears to be the strategy of least cost to themselves.

The surprising aspect is the failure of so many victims -- especially in peaceful democracies -- to appreciate the *aggregate* consequences which inevitably accrue, when each small injustice has such a high chance of prevailing.

---

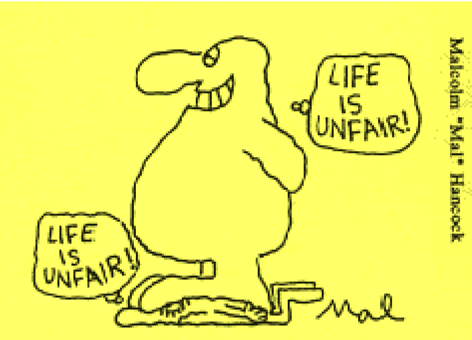
2 • The Real Scope of the Injury

We regard Concentrated Benefit as the most harmful law of all humanity. Is this correct?

The terrible feature of this law is that each incremental injustice has a very high chance of prevailing. So, even when new injuries or injustices truly are small, the aggregate abuse can accumulate to tragic proportions after the axiom of Concentrated Benefit has operated on behalf of various narrow interests again ... and again ... and again.

We often wonder at the vast abuse which the general public has failed to prevent: Tyrannies, wars, genocides, mass starvations, proliferation of nuclear weapons, intimidation by well-armed international and local thugs, corrupted democracies, corrupted markets, massive thefts via inflation, inadequate schools, unnecessary poverty, destruction of wildlife, and gross pollution, to name a few.

Why do people tolerate this severe abuse, when they so vastly outnumber the few beneficiaries?



The main explanation, in our opinion, is the operation of Concentrated Benefit over Diffuse Injury, insidiously and incessantly. By the time people think, "We're just not going to take this anymore," the costs and personal dangers of reversing the abuse have usually grown too. Moreover, there is no inherent limit to the scope and number of attempted abuses, whereas citizens have inherently limited resources to resist.

3 • Pollution Fights: What Every Activist Soon Learns

Narrow, special interests can prevail via government force, via direct force, or via deceit. Direct force is used by gangs and tyrants, but polluters achieve their aims "peacefully" by using both deceit and the force of government on their behalf.

This essay explores some strategies in the environmental movement toward the law of Concentrated Benefit -- with emphasis on the problem of pollution at *low* levels.

The axiom of Concentrated Benefit over Diffuse Injury accounts for the current promotion of a "de minimis" policy toward nuclear (and other) pollution. A de minimis policy asserts that society should not concern itself with trivia. (Latin: De minimis non curat lex. The law does not concern itself with trifles.) A de minimis policy toward *pollution* asserts that poisonous discharges and human exposures below a certain level should be treated as non-existent -- because their consequences are allegedly trivial.

Trivial. That is the essence of the axiom. Triumph for each injustice is virtually assured if the advocates succeed in presenting it as trivial.

When polluters and their agents accuse citizens who oppose them ("activists") of being Chicken Littles and hysterics and ignorant extremists, the polluters are working for a public perception that the injury is trivial.

And because the general public can not afford to do battle against *trivial* injustices, citizen activists against pollution know that their chances of prevailing are improved if they can show that the pollution constitutes a calamity for the community. Anyone who has been an activist for a year has learned how the axiom of Concentrated Benefit over Diffuse Injury "demands" proof of a calamity.

4 • The Meaning of No Safe Doses

As a result of the axiom, we receive appeals again and again from citizen-groups who need an expert to swear that nuclear pollution in their locality is (or will be) a calamity. And since we are well known for stating that human evidence proves, "There is no safe dose of radiation," it is natural that we hear from these groups.

The word "safe" means free from risk of injury. Existing human studies combined with nuclear track-analysis show that every dose of ionizing radiation confers a risk of carcinogenic injury, even at the lowest possible total dose and dose-rate (Gofman 1981, Gofman 1990). Government statements are false when they say that it is impossible to know what happens at very low doses of ionizing radiation.

Our statement that there is no safe dose of ionizing radiation does not mean that every dose -- regardless of its size -- produces the *same* amount of hazard or qualifies as a calamity. Our books show again and again that the size of a radiation risk is tied to the amount of the accumulated dose and the number of people who receive it.

"Two billion people on the planet have no electricity. But they want it -- and how they get it is going to be one of the most critical environmental issues of the next century."
● - Neville Williams, Solar Electric Light Fund (cited in 1993 by Sustainable Technologies International, Box 1115, Carbondale CO 81623).

Even after a nuclear accident as severe as Chernobyl, it is unrealistic for an irradiated population to feel, "We are all doomed," or "The children are all doomed." Although the aggregate number of Chernobyl-induced cancers will be very large -- at least a million over all time -- this will occur not because everyone in fallout areas has a *high* personal risk of cancer from Chernobyl. It will occur because there is no safe dose, and therefore the accident creates a small extra risk of cancer for *many* people (over 500 million exposed individuals, inside and outside the ex-USSR).

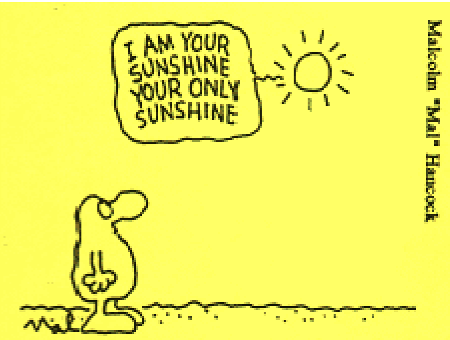
The fact that the enormous health consequences of the Chernobyl accident are diffused among so many people is what allows powerful operation of the law of Concentrated Benefit over Diffuse Injury. Governments which sponsor nuclear power can say that personal cancer-risks even from Chernobyl are small. This assurance is supposed to inactivate public resistance to "routine" levels of nuclear pollution.

---

5 ● Kiev's Children: Their Fate Was "Blowing in the Wind"

It would be much harder for people to obscure the health consequences of nuclear pollution if the wind and weather during the Chernobyl accident had happened to concentrate most of Chernobyl's fallout on Kiev, an ancient city of about two million people only some 50 miles south of the reactor-site. This could easily have happened, with a different combination of weather and a somewhat less powerful explosion (giving less altitude to the radioactive plume).

With very unlucky circumstances for Kiev, the whole-body doses from Chernobyl could have been high enough in that city to cause radiation-induced cancer sometime during the lifespan of one-third of all the young children exposed during the accident there. What sort of dose would do that? The answer is approximately 17.5 whole-body rems, average, per child (Chapter 5 in CNR's forthcoming book). Fortunately for Kiev (and for the nuclear power industry), the city was spared from such exposures, and the fallout was diffused over an enormous area inside and outside the ex-USSR.



6 • If the Sum Matters, Then Each Contribution Matters

Even when there is no safe dose of a pollutant, the individual risks and also the collective risks from a single local source of pollution or from a single release can be low -- but that does not necessarily mean that small releases of such pollutants are "born trivial."

With respect to nuclear pollution and every other type of persistent pollutant which lacks a safe dose, the following point deserves emphasis again and again:

What counts biologically is the **sum** ***of all the injuries over time from ALL the combined sources and events which release persistent poisons (radioactive or other) into the biosphere. If the*** **sum** ***matters biologically, then each contribution to the sum matters. Whoever consents to the small releases is consenting automatically to their worldwide*** **sum*****, whatever it turns out to be.***

It follows that there should be no need for citizen-activists to argue that each small source of pollution by itself, in isolation, constitutes a calamity. Unless activists object to releases of "even one molecule," their opposition to small sources is both rational and morally imperative.

7 • De Minimis Policies on a Global Scale

Suppose that the United States adopts a de minimis policy toward pollution. Then every other nation is also entitled to such a policy. A likely result:

Polluters worldwide will actually release *more* (not less) of their total poisons by the simple technique of sub-dividing them in time and space, so that the consequence of each proposed release, by itself, can be convincingly presented as "too trivial to count at all."

We can expect the total poison produced by human activity to increase a great deal as living standards rise, at least for 2 billion very poor people. Moreover, as population expands from the current 5 billion toward 10 billion people, the total quantity of poisons produced by human activity is likely to increase by a very great deal.

Legalized and non-legalized releases of even a "trivial" fraction of a growing total could still be devastating.

8 • "But Humans Are Living Longer Than Ever!"

Devastating? With regard to poisonous emissions at very low levels, claims are made that diffuse injury to humans has never been proven and therefore is probably just imaginary. Suggestions that unproven means unreal are false. Dangerously false.

Pollutants which are mutagens, for example, injure the health of *future* generations. Genetic afflictions whose cause is not identified can build up gradually, over many generations of exposure. For this and other reasons, the cause-effect relationship between certain pollutants and human health problems can be real but *never* provable.

Humans need some humility about unforeseen and unforeseeable consequences of messing with the ecosystem. In a system, by definition, everything is connected to everything else. It is said that toad populations are declining, worldwide. If true, then why? What else is occurring that we have not measured yet? What is next?

A familiar response of polluters and their defenders is that *humans* are living longer than ever.

So? Increases in human lifespan might continue right up until the ecosystem which supports us collapses (if it ever does). There are many reasons for the increase in longevity, including sanitation, pharmaceuticals, and nutrition. Perhaps we would be living even longer and in better health if it were not for pollution. Longevity and good health are not the same thing. (For example, many neurotoxins and genetic afflictions cause misery but not early death.)

With respect to debate over de minimis policies toward pollution, the song that "humans are living longer than ever" is a deceitful use of truth. Deceit is sometimes a sophisticated substitute for force used by people intending to *prevail*.

9 • The Inherent Imbalance of Forces

The fundamental law of Concentrated Benefit over Diffuse Injury always operates in favor of specific polluters, not ever in favor of the general public.

This does not mean that citizens *always* lose. For example, citizens have battled the Yucca Mountain nuclear waste repository to a current standstill. The odds against successful opposition were enormous at the outset, many years ago. But determined citizens, even without an immediate personal stake in the outcome, changed the odds little by little. We are in awe of their selfless and effective work.

On the other hand, all of us have an obligation not to let an occasional success blind us to reality. Citizens have inherently limited time and resources, whereas the number of abuses attempted upon them *has no inherent limit*. Thus, for every success, there are necessarily tens, or hundreds, or thousands of other abuses which are neglected. In addition, each success inspires well-funded campaigns by narrow, special interests to reverse the cumulative successes and -- in our field -- to cultivate the perception that people against nuclear (and other) pollution are fanatics who impose huge and unfair costs on society.

10 ■ A Win-Win Strategy -- with Limits

Correctly or not, polluters believe in a huge benefit for themselves from de minimis policies and lenient "permissible" releases. By polluters, we mean owners and employes from top to bottom in a polluting industry.

The polluters' belief in a huge benefit is the focus of action by many environmental organizations, which work to provide the polluters with an equally attractive benefit which can be achieved with less pollution. More efficient use of energy with equal or greater profits. Utility-owned solar energy instead of nuclear power. More efficient manufacturing with less waste-production and with equal or greater profits. Cost-effective recycling. No decrement in employment.

This strategy of coping with the axiom of Concentrated Benefit is sometimes truly a win-win affair. "Both sides" achieve what they want. Although CNR was a leader for some of these proposals in the early 1970s, we also must point out that an exclusive focus on the axiom's "benefit" side has limits.

"Emotional" Assertions about Human Rights

The win-win strategy tacitly assumes that the victims have the burden of creating a solution, and that the aggression (pollution) must continue if the victims can not think up and arrange an attractive substitute which pleases the aggressor. This strategy avoids "emotional" assertions about the *right* of ordinary people not to be dumped upon, not to be used in biological experimentation, and not to have the common heritage of ozone, acquifers, and remaining wildlife injured. But in the end, it may be impossible to avoid the issue of genuine human rights. An example:

When the need is to contain nearly 100% of an activity's poison, the per-unit cost of containment is usually much higher for the last 10% contained than the per-unit cost for the first 90% contained. This makes better containment inherently unattractive to polluters. The chance of cost-effective recycling for the last 10% of the poison is very low (and is non-existent for radioactive pollutants). The alternative of passing the extra containment cost along to customers is also unatttractive. Why? Because (in general) the higher the price of something, the less people will buy of it.

"What's wrong with emotion? According to Webster's Dictionary, emotion simply means a strong feeling. Of course we feel strongly or emotional when we're engaged in struggles to protect the species and life-support systems of this planet ... To be called `emotional' should not be something to run from ..."
● - Michael C. Colby (in 1993), editor, *Safe Food News*, RD 1, Box 30, Marshfield VT 05658.

In short, the hope of crafting a win-win solution on the crucial issue of ubiquitous, low-level emissions is often unrealistic. Without taking a stand on the human rights issue, what ground is there to stand on?

---

11 ● Some Morally Dubious Strategies against Pollution

In contrast with the win-win strategy, some ways of coping with the law of Concentrated Benefit are morally dubious. We are shocked whenever a major environmental group appears to concede a right to *pollute*. We quote an example from an influential group in 1991:

"The key to creating an environmentally sustainable global economy is partially to replace income taxes with environmental taxes -- taxing such environmentally destructive activities as burning fossil fuels, the use of pesticides, and the discharge of toxic wastes."

While it is true that sufficient taxation would reduce destructive activities, how does the proposal differ (in moral terms) from taxing homicide? "It's OK to commit premeditated random mayhem, provided you do less of it." Beside this, it would be difficult to create sufficient political support for punitive levels of taxation (not just lipservice). A difficult but morally better goal might be creating support for the position:

"Low-level pollution must stop because narrow special interests (polluters) have *no right* to impose trespass, experimentation, or diffuse injury upon the general public and its common property."

I've seen more people win what they wanted by informing themselves about the nature of the problem and the process that they're involved in, and then expressing their goals in terms of their feelings ... Our emotions were put into us by the evolutionary process for good reason ... I often hear government officials or corporate officials say this person is `just an hysterical housewife.' I have high regard for hysterical housewives. I think they're a very good force in American society. And I think we need more of them."

●- **Peter Montague, Ph.D., (in 1993), director of the Environmental Research Foundation, POB 5036, Annapolis MD 21403.**

A Great Big Pitfall

The taxation approach is morally similar to the provision of the Clean Air Act which establishes "emissions allowances" for sulfur-dioxide from electric power plants. Utilities which bring emissions below the required levels obtain pollution credits (issued by government) to use for expansion or to sell to other utilities. The goal is to achieve a net reduction in total emissions, and to do it at plants where reduction is most cost-effective. Fine. Nonetheless, a market in government-issued pollution-credits is a statement that pollution at certain levels is not only legal but also morally legitimate.

If "environmental taxes" and "pollution-credits" succeed in reducing pollution, then it would appear that the policies help meet our moral obligation to future generations not to pollute and not to destroy the ecosystem. It can be argued that any strategy which moves society in the right direction must be morally right.

But when environmental taxes and pollution-credits legitimize pollution, they work in *favor* of low-level pollution and de minimis policies. This is the *wrong* direction. We repeat: If the *sum* of individually small acts of pollution is what counts biologically, then no contribution to the sum is negligible.

12 ● A Worthwhile Task for All of Us

The "iron law" of Concentrated Benefit over Diffuse Injury is so powerful in every aspect of life, and some of its consequences are so abominable, that victims are sometimes driven into strategies which they find morally distasteful. Such strategies are, themselves, a type of debasement and humiliation.

We have hope that humans can develop loftier strategies. A necessary requirement is that most people *recognize* the nature of the universal law which favors injustice over justice -- even in peaceful democracies. Since this type of education so rarely comes "from the top," either grassroots activists will do it, or it will not occur. The ground for inventing good and effective strategies will be much more fertile when everyone is so aware of the axiom that it enters the folklore ... when just the two words, "Concentrated Benefit," can communicate the ages-old dilemma and the dynamics of it.

Successful solutions to the dilemma are far more likely to come from the grassroots than from prominent intellectuals who so often depend today, directly and indirectly, on approval from one special interest or another. We note that the "founding fathers" of the United States were less beholden to special interests than today's professional intellectuals. The founding fathers actually addressed the law of Concentrated Benefit.

The preamble to the United States' Constitution speaks of a government which would promote the *general* welfare, meaning that laws would benefit the population at large, not benefit small sub-sets at the expense of the general public. In the text of the Constitution, its authors tried to *limit* the areas of government activity -- limits which (if they had been honored) would have greatly reduced opportunities for narrow interests to "persuade" elected officials to operate on behalf of the narrow interests.

---

13 ● A Central Goal, an Earth-Shaking Achievement

It is hard to imagine a more beneficial achievement in human history than the future development of *generic* ways for the public to cope with the law of Concentrated Benefit over Diffuse Injury, and thus to prevent endless repetition of its many dreadful consequences (see Part 2).

Some years ago, an interviewer suggested to one of us (jwg) that it is too difficult for grassroots people to solve the *big* problems. He thought it was futile. I still answer now, as I answered then:

Of course it will be difficult to solve the big problems of humanity. But can ***you****, or I, or anyone justify directing all our efforts toward solving trivial problems -- just because the ones we all really need to face are difficult?*

# # # # #

●- We encourage you to reprint this essay in whole or in part. Permission granted.

●- John W. Gofman, M.D., Ph.D., is chairman of the Committee for Nuclear Responsibility, and Egan O'Connor is editor. Dr. Gofman is professor emeritus of Molecular and Cell Biology at the University of California, Berkeley, and author of several books on the health consequences of exposure to ionizing radiation.

Appendix N

WHY RADIOACTIVE WASTES SHOULD BE SEQUESTERED FOR THE FULL DURATION OF THEIR HAZARD: CONSIDERING THE "MACS EFFECT"

Judith Johnsrud, Ph.D.

Legal and Regulatory Background

One of the understated troublesome issues faced by all users and generators of radioactive materials, and particularly the proponents of nuclear power and nuclear weapons in their current efforts to revive those industries, is the maintaining of control over radioactive wastes. They encourage deregulation by the Nuclear Regulatory Commission (NRC) and unregulated disposal or recycling of the vast quantities of so-called "Low-level" Radioactive Wastes (LLRW).

In the United States, the federal Low-Level Radioactive Waste Policy of 1980 defined the term "disposal" as:

> The term "disposal" means the permanent isolation of low-level radioactive waste pursuant to the requirements established by the Nuclear Regulatory Commission under applicable laws, or by an agreement State of such isolation occurs in such Agreement State.

The 1980 law then states that "low-level radioactive waste" means radioactive material that –

> (A) is not high-level radioactive waste, spent nuclear fuel, or byproduct material (as defined in section 11e.2 of the Atomic Energy Act of 1954 (42 U.S.C. 201(e)(2)));

and

> (B) the Nuclear Regulatory Commission, consistent with existing law and in accordance with paragraph (A), classifies as low-level radioactive waste.

In the NRC's regulations governing LLRW disposal [10 CFR Part 61] adopted in 1982 and later modified,] the term "disposal" is defined, with more sophistication, as, "the isolation of radioactive wastes from the biosphere inhabited by man and containing his food chains by emplacement in a land disposal facility."

Waste disposal facilities were divided into Class A considered least hazardous, Classes B and C that were deemed more toxic requiring greater isolation from the environment. Thus, a wide variety of materials, radionuclides present, concentrations, and longevity of biological hazards were lumped together in these broad, "everything except," categories. A Class D category is deemed simply "Greater than Class C" and designated to be buried with highly irradiated "spent" reactor fuel and other high level wastes in a national repository.

There followed in the early 1980's much disagreement and national debate about the siting of LLRW disposal facilities and the number and contents of disposal facilities needed, with the public expressing health, safety and economic concerns that were heightened by the 1979 accident at Three Mile Island.

The costs for "disposal"--more accurately termed sequestration--have soared, as most of the initial six LLRW burial sites were found to be leaking or otherwise deemed unsafe or undesired, and were closed down in the 1970s.

In 1986, the Congress attempted to resolve this waste issue by passage of the Omnibus Low-Level Radioactive Waste Interstate Compact Consent Act. States were encouraged to form compacts for regional or other groupings of states and to select one state to host disposal of the commercial LLRW generated by the nuclear power industry and other generators from Compact member states.

Compacts were formed. Criteria for disposal sites were developed. But strong opposition to site selection soon surfaced everywhere. Of the many arguments that defeated potential locations, one of the most persuasive was the open-ended nature of the commitments. There appeared to be no conclusion to the generation of ever more radioactive wastes. Among other concerns were the continuing rise in disposal costs and uncertainties about the longevity of facility operations and responsibility for future post-closure controls. All siting attempts failed, primarily from popular opposition or, in some instances, litigation.

NRC simultaneously attempted in the late 1980s to develop regulations for release from control of certain

LLRW. They called this policy "Below Regulatory Concern" (BRC), and intended to allow release from regulation altogether of large amounts of certain low activity wastes, to be sold off and enter the marketplace for recycling into consumer products.

The levels of radioactivity remaining in the host of consumer products proposed for deregulation and recycle were presented as if they would be extremely low. The nuclear regulators and industry claimed that an individual's doses would be "too low to measure" and hence of no concern. They argued that those doses could be compared with normal naturally-occurring background radiation and therefore were to be deemed "harmless." The industry did not acknowledge that even natural background radiation has health consequences that are not trivial, resulting in a background level of “natural cancer.”

In 1990, when the NRC was preparing to adopt its BRC regulation, the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation issued its BEIR V Report. In it, the BEIR Committee recognized for the first time the Linear No-Threshold Hypothesis (LNT)--and concluded that all ionizing radiation exposures carried risk of biological damage to the recipient. The conclusion of these experts was clear: that there is no safe level of radiation dose. This conclusion was restated in the Committee’s recent BEIR VII document.

In the Energy Policy Act of 1992, the Congress revoked the NRC's BRC policy statement. But the public had begun to grasp the implications of the NRC's BRC policy. It meant that those unlabeled consumer products could include essentially any radioactive materials released from regulatory control: contaminated steel, copper, nickel, other metals, plastics, concrete, fabrics, wood, and many others. Contaminated consumer products could range from cooking pots to furniture to children's toys, zippers, jewelry, coins, belt buckles, building construction products, road beds, automobile bodies and parts, and many others. None of the slightly contaminated products would carry warning labels. Most people do not own highly sensitive radiation detection equipment. Therefore individuals would have no way to measure additional doses they were receiving–nor to determine the total extra doses received–absent any benefit to the recipient of the added dose, a violation of a basic tenet of radiation protection philosophy: First, to do no harm.

Contact by members of the public with each slightly contaminated object would result in a small exposure, probably a very small dose. But each dose would be an additive and uncounted dose to the total **multiple** exposures of that individual. The damage might be long delayed, with years or even decades passing before the delayed response appeared in the form of a cancer or leukemia, or other damage. The potential for radiation harm from multiple doses would be both **additive** and, over time, **cumulative**.

Recent advances in the field of radiation microbiology have now clearly established that alterations and injuries at the cellular, molecular, and DNA levels may occur at very low radiation doses. They include a variety of previously unanticipated effects, including but not limited to:

- Phenomena such as delayed mutational responses, whereby a cell may appear to reproduce normally with a mutation manifesting itself numerous cell generations later;
- Adaptive responses that may be genetically either positive or negative in their impacts on the exposed organism;
- Faulty cellular repair with potential subsequent adverse impacts on other organs;
- Bystander effects, with information transfer from one cell to another noncontiguous cell.

As scientific understanding of the complexities of radiation injury have advanced, questions have also arisen about the interrelationships between and among other contaminants that are routinely released into the biosystem from industrial plants and pollutants, from agricultural poisons, from herbicides, pesticides, and other substances that negatively affect recipients of exposures to one or many of these contaminants. The lessons taught by Rachel Carson and others began to be applied to the consequences of **synergies** between and among these many sources of exposures with their adverse consequences to the individual exposed. Very little research has been undertaken on these highly variable and complex biological relationships and consequences.

The Meaning of MACS: MULTIPLE, ADDITIVE, CUMULATIVE, and SYNERGISTIC impacts of our exposures to low-level radiation, chemicals and other somatic and genetic health hazards in our environment.

Of increasing concern among specialists in public health and environmental protection are the adverse impacts from repetitive undetectable low dose irradiations, both from the increasing sources of radioactive exposures that are released into the biosphere and the interactions between and among the multitude of other sources of biological damage that may be combined with increased radiation sources.

In the absence of certainty about the MACS impacts, the wise course of societal response would be the exercise of the Precautionary Principle that advises prevention in the absence of certainty about impacts. For, once either the somatic or genetic injury has occurred, the damage has been done, not only to the affected individual but also to future generations of her or his descendants, far into the future beyond just the gross genetic defects in the first two generations in the standards employed by the governmental regulators.

The present time is crucial for these issues of the MACS consequences. The demands of economic globalization are causing encouragement of trade in radioactive materials, as well as the multitudes of chemical and other contaminants in commerce. New worldwide recommendations of the International Commission on Radiological Protection (ICRP) that have just been adopted will result in relaxation of many of the dose standards, will continue the use of inappropriate "Standard (Reference) Man" as the basis for allowable radiation exposure levels for the sensitive fetus, and for rapidly growing young children, pregnant women, the elderly and others with impaired health. If the nuclear industries expand, there will be more exposures causing Multiple, Additive, Cumulative, and Synergistic injuries--MACS means damage to all.

June 1974

U.S. ATOMIC ENERGY COMMISSION

REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

REGULATORY GUIDE 1.86

TERMINATION OF OPERATING LICENSES FOR NUCLEAR REACTORS

A. INTRODUCTION

Section 50.51, "Duration of license, renewal," of 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that each license to operate a production and utilization facility be issued for a specified duration. Upon expiration of the specified period, the license may be either renewed or terminated by the Commission. Section 50.82, "Applications for termination of licenses," specifies the requirements that must be satisfied to terminate an operating license, including the requirement that the dismantlement of the facility and disposal of the component parts not be inimical to the common defense and security or to the health and safety of the public. This guide describes methods and procedures considered acceptable by the Regulatory staff for the termination of operating licenses for nuclear reactors. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

B. DISCUSSION

When a licensee decides to terminate his nuclear reactor operating license, he may, as a first step in the process, request that his operating license be amended to restrict him to possess but not operate the facility. The advantage to the licensee of converting to such a possession-only license is reduced surveillance requirements in that periodic surveillance of equipment important to the safety of reactor operation is no longer required. Once this possession-only license is issued, reactor operation is not permitted. Other activities related to cessation of operations such as unloading fuel from the reactor and placing it in storage (either onsite of offsite) may be continued.

A licensee having a possession-only license must retain, with the Part 50 license, authorization for special nuclear material (10 CFR Part 70, "Special Nuclear Material"), byproduct material (10 CFR Part 30, "Rules of General Applicability to Licensing of Byproduct Material"), and source material (10 CFR Part 40, "Licensing of Source Material"), until the fuel, radioactive components, and sources are removed from the facility. Appropriate administrative controls and facility requirements are imposed by the Part 50 license and the technical specifications to assure that proper surveillance is performed and that the reactor facility is maintained in a safe condition and not operated.

A possession-only license permits various options and procedures for decommissioning, such as mothballing, entombment, or dismantling. The requirements imposed depend on the option selected.

Section 50.82 provides that the licensee may dismantle and dispose of the component parts of a nuclear reactor in accordance with existing regulations. For research reactors and critical facilities, this has usually meant the disassembly of a reactor and its shipment offsite, sometimes to another appropriately licensed organization for further use. The site from which a reactor has been removed must be decontaminated, as necessary, and inspected by the Commission to determine whether unrestricted access can be approved. In the case of nuclear power reactors, dismantling has usually been accomplished by shipping fuel offsite, making the reactor inoperable, and disposing of some of the radioactive components.

Radioactive components may be either shipped offsite for burial at an authorized burial ground or secured on the site. Those radioactive materials remaining on the site must be isolated from the public by physical barriers or other means to prevent public access to hazardous levels of radiation. Surveillance is necessary to assure the long term integrity of the barriers. The amount of surveillance required depends upon (1) the potential hazard to the health and safety of the public from radioactive material remaining on the site and (2) the integrity of the physical barriers. Before areas may be released for unrestricted use, they must have been decontaminated or the radioactivity must have decayed to less than prescribed limits (Table I).

The hazard associated with the retired facility is evaluated by considering the amount and type of remaining contamination, the degree of confinement of the remaining radioactive materials, the physical security provided by the confinement, the susceptibility to release of radiation as a result of natural phenomena, and the duration of required surveillance.

C. REGULATORY POSITION

1. APPLICATION FOR A LICENSE TO POSSESS BUT NOT OPERATE (POSSESSION-ONLY LICENSE)

A request to amend an operating license to a possession-only license should be made to the Director of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545. The request should include the following information:

a. A description of the current status of the facility.

b. A description of measures that will be taken to prevent criticality or reactivity changes and to minimize releases of radioactivity from the facility.

c. Any proposed changes to the technical specifications that reflect the possession-only facility status and the necessary disassembly/retirement activities to be performed.

d. A safety analysis of both the activities to be accomplished and the proposed changes to the technical specifications.

e. An inventory of activated materials and their location in the facility.

2. ALTERNATIVES FOR REACTOR RETIREMENT

Four alternatives for retirement of nuclear reactor facilities are considered acceptable by the Regulatory staff. These are:

a. **Mothballing.** Mothballing of a nuclear reactor facility consists of putting the facility in a state of protective storage. In general, the facility may be left intact except that all fuel assemblies and the radioactive fluids and waste should be removed from the site. Adequate radiation monitoring, environmental surveillance, and appropriate security procedures should be established under a possession-only license to ensure that the health and safety of the public is not endangered.

b. **In-Place Entombment.** In-place entombment consists of sealing all the remaining highly radioactive or contaminated components (e.g., the pressure vessel and reactor internals) within a structure integral with the biological shield after having all fuel assemblies, radioactive fluids and wastes, and certain selected components shipped offsite. The structure should provide integrity over the period of time in which significant quantities (greater than Table I levels) of radioactivity remain with the material in the entombment. An appropriate and continuing surveillance program should be established under a possession-only license.

c. **Removal of Radioactive Components and Dismantling.** All fuel assemblies, radioactive fluids and waste, and other materials having activities above accepted unrestricted activity levels (Table I) should be removed from the site. The facility owner may then have unrestricted use of the site with no requirement for a license. If the facility owner so desires, the remainder of the reactor facility may be dismantled and all vestiges removed and disposed of.

d. **Conversion to a New Nuclear System or a Fossil Fuel System.** This alternative, which applies only to nuclear power plants, utilizes the existing turbine system with a new steam supply system. The original nuclear steam supply system should be separated from the electric generating system and disposed of in accordance with one of the previous three retirement alternatives.

3. SURVEILLANCE AND SECURITY FOR THE RETIREMENT ALTERNATIVES WHOSE FINAL STATUS REQUIRES A POSSESSION-ONLY LICENSE

A facility which has been licensed under a possession-only license may contain a significant amount of radioactivity in the form of activated and contaminated hardware and structural materials. Surveillance and commensurate security should be provided to assure that the public health and safety are not endangered.

a. Physical security to prevent inadvertent exposure of personnel should be provided by multiple locked barriers. The presence of these barriers should make it extremely difficult for an unauthorized person to gain access to areas where radiation or contamination levels exceed those specified in Regulatory Position C.4. To prevent inadvertent exposure, radiation areas above 5 mR/hr, such as near the activated primary system of a power plant, should be appropriately marked and should not be accessible except by cutting of welded closures or the disassembly and removal of substantial structures and/or shielding material. Means such as a remote-readout intrusion alarm system should be provided to indicate to designated personnel when a physical barrier is penetrated. Security personnel that provide access control to the facility may be used instead of the physical barriers and the intrusion alarm systems.

b. The physical barriers to unauthorized entrance into the facility, e.g., fences, buildings, welded doors, and access openings, should be inspected at least quarterly to assure that these barriers have not deteriorated and that locks and locking apparatus are intact.

c. A facility radiation survey should be performed at least quarterly to verify that no radioactive material is escaping or being transported through the containment barriers in the facility. Sampling should be done along the most probable path by which radioactive material such as that stored in the inner containment regions could be transported to the outer regions of the facility and ultimately to the environs.

d. An environmental radiation survey should be performed at least semiannually to verify that no signficant amounts of radiation have been released to the environment from the facility. Samples such as soil, vegetation, and water should be taken at locations for which statistical data has been established during reactor operations.

e. A site representative should be designated to be responsible for controlling authorized access into and movement within the facility.

f. Administrative procedures should be established for the notification and reporting of abnormal occurrences such as (1) the entrance of an unauthorized person or persons into the facility and (2) a significant change in the radiation or contamination levels in the facility or the offsite environment.

g. The following reports should be made:

(1) An annual report to the Director of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545, describing the results of the environmental and facility radiation surveys, the status of the facility, and an evaluation of the performance of security and surveillance measures.

(2) An abnormal occurrence report to the Regulatory Operations Regional Office by telephone within 24 hours of discovery of an abnormal occurrence. The abnormal occurrence will also be reported in the annual report described in the preceding item.

h. Records or logs relative to the following items should be kept and retained until the license is terminated, after which they may be stored with other plant records:

(1) Environmental surveys;

(2) Facility radiation surveys;

(3) Inspections of the physical barriers, and

(4) Abnormal occurrences.

4. DECONTAMINATION FOR RELEASE FOR UNRESTRICTED USE

If it is desired to terminate a license and to eliminate any further surveillance requirements, the facility should be sufficiently decontaminated to prevent risk to the public health and safety. After the decontamination is satisfactorily accomplished and the site inspected by the Commission, the Commission may authorize the license to be terminated and the facility abandoned or released for unrestricted use. The licensee should perform the decontamination using the following guidelines:

a. The licensee should make a reasonable effort to eliminate residual contamination.

b. No covering should be applied to radioactive surfaces of equipment or structures by paint, plating, or other covering material until it is known that contamination levels (determined by a survey and documented) are below the limits specified in Table I. In addition, a reasonable effort should be made (and documented) to further minimize contamination prior to any such covering.

c. The radioactivity of the interior surfaces of pipes, drain lines, or ductwork should be determined by making measurements at all traps and other appropriate access points, provided contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement should be assumed to be contaminated in excess of the permissable radiation limits.

d. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated in excess of the limits specified. This may include, but is not limited to, special circumstances such as the transfer of premises to another licensed organization that will continue to work with radioactive materials. Requests for such authorization should provide:

(1) Detailed, specific information describing the premises, equipment, scrap, and radioactive contaminants and the nature, extent, and degree of residual surface contamination.

(2) A detailed health and safety analysis indicating that the residual amounts of materials on surface areas, together with other considerations such as the prospective use of the premises, equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

e. Prior to release of the premises for unrestricted use, the licensee should make a comprehensive radiation survey establishing that contamination is within the limits specified in Table I. A survey report should be filed with the Director of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545, with a copy to the Director of the Regulatory Operations Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report should:

(1) Identify the premises;

(2) Show that reasonable effort has been made to reduce residual contamination to as low as practicable levels;

(3) Describe the scope of the survey and the general procedures followed; and

(4) State the finding of the survey in units specified in Table 1.

After review of the report, the Commission may inspect the facilities to confirm the survey prior to granting approval for abandonment.

5. REACTOR RETIREMENT PROCEDURES

As indicated in Regulatory Position C.2, several alternatives are acceptable for reactor facility retirement. If minor disassembly or "mothballing" is planned, this could be done by the existing operating and maintenance procedures under the license in effect. Any planned actions involving an unreviewed safety question or a change in the technical specifications should be reviewed and approved in accordance with the requirements of 10 CFR §50.59.

If major structural changes to radioactive components of the facility are planned, such as removal of the pressure vessel or major components of the primary system, a dismantlement plan including the information required by §50.82 should be submitted to the Commission. A dismantlement plan should be submitted for all the alternatives of Regulatory Position C.2 except mothballing. However, minor disassembly activities may still be performed in the absence of such a plan, provided they are permitted by existing operating and maintenance procedures. A dismantlement plan should include the following:

a. A description of the ultimate status of the facility

b. A description of the dismantling activities and the precautions to be taken.

c. A safety analysis of the dismantling activities including any effluents which may be released.

d. A safety analysis of the facility in its ultimate status.

Upon satisfactory review and approval of the dismantling plan, a dismantling order is issued by the Commission in accordance with §50.82. When dismantling is completed and the Commission has been notified by letter, the appropriate Regulatory Operations Regional Office inspects the facility and verifies completion in accordance with the dismantlement plan. If residual radiation levels do not exceed the values in Table I, the Commission may terminate the license. If these levels are exceeded, the licensee retains the possession-only license under which the dismantling activities have been conducted or, as an alternative, may make application to the State (if an Agreement State) for a byproduct materials license.

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDE[a]	AVERAGE[b c]	MAXIMUM[b d]	REMOVABLE[b e]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1000 dpm/100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 dpm β-γ/100 cm^2	15,000 dpm β-γ/100 cm^2	1000 dpm β-γ/100 cm^2

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

Out of Control – On Purpose: DOE's Dispersal of Radioactive Waste into Landfills and Consumer Products

Nuclear Information and Resource Service, May 2007

REFERENCES

Atomic Energy Commission

US Atomic Energy Commission , Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors." June 1974 [ML003740243], commonly called REG GUIDE 1.86

California Department of Health Services

California Department of Health Services, DECON-1, "State of California Guidelines for Decontamination of Facilities and Equipment prior to Release for Unrestricted Use." June 1977.

Department of Energy

DOE resources and reports

DOE/EM-0342, "Accelerating Cleanup: Paths to Closure," Draft, Office of Environmental Management, February 1998

DOE/EM-0362, "Accelerating Cleanup: Paths to Closure," Office of Environmental Management, June 1998

DOE/EM-0466, "From Cleanup to Stewardship, a Companion Report to Accelerating Cleanup: Paths to Closure," Office of Environmental Management, October, 1999

DOE/EM-0563, "A Report to Congress on Long-Term Stewardship," Office of Environmental Management, Office of Long-Term Stewardship, Vol. I-II; January 2001

"Closing the Circle on the Splitting of the Atom, The Environmental Legacy of Nuclear Weapons Production in the United States and What the Department of Energy is Doing About It, Office of Environmental Management, January 1995

Annual Site Environment Reports (ASERs) http://www.em.doe.gov/Pages/asers.aspx
Site specific, not all years and sites available.

Pollution Prevention Tracking and Reporting System

DOE has a P2 or Pollution Prevention program which includes recycling of "clean" materials. As discussed throughout this report, the definition of clean can vary and can, in some cases, include materials contaminated with some DOE-generated radioactivity. A database entitled *Pollution Prevention Tracking and Reporting System* provides reports of materials recycled at each site, but does not indicate details of where on site the material originated or where they went. The data base can be seen and used at
https://www.eh.doe.gov/p2/data_entry/reports/ro_recycleRpt.aspx or
https://www.hss.energy.gov/NuclearSafety/NSEP/p2/data_entry/reports/ro_recycleRpt.aspx

"Update on the Activities of the DOE Office of Environmental Guidance (EH-23) in Calendar Year 2003," DOE/EH-0384, U.S. Department of Energy, Office of Environment, Safety and Health, Office of Environment, Washington, DC 20585, 2004

Abraham Announces 2nd Major Nuclear Non-Proliferation Effort with Kazakhstan: Former Nuclear Weapons Facility to Produce Commercial Copper Beryllium; NNSA News: NA-02-13, contact Jeanne Lopatto, DOE, 202/586-4940, Lisa Cutler, NNSA, 202/586-7371, July 1, 2002.

Incomplete response to NIRS FOIA F2005-00782, dated September 7, 2006.

"Material Disposition Alternatives and Approaches Workshop, Presentations, National Center for Excellence for Metals Recycle," DOE Assets Utilization Program, Oak Ridge Operations, Knoxville, Tennessee, June 12-16, 2000.

"Authorized Release Overview: Obtaining DOE Authorized Release Limits for Property Containing Residual Radioactivity," power point presentation accessed 2/3/06 and 3/23/06 at http://www.bnl.gov/wmd/Linkable%20files/Power%20Point/Authorized%20Release%20Overview.ppt

DOE regulations

10 CFR 835 Department of Energy Occupational Radiation Protection, as amended on June 8, 2007, 72 Federal Register110: 31904/ Friday, June 8, 2007 / Rules and Regulations [Docket No. EH–RM–02–835] RIN 1901–AA95 Procedural Rules for DOE Nuclear Activities and Occupational Radiation Protection, Office of Health, Safety and Security, Department of Energy. (Changes summarized at http://hss.energy.gov/HealthSafety/WSHP/radiation/rule.html)

Draft 10 CFR 834, Radiation Protection of the Public and Environment, published in *Federal Register*, March 25, 1993 (Vol. 58, p.16268)

DOE internal orders

DOE ORDER 5400.5 2-8-90, Change 2: 1-7-93, Radiation Protection of the Public and Environment, U.S. Department of Energy Washington, D.C. January 7, 1993

DOE O 450.1, Environmental Protection Program. DOE, 2003.

DOE G 450.1-5, Implementation Guide for Integrating Pollution Prevention into Environmental Management Systems. DOE, 2005.

DOE ORDER 5820.2A Radioactive Waste Management, U.S. Department of Energy Washington, D.C. 9-26-88.

DOE guidance documents and implementation guides to internal orders

Application of DOE 5400.5 requirements for release and control of property; November 17, 1995. Department of Energy Memo from Air, Water and Radiation Division: EH-412: Wallo

DOE-STD-XXXX-YR Proposed: Guide to Good Practice for Establishing Authorized limits for the release of waste and property contaminated with residual radioactivity

DOE-STD March 1997: Application of best available technology for radioactive effluent control

DOE-STD-ALARA 1 draft: Applying the ALARA process for radiation protection of the public and environmental compliance with 10 cfr part 834 and doe 5400.5 ALARA program requirements

DOE-STDE-ALARA 2 draft April 1997: Applying the ALARA process for radiation protection of the public and environmental compliance with 10 cfr part 834 and doe 5400.5 ALARA program requirements

DOE HDBK-XXXX-97 JUNE 1997: Draft handbook for controlling release for reuse or recycle of non-real property containing residual radioactive material

DOE XXXX: Draft, Environmental Implementation guide for radiological survey procedures, February 1997

ANL/EAD/TM-92: Protocol for development of authorized release limits for concrete at US department of energy sites

ANL/EAD/TM-94: Concrete release protocol case studies for decommissioning work at the Idaho national engineering and environmental laboratory

DOE G 435.1-1 IV Implementation Guide for use with DOE M 435.1-1,7-09-99, Chapter IV Low-Level Waste Requirements.

US DOE 1997 Draft Handbook for Controlling Release for Reuse or Recycle of Property Containing Residual Radioactive Materials, Office of Environmental Management, Germantown, MD, March 1997.

DOE G 441.1-XX-XX-XX-02, Implementation Guide, Control and Release of Property with Residual Radioactive Material, for use with DOE 5400.5, *Radiation Protection of the Public and the Environment*, April 2002

DOE Memos and Directives

Memorandum 2001-001288, January 19, 2001, Managing the Release of Surplus and Scrap Materials.

Department of Energy press release: Secretarial Announcement Blocking Nickel Recycling at Oak Ridge and "prohibiting the release of all volumetrically contaminated metals" Jan. 12, 2000

Department of Energy press release: Secretarial Announcement of Suspension of Release of Materials (Metals) from DOE Facilities July 13, 2000

DOE Secretarial Memo on Release of Surplus and Scrap Materials July 13, 2000

6450-01-P: DOE Record of decision for the DOE's waste management program: Treatment and Disposal of Low-Level waste and mixed low-level waste; Amendment of the record of decision for the Nevada test site.

DOE memos: Secretarial moratorium memoranda 1999-July 2001
DOE recycle policy 2000 carbon steel
DOE use of recycling revenue for pollution prevention 1999
NRC/DOE MOU Concerning the Management of Sealed Sources

Environmental Protection Agency

EPA Background Information Document and Technical Support Documents, draft and final:
Draft Technical Support Document (TSD) (3 volumes) July 1997
Draft Cost Benefit Analysis June 1997
Final TSD 3 volumes Sept 2001

Accessible (as of May 2007) at www.epa/radiation/cleanmetals:

Technical Support Document, *Potential Recycling of Scrap Metal from Nuclear Facilities* (*Part 1*: *Radiological Assessment of Exposed Individuals),* Volumes 1-3, Anigstein, R., W.C. Thurber, J.J. Mauro, S.F. Marschke and U.H. Behling, S. Cohen and Associates, prepared for US EPA Office of Radiation and Indoor Air, Deborah Kopsick, under contract 1-W-2603-LTNX; September 2001

Radiation Protection Standards for Scrap Metal: Preliminary Cost-Benefit Analysis prepared for Radiation Protection Division, Office of Radiation and Indoor Air, US EPA under contract numbers 68-D4-0102 and 0155, June 1997

Environmental Protection Agency and Department of Energy

Reference documents compiled by EPA for DOE on radioactive release and clearance

File	Date	Subject
A	1999	Evaluation of Guidelines for Exposure to TENORM, NAS NRC-preliminary conclusions
B	1-21-99	RESRAD Recycle Computer Model Argonne National Labs
C	1998	Radiation Protection 89 European Commission Directorate, Recommends Guidelines for recycling metal from dismantling nuclear installations
D	12-98	NUREG 1640 NRC 2 Volumes SAIC Assessments of clearing equipment and materials from nuclear facilities
E	6-98	Final Draft Report on Recycling Scrap Metals from Nuclear Facilities Sensitive Industries (Cohen and Assoc for EPA)
F	6-98	Draft Report comparing EPA TSD doses to IAEA doses (Cohen &Assoc)
G	5-98	Compares Health Impacts of Recycling vs. Disposal of Radioactive Metal (Cohen and Assoc for EPA)
H	5-98	Direct Disposal in RCRA Permitted Landfill (Cohen and Assoc for EPA)
I	4-98	Draft Report – doses from personal devices such as hip replacement joints, braces and baby strollers
J	3-98	ALARA effect reducing collective impacts of recycling
K	9-97	collective low dose scenarios (SC&A)
L	9-97	Uncertainty analysis of dilution using unique geographic analysis (SC&A)
M	9-97	Models 17 RMEI steel scenarios w/ 40 radionuclides, ltg scenario, PRA
N	9-97	Assesses doses and risks from non-ferrous metals (Al, Cu, Ni, Stainless Steel, silver and gold (SC&A)
O	9-97	Doses for Alternative "Low Dose" Scenarios
P	7-97	Dose + Risk for Reuse Scenarios, estimates doses from RG 1.86 <10 mr/y
Q	3-97	Descriptions of dilution of scrap metal from n facilities, exposure scenarios, leaching of rads from slags, doses and risks to MEIs by scenario, uncertainties in recycling evaluations
R	3-97	Characterizes metal industries and inventories in US, aluminum, copper scrap, radionuclides for impact assessments, distribution during melting of Carbon steel, distribution of contaminants
S	3-97	Technical document
T	3-97	Vulnerable Industries
U	8-96	Analysis of No Action, Safestorage, Burial, Restricted Recycle, Restricted Recycling
V	8-95	cost benefits of recycling
W	8-95	Assumptions for cost benefit anlyses done in V
X	8-95	Technical support for cost benefits
Y	1987-89	Comments of NRC Advisory Committee on Nuclear Wastes and Advisory Committee on Reactor Safety on previously proposed BRC policy

Health Physics Society and American National Standards Institute

American National Standards Institute, ANSI/HPS N13.12-1999, "Surface and Volume Radioactivity Standards for Clearance." published by the Health Physics Society, August 31, 1999.

International Atomic Energy Agency, and other international resources

European Council (EC) Directive 96/29/Euratom of 13 May 1996.

EC Directive 96/29/Euratom Critique at http://www.llrc.org/regulation/subtopic/brifsept.htm

INTERNATIONAL ATOMIC ENERGY AGENCY *Exemption of Radiation Sources and Practices from Regulatory Control.* IAEA TEC DOC 401, 1987

INTERNATIONAL ATOMIC ENERGY AGENCY, *Principles for the Exemption of Radiation Sources and Practices from Regulatory Control*, Safety Series No. 89, IAEA, Vienna, 1988

INTERNATIONAL ATOMIC ENERGY AGENCY, *Application of Exemption Principles to the Recycle and Reuse of Materials from Nuclear Facilities*. IAEA Safety Series No 111P1. 1, Vienna, 1992

INTERNATIONAL ATOMIC ENERGY AGENCY publication, *Application of Exemption Principles to the Recycle and Reuse of Materials from Nuclear Facilities*, (Safety Series No. 111-P-1.1, ISBN 92-0-104992-7), 1992

INTERNATIONAL ATOMIC ENERGY AGENCY, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (jointly sponsored by FAO, IAEA, ILO, OECD/NEA, PAHO and WHO), Safety Series No. 115, IAEA, Vienna, 1996

INTERNATIONAL ATOMIC ENERGY AGENCY, *Regulations for the Safe Transport of Radioactive Material*, 1996 Edition, Safety Standards Series No. ST-1, IAEA, Vienna, 1996

INTERNATIONAL ATOMIC ENERGY AGENCY, *Clearance Levels for Radionuclides in Solid Materials, Application of Exemption Principles, Interim report for comment*, IAEA-TECDOC-855, Vienna, 1996

Proceedings of a Specialists' Meeting on Application of the concepts of Exclusion, *Exemption and Clearance: Implications for the Management of Radioactive Materials*. IAEA, Vienna, May 6-9, 1997

INTERNATIONAL ATOMIC ENERGY AGENCY, *Clearance of Materials Resulting from the Use of Radionuclides in Medicine, Industry and Research*, IAEA-TECDOC- 1000, Vienna, 1998

MARSSIM, MARSAME (DOD, DOE, EPA, NRC)

NUREG-1575 Revision 1, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, Aug. 2000 [ML003761476]
Nuclear Regulatory Commission NUREG-1575, Environmental Protection Agency EPA 402-R97-016. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, December 1997.

NUREG-1575, Supp. 1 EPA 402-R-06-002 DOE/EH-707 *Multi-Agency Radiation Survey & Assessment of Materials & Equipment Manual (MARSAME)*, Draft Report for Comment, Dec. 2006

DOD, DOE, NRC, EPA *Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSAME)* [Docket No. EPA–HQ–OAR–2006–0957] 72 Federal Register 9:1708, January 16, 2007

National Academy of Sciences

The Disposition Dilemma: Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities, Committee on Alternatives for Controlling the Release of Solid Materials from US NRC-Licensed Facilities, Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences, National Research Council, National Academy of Sciences, National Academy Press, Washington, D.C., 2002.

Improving the Regulation and Management of Low-Activity Radioactive Wastes, Committee on Improving Practices for Regulating and Managing Low-Activity Radioactive Waste, Nuclear and Radiation Studies Board, Division on Earth and Life Studies, National Research Council of the National Academies of Science, National Academies Press, Washington, D.C. 2006

Nuclear Regulatory Commission

NUREG-0518, Draft Environmental Statement concerning proposed rulemaking exemptions from licensing requirements for smelted alloys containing residual technetium-99 and low-enriched uranium. Office of Standards Development, October 1980

NUREG-1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions, Draft Report for Comment, Office of Nuclear Regulatory Research, August 1995

NUREG-1727, "NMSS Decommissioning Standard Review Plan," September 2000

NUREG 1640, Volumes 1 & 2, Radiological Assessments for Clearance of Equipment and Materials From Nuclear Facilities, June 2003

NUREG-1640 V2 Radiological Assessments for Clearance of Materials from Nuclear Facilities: Appendices A through E, Oct. 2004, [ML04309].

NUREG-1640 V3 Radiological Assessments for Clearance of Materials From Nuclear Facilities: Appendices F and G, June 2003, [ML032250706].

NUREG-1640 V4 Radiological Assessments for Clearance of Materials from Nuclear Facilities: Appendices H through O, May 2004, [ML041550973].

NRC Staff Requirements - SECY-98-028 – Regulatory Options for Setting Standards on Clearance of Materials and Equipment Having Residual Radioactivity, June 30, 1998.

NRC Staff Requirements Memo SRM -SECY-02-0133-Control of Solid Materials: Options and Recommendations for Proceeding, October 2002.

NUREG-1717 Systematic Radiological Assessment of Exemptions for Source and Byproduct Materials. June 2001.

NUREG/CR-6682 Summary and Categorization of Public Comments on the Control of Solid Materials, September 2000 [ML00375].

NUREG-1736 Draft for Comment Consolidated Guidance About Materials Licenses: Consolidated Guidance: Standards for Protection Against Radiation in 10 CFR Part 20, Sept. 2000, [ML003766447].

NUREG-1761 Draft for Comment Radiological Surveys for Controlling Release of Solid Materials July 2002, [ML022320121].

NRC-04-01-049: SC&A Contract; Inventory of Materials with very low levels of radioactivity potentially clearable from various types of facilities

NUREG/CR-5849, ORAU-92/C57 Manual for Conducting Radiological Surveys in Support of License Termination, Draft Report for Comment, J.D. Berger, Oak Ridge Associated Universities, prepared for US NRC Division of Regulatory Applications, Office of Nuclear Regulatory Research, June 1992

NUREG/CR-5512, Residual Radioactive Contamination from Decommissioning, Technical Basis for Translating Contamination Levels to Annual Total Effective Dose Equivalent, Final Report, Office of Nuclear Regulatory Research, October 1992

NRC Response to FOIA 2005-0293 regarding 10 CFR 20.2002 requests, May 11, 2006

Radiation Studies

Morgan, Karl Z., “Cancer and low level ionizing radiation” *The Bulletin of the Atomic Scientists*. September 1978.

Bertell, Rosalie, *No Immediate Danger? Prognosis for a Radioactive Earth*. Women’s Educational Press, Toronto, Ontario. 1985: 45. isbn 0-88961-092-4

Caufield, Catherine. *Multiple Exposures: Chronicles of the Radiation Age*. Harper and Row, New York. 1989: 48. isbn 0-06-015900-6.

Gofman, John and Egan O’Connor, *Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis*. Committee for Nuclear Responsibility, Inc.1990:18-16, 18-18. Isbn 0-932682-89-8.

Garloch, Karen. “Repeated low radiation doses hike leukemia risk, UNC study finds.” *The Charlotte Observer*. Wednesday, March 20, 1991

Kneale, G.W. and Alice Stewart, “Reanalysis of Hanford Data: 1944-1986 Deaths.” *American Journal of Industrial Medicine*. 23:371-389, 1993

Little, M.P. and C.R. Muirhead, “Curvilinearity in the Dose-Response Curve for Cancer in Japanese Atomic Bomb Survivors.” *Environmental Health Perspectives*.105 (6): 1505, 1997

Wright, Eric, “Chromosomal instability in the descendants of unirradiated surviving cells after alpha particle irradiation.” *Proc. Natl. Acad. Sci. USA*.95: 5730, 1998

Epidemiology:

Stewart, A.M., et al. ”Radiation Exposures of Hanford Workers Dying from Cancer and Other Causes.” *Health Physics*. Nov. 1977

Stewart, A.M, et al. “Delayed Effects of A-bomb radiation: a review of recent mortality rates and risk estimates for five-year survivors.” *Journal Epidemiology and Community Health*. 36(2):80-6, 1982

Morgenstern, H., et al. “Epidemiologic Study to Determine Possible Adverse Effects to Rocketdyne/Atomic International Workers from Exposure to Ionizing Radiation” Report by the UCLA School of Public Health, September 1997

Wing, S., et al. “Mortality Among Workers at Oak Ridge National Laboratory.” *JAMA*, 26 (11):1397, 1991

Cell studies:

Lorimore, S. A., Wright, E et. al. “Chromosomal Instability in the descendants of unirradiated surviving cells after alpha particle irradiation.”*Proc. Natl. Acad. Sci. USA*. 95: 5730-5733, 1998

Other:

European Committee on Radiation Risk--Comité Européen sur le Risque de l'Irradiation, *2003 Recommendations of the ECRR: The Health Effects of Ionising Radiation Exposure at Low Doses and Low Dose Rates for Radiation Protection Purposes: Regulators' Edition* Edited by Chris Busby with Rosalie Bertell, Inge Schmitz-Feuerhake, Molly Scott Cato and Alexei Yablokov, published on behalf of ECRR by Green Audit, Brussels, 2003. ISBN: 1 897761 24 4

Kadhim, M. A., Wright E. et al. "Transmission of chromosomal instability after plutonium alpha particle irradiation." *Nature*. 355:738, 1992

Southwest Research and Information Center, "Uranium Legacy." *The Workbook*, v8, no6. Albuquerque, NM, 1983

Morris, M. and R. Knorr, *The Southeastern Massachusetts Health Study 1978-1986-Report of the Massachusetts Department of Public Health*. October 1990. See also: Clapp R. Cobb S. et al. "Leukemia Near Massachusetts Nuclear Power Plant." Letter in *Lancet*. December 5, 1987

Wing, S. and D. Richardson et al. "A Reevaluation of Cancer Incidence Near the Three Mile Island Nuclear Power Plant: The Collision of Evidence and Assumptions." *Environmental Health Perspectives*, v 105, no 1. National Institutes of Health. Bethesda, Maryland, Jan. 1997

Hatch, M. et al. "Background Gamma Radiation and Childhood Cancers Within Ten Miles of a US Nuclear Power Plant." *International Journal of Epidemiology*, v 19, no 3. 1990.

Hudson, R.L. "Child Cancers Found to Rise Near Chernobyl." The Wall Street Journal. September 3, 1992. The article quoted was published in *Nature* on the same day and was researched by the World Health Organization.

Rupert, J. "Illness Tied to Disaster Still on Rise." The Washington Post. June 24, 1995. *The reporter was quoting Britain's Imperial Cancer Research Fund, The Ukrainian Health Ministry and the United Nations, 1995.*

Wing S. Shy C. et al. "Mortality Among Workers at Oak Ridge National Laboratory: Evidence of Radiation Effects in Follow-up Through 1984." *JAMA*, v 265 no 11, March 20, 1991

Mancuso, T.F., A. Stewart and G. Kneale "Radiation Exposures of Hanford Workers Dying From Cancer and Other Causes." *Health Physics*, v 33. Pergamon Press, Great Britain, November 1977.

Roman, E. et al. "Case-control Study of Leukemia and Non-Hodgkin's Lymphoma Among Children Aged 0-4 years Living in West Berkshire and North Hampshire Health Districts." *BMJ* 1993 #306, 1993

Sorahan, T. and P.J. Roberts, “Childhood Cancer and Paternal Exposure to Ionizing Radiation: Preliminary Findings From the Oxford Survey of Childhood Cancers.” *American Journal of Industrial Medicine*, v 23: 343-354, 1993

Kendall, G.M. et al. “Mortality and Occupational Exposure to Radiation: First Analysis of the National Registry for Radiation Workers.” *BMJ* v 304: 220-5, 1992

Viel, J.F. and D. Pobel, “Incidence of Leukaemia in Young People Around the La Hague Nuclear Waste Reprocessing Plant: A Sensitivity Analysis.” *Statistics in Medicine*, v 14: 2459-2472, 1995

Gardner et al. “Results of Case-control Study of Leukemia and Lymphoma Among Young People Near Sellafield Nuclear Plant in West Cumbria.” *BMJ* v 300, February 17, 1990

Heasman et al. “Childhood Leukemia in Northern Scotland.” *Lancet*, v 1:266, 1986

Morgenstern, H. and J. Froines, “Epidemiologic Study to Determine Possible Adverse Effects to Rocketdyne/Atomics International Workers from Exposure to Ionizing Radiation.” State of California Health and Welfare Agency, June 1997

Johnson, C.J. “Cancer Incidence in an Area of Radioactive Fallout Downwind From the Nevada Test Site.” JAMA, v 251 n 2: 231-6, January 13, 1984

Ortmeyer P., Makhijani A. “Let Them Drink Milk.” *The Bulletin of the Atomic Scientists*, Nov/Dec. 1997

Bishop, J.E. “Study Links Breast Cancer Treatment to Higher Risk of the Disease in Lungs.” *The Wall Street Journal*, May 14, 1993: B6.

Kneale, G.W. and A.M. Stewart, “Childhood Cancers in the UK and their Relation to Background Radiation” *Radiation and Health*, 1987

Nuclear Information and Resource Service radiation fact sheets at www.nirs.org/radiation

RESRAD (DOE and NRC)

RESRAD Family of Codes available online at http://web.ead.anl.gov/resrad/home2/ Environmental Assessment Division Argonne National Laboratory operated by the University of Chicago, under Contract W-31-109-Eng-38, for the United States Department of Energy.

RESRAD 5.0, 6.3
RESRAD-BUILD 3.3
RESRAD-BIOTA 1.21
RESRAD-RECYCLE 3.10

RESRAD Benchmarking Against Six Radiation Exposure Pathway Models, ANL/EAD/TM-24, Faillace, E.R., Cheng, J. J., Yu, C. Environmental Assessment Division, Argonne National Laboratory, 9700 south Cass Avenue, Argonne, Illinois, October 1994

Validation of dose Calculation Programmes for Recycling, Menon, Shankar, Brun-Yaba, Christine, Yu, Charley, Cheng, Jing-Jy, Bjerler, Jan, Williams, Alexander, Statens Stralskyddsinstitut, Swedish Radiation Protection Authority, SSI Rapport (SSI report). 2002-3

ANL/EAD-TM-50, Evaluation of Radioactive Scrap Metal Recycling, Environmental Assessment Division Argonne National Laboratory USDOE Office of Environmental Restoration, Argonne's Decision and Information Sciences Division and Reactor Engineering Division, Argonne, Illinois. Dec. 1995

ANL/EAD/LD-2, "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0, Working Draft for Comment, Argonne National Laboratory, Sept. 1993

NUREG/CR-6676 Probabilistic Dose Analysis Using Parameter Distributions Developed For RESRAD and RESRAD-BUILD Codes, July 2000 [ML003741920]

NUREG/CR-6697 Development of Probabilistic RESRAD 6.0 and RESRAD-BUILD 3.0 Computer Codes, Dec. 2000 [ML010090284]

Tennessee Department of Environmental Conservation

Tennessee State Regulations for Protection Against Radiation, TDEC Chapter SRPAR 12-2-10 Licensing and Registration.

TDEC Department of Environment and Conservation, Solid Waste Permit Status at Radiological Facilities, Memorandum of Agreement, 2006.

TDEC White Paper, Evaluation and Acceptance of Licensee Requests for the Disposal of Materials with Extremely Low Levels of Contamination in Class D Landfills, September 2006.

Research at, interviews and correspondence with Tennessee Department of Environment and Conservation Divisions of DOE Oversight, Radiological Health and Solid Waste.