SITE ASSESSMENT SUMMARIES

This chapter summarizes the results of the site assessments. Attachment B provides specific site and facility information, and Attachment C a site-by-site listing of all 155 environmental, safety and health vulnerabilities. Detailed information on sites, facilities, highly enriched uranium holdings, and vulnerabilities is provided in team reports in Volume II.

OAK RIDGE Y–12 PLANT

SITE DESCRIPTION

The Y–12 Plant in Oak Ridge, Tennessee, 40 kilometers west of Knoxville, is DOE's primary site for HEU processing and storage. The plant holds the largest quantity of HEU of any DOE site, over 189 metric tons. Twenty-six thousand containers hold 32,000 HEU items in the form of dismantled weapons parts, solutions from chemical recovery operations, canned oxides, combustibles stored in drums, and canned residues. The bulk of the HEU is in the form of metal packaged in shipping or shipping-like containers. Most containers have low-concentration HEU, approximately 100 metric tons of bulk material forms. Surplus HEU from various DOE sites is expected to be shipped to Y–12 for future processing and storage. Building 9212 is the main HEU-processing facility, and Building 9720–5 is the main HEU storage facility. Thirteen other facilities store or process HEU.

Y–12 Buildings 9212, 9995, 9204–2, 9206, and 9720–17

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

An 18-member Working Group Assessment Team (WGAT) and a 28-member Site Assessment Team (SAT) conducted the Y–12 vulnerability assessment.

Stakeholder groups that had previously expressed interest in Oak Ridge activities were notified about the on-site assessment. Two former Y–12 employees and three Tennessee Department of Environment and Conservation personnel attended several joint SAT and WGAT meetings and toured various buildings with the WGAT. A public meeting was held June 17, 1996, to discuss the assessment. An exit briefing was given to the DOE Office of Defense Programs, Oak Ridge Operations Office, Y–12 Plant management, and contractor managers on July 10, 1996. A local stakeholders exit briefing was held the following day.

SUMMARY OF VULNERABILITIES

A total of 49 ES&H vulnerabilities were identified at Y–12: 20 facility condition, 9 material/packaging, and 20 institutional. The most significant vulnerabilities, in decreasing order of priority, are:

- Incompleteness of existing safety analysis reports in identifying engineered features and controls needed for accident prevention or mitigation, changes to facility operations, or natural phenomena events. (VAF nos. Y–12–INST–WGAT–001, Y–12–INST–WGAT–002, Y–12–INST–SAT–005, Y–12–9720–12–WGAT –003)

- Conduct of operations weaknesses in areas not reactivated since stand-down. (VAF nos. Y–12–INST–SAT–009, Y–12–MULTIPLE–SAT–009, Y–12–MULTIPLE–WGAT–001)

Y–12 HEU Facilities

Building	Mission
9720–5	Warehouse Storage
9212	Chemical Recovery Operations
9206/9720–17	Chemical Recovery Operations
9215/9998	Fabrication, Dismantlement, Storage
9204–2/9204–E	Component Assembly/Disassembly, Storage
9201–5	Production/Processing
9995	Analytical Laboratory
9720–12	Combustible Residue Storage
9204–4	Quality Evaluation, Storage
9119/9983/9710–3	Offices with Approximately 200 Sources

Note: Approximately 26,000 containers of HEU material are stored in these buildings.

- Large backlog of maintenance jobs (equipment repair, roof leaks, facility lighting) and routine preventive maintenance. (VAF nos. Y–12–INST–SAT–010, Y–12–INST–WGAT–008, Y–12–MULTIPLE–WGAT–007, Y–12–MULTIPLE–SAT–002)

- Accumulations of combustible materials in process areas. (VAF no. Y–12–MULTIPLE–WGAT–006)

- Incompletely developed radiological control program. (VAF nos. Y–12–INST–SAT–004, Y–12–INST–WGAT–006)

- Leaks and spills of HEU from old storage containers and equipment. (VAF nos. Y–12–MULTIPLE–SAT–005, Y–12–MULTIPLE–WGAT–003, Y–12–9720–5–SAT–002, Y–12–9212/9206–WGAT–004, Y–12– MULTIPLE– WGAT–005)

- Large HEU backlog awaiting processing with no defined processing plan or schedule. (VAF nos. Y–12–MULTIPLE–SAT–007, Y–12–INST–WGAT–005)

- Lack of readily available information on container and material history, age, and condition. (VAF no. Y–12–INST–SAT–001)

- Potential for fires, with resulting release of HEU. (VAF nos. Y–12–EW9212–SAT–003, Y–12–CR9212–SAT–001, Y–12–MULTIPLE–SAT–011, Y–12–9206–SAT–001)

- Potential earthquake and wind failures of Building 9212. (VAF no. Y–12–9212–WGAT–002)

- Legacy contamination on roofs, loading docks, and other areas. (VAF no. Y–12–MULTIPLE–SAT–003)

FACILITY CONDITION VULNERABILITIES

FIRE VULNERABILITIES

Fire dominates all Y–12 Plant HEU accident release scenarios. Building 9720–5, the primary HEU storage facility, is a warehouse of timber frame construction. Other facilities are vulnerable to fire because of the presence of combustible materials (e.g., low-level radioactive waste, liquid organics), the absence of sprinklers and fire detectors, and the fact that some operations require the handling of finely divided pyrophoric uranium metal. From information in existing safety analyses, fire vulnerabilities were identified for Buildings 9212, 9206, 9215, 9720–5, 9720–12, 9204–2, 9204–2E, 9204–4, and 9995. For most, the estimated likelihood of fire is low or very low. However, a fire involving the accumulation of low-level radioactive combustibles at any one of several HEU facilities was given a high likelihood.

Fire vulnerabilities were also identified for the methanol brine–cooling system used in some buildings. Since methanol brine has a low flash point, a leak could increase the likelihood or consequences of fire. Combustible materials (e.g., low-level radioactive waste) stored in these buildings could allow fires to spread to areas in which HEU is stored or processed.

Combustible material present at Y–12 Building 9206

LEGACY CONTAMINATION

Buildings 9212, 9206, 9201–5, 9720–5, 9204–4, 9215, and 9995 have many internal and external contaminated areas, including docks, roofs, and equipment storage areas, with no permanent barriers between the worker and the contamination. In large internal operating spaces, workers are required to don full anticontamination clothing and sometimes respiratory protection for extended periods.

SEISMIC AND WIND VULNERABILITIES

Some Y–12 vulnerabilities involve potential damage to buildings and equipment from earthquakes, wind, and tornadoes. The Building 9212 E-Wing and B–1Wing penthouse have known structural weaknesses that make them susceptible to earthquake and wind damage. In addition, the Building 9212 filter baghouse appears susceptible to wind damage but has

not been evaluated for such events. Building 9720–12, a sheet metal storage facility, houses containers of HEU combustibles yet has never been evaluated for wind and earthquake resistance even though it appears susceptible to damage from such events. Cans and bottles containing HEU in open storage in Buildings 9212 and 9206 and in-process solutions in glass extraction columns in Building 9206 pose the threat of significant spills during earthquakes. Incomplete natural phenomena hazard evaluations for HEU facilities were identified as a sitewide institutional vulnerability.

Masonry block wall in Y–12 Building 9212 susceptible to earthquake damage

MATERIAL/PACKAGING VULNERABILITIES

Material/packaging vulnerabilities involve leaks and spills, chemical reactions (causing gas generation, excessive accumulation, rapid oxidation, or spills), and packaging deterioration, any of which cause loss of the package barrier and result in potential worker exposure. Some 26,000 containers at Y–12 contain HEU solids and liquids ranging from pure metal to very dilute waste and solutions.

SPILLS AND LEAKS

Past spills and leaks from Y–12 uranium processing and handling have resulted in significant contamination both within and on buildings and grounds. Future spills and leaks from the large quantities of in-process materials could contribute to low levels of airborne contamination or the spread of contamination within the facility. Throughout Building 9212, bottles of HEU liquids with loose, vented caps are vulnerable to spillage. The unsecured storage of cans of HEU within processing areas increases the possibility of spills.

CHEMICAL REACTIONS: FIRES, EXPLOSIONS, AND SPILLS

Several unintentional chemical reactions have occurred during past Y–12 operations. These resulted from the dissolution of reactive alloys or the ignition of pyrolysis products during the destructive distillation of organic wastes. Explosions or fires could recur unless safety procedures are carefully followed.

In Building 9212, chemical processes using oxidizing acids, organics, and flammable gases could, under certain conditions, result in unintended chemical reactions, fires, minor explosions, or spills that could breach vessels and contaminate workers. In addition, the use of natural gas creates a potential for gas accumulation and explosion. The mixing of incompatible chemicals in Building 9995 could result in chemical reactions, fires, or explosions, leading to releases of small quantities of HEU. Inadvertent storage of uranium turnings and chips in water-based coolant could result in small fires.

PACKAGING DEGRADATION

In many Y–12 facilities, in-process storage containers are degrading, tape seals are falling off, and labels are becoming unreadable. When labels become unreadable, administrative controls cannot be followed for criticality safety. Corrosion of carbon steel residue cans containing dry uranium compounds could result in localized airborne contamination. Unsealed containers and the lack of additional barriers increase the potential for worker HEU uptake and the release of airborne HEU. Furthermore, an inability to verify the integrity of inner containers in storage drums in Building 9720–5 increases the potential for worker exposures at the time the drums are opened.

Corrosion of HEU storage containers at Y–12 Building 9206

INSTITUTIONAL VULNERABILITIES

NUCLEAR CRITICALITY VULNERABILITIES

This HEU vulnerability assessment was designed to build on existing data and assessments, as directed by the Secretary in her letter of February 22, 1996. The Y–12 Working Group Assessment Team evaluated whether new criticality safety vulnerabilities existed in the light of deficiencies identified in September 1994 in Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94–4, *Deficiencies in the Criticality Safety at the Oak Ridge Y–12 Plant*. In February 1995, the Department issued an implementation plan in response to Recommendation 94–4. That plan describes near- and long-term actions that the contractor and DOE should undertake to correct Y–12 deficiencies. At the time of this HEU vulnerability assessment, the corrective actions had been identified and were in the process of implementation. Accordingly, those deficiencies were not designated as vulnerabilities in the assessment and are not addressed in this assessment report. The DOE's Office of Defense Programs and Office of Environment, Safety and Health plan to conduct further assessments of the plant's criticality safety program.

Criticality safety was assessed, however, in accordance with the HEU assessment plan for new criticality safety vulnerabilities. The assessment raised nuclear criticality concerns relative to seismic weaknesses in the Building 9720–5 High Flux Beam Reactor fuel vault, the flooding of a tube vault, and the potential earthquake-caused loss of packaging barriers for materials in racks and tanks in other buildings. Inaudibility of the criticality alarms (an administrative control barrier) was also identified as a vulnerability, and the potential loss of administrative controls for criticality due to the state of the conduct of operations program as a sitewide criticality safety vulnerability. The viability of the criticality safety program at Y–12 is the subject of future assessments, some of which are under "Task 3" of the February 1995 Implementation Plan.

HEU STORAGE VULNERABILITIES

Storage facilities at Y–12 do not meet DOE General Design Criteria (DOE 6430.1A) for new HEU storage facilities. These facilities have not been upgraded to protect the material from fire or other natural phenomena. In some cases, old production facilities have been converted for storage. The integrity of facility structures under accident conditions is questionable. Failure of these barriers could impact the workers and the environment. Over 100 metric tons of bulk materials containing quantities of HEU that cannot be disposed of are stored in forms and packaging that have to be processed for long-term storage. The funding and schedule for processing this HEU backlog have yet to be established.

At Y–12, there is no adequate and readily available information about packaging configurations within some storage containers, the chemical characteristics of HEU residue and scrap, the number and physical characteristics of items within containers, physical characteristics of storage containers and their location by vault or room number, or the physical condition of each container. These conditions increase the potential for worker exposure, and prevent effective prioritization of the repackaging and processing of the HEU backlog that will be required when operations are resumed.

Corroded drums on aluminum pallets at Y–12 Building 9206

CONDUCT OF OPERATIONS WEAKNESSES

Weaknesses in conduct of operations at the plant have contributed to many vulnerabilities: the degradation of barriers against nuclear criticality, the spread of contamination, ineffective control of combustibles, the neglect of independent checks in the lockout/tagout program, and worker training deficiencies. Conduct of operations weaknesses initially identified during a DNFSB technical review in September 1994 led to the suspension of Y–12 operations. High standards of conduct of operations are essential to ensuring that administrative barriers contained in procedures, criticality safety documents, and postings are kept current and thus that operations can be conducted safely.

AUTHORIZATION BASIS DEFICIENCIES

Current Y–12 safety analysis documents do not identify all engineered features and controls (barriers) essential to the prevention or mitigation of accidents. The absence of comprehensive, up-to-date hazard analyses means that the existing change control program for facility operations and configurations and the unreviewed safety question (USQ) process cannot ensure adequate facility safety bases.

The authorization bases for Y–12 Plant HEU facilities consist of safety analysis reports and preliminary hazard screening analyses developed in the early 1980s and 1990s, respectively. The analyses were qualitative; few structures, systems, or components were identified as safety class or safety significant. As a result, the administrative control barriers (i.e., operational safety requirements) do not include all systems necessary to protect workers in the facility or in adjacent buildings, and may not provide all of the administrative controls necessary to prevent or mitigate accidents. There are no administrative limits on material quantities and combustible loadings within rooms or buildings. The lack of controls

necessary to ensure that systems are being kept fully operable jeopardizes barriers relied on to separate HEU from workers, the public, and the environment.

Facility changes at Y–12 are not always reflected in safety documentation. Similarly, many USQ evaluations performed to support new storage activities contain only qualitative evaluations of risks and no analysis of the potential for increased consequences given increases in materials at risk or changes in material form.

RADIOLOGICAL CONTROL VULNERABILITY

The current Y–12 radiological control program is not yet sufficiently developed to ensure that worker exposures are minimized.

MAINTENANCE VULNERABILITIES

A large backlog of maintenance items exists at Y–12. Recurring roof leaks and inadequate lighting in some facilities increase the potential for the spread of radioactive material or worker injury. In addition, the lack of an equipment preservation plan will prolong startup from the current facility stand-down.

Maintenance crucial to the resumption of HEU operations has not been identified, and requests for such maintenance could add considerably to the current backlog of some 18,000 requests.

Oil leakage from poorly maintained equipment in Y–12 Building 9212

INSUFFICIENT TRAINING, QUALIFICATIONS, AND EXPERIENCE

The Y–12 Plant is in the process of developing a comprehensive training program that entails identifying personnel needs and designing training in process knowledge, the facility safety basis, nuclear criticality safety, and ES&H issues. It has yet to fully implement DOE 5480.20A across all organizational units. Many experienced operational personnel have been lost through downsizing, retirement, and relocation. These losses of personnel have weakened the emergency management program and resulted in a vulnerability.

INCOMPLETE NATURAL PHENOMENA EVALUATIONS

Safety equipment and piping, storage configurations, and non–load-bearing structures (e.g., internal walls, stairwells, add-on vaults, filter baghouses) have not been seismically evaluated. This is also true for most HEU open-storage configurations. Potential sitewide effects of winds and earthquakes, such as the ability to manually fight earthquake-caused fires in multiple facilities, have not been evaluated. Most Y-12 Plant HEU facilities were designed 40 to 50 years ago. Thorough, modern natural phenomena hazard reviews have not been completed. Although three Y–12 facilities have recently undergone detailed earthquake and wind evaluations, these were limited to determining whether the buildings would or would not collapse.

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

SITE DESCRIPTION

The Rocky Flats Environmental Technology Site is in Colorado, 26 kilometers northwest of Denver. Its original mission was the manufacture of nuclear weapons components and the recovery and purification of plutonium scrap/residues for reuse. Its current mission is the interim storage of uranium and plutonium; facility deactivation, decontamination, and decommissioning; and environmental restoration. Rocky Flats has 6.7 metric tons of HEU on-site. This HEU is in five basic forms—weapons components, metals, oxides, solutions, and scrap/residues—stored in nine facilities. There are 3,206 HEU items in various packaging configurations, including plastic bags, polyethylene bottles, tanks, metal cans, and drums. Of these items, 1,221 were addressed in the previous plutonium vulnerability assessment, so they were not included in this study. Significant amounts of plutonium, transuranic, and mixed wastes are stored in the same facilities as HEU.

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

A 14-member WGAT and a 10-member SAT conducted the RFETS vulnerability assessment. A press release on the pending WGAT visit was issued by the DOE Rocky Flats Operations Office on May 31, 1996. The in-briefing was on June 4, 1996; the exit briefing, June 13, 1996. Public participation, comments, and questions were solicited. In addition, 41 direct mailings were made to potentially interested stakeholders. A member of the RFETS Citizens Advisory Board toured Building 886 to gain firsthand knowledge of some of the vulnerabilities.

RFETS HEU Items

Item Type	Buildings 371	559	707	771	776/777	779	881	886	991	Total
Metal	35	1	587	8	1,141				10	1,782
Oxide	21		8	4	3	2		1	30	69
Residue	29		10	3	10		2		1	55
Solutions	5	4		27		3		8		47
Standards, Sources	10			7	2		10	1	2	32
Items Previously Covered in Plutonium Vulnerability Assessment	668		8	114	411	20				1,221
Total										3,206

SUMMARY OF VULNERABILITIES

In December 1989, the Secretary of Energy curtailed plutonium operations at Rocky Flats. Subsequently, HEU operations were also shut down and a large inventory of HEU, in various forms, was placed in interim storage. Since long-term storage was not expected, there were no formal plans for the safe and orderly shutdown of operations. As a result, HEU materials are being stored without appropriate packaging and labeling in facilities not suited for extended storage. Nuclear criticality safety vulnerabilities were identified in several facilities. Fissile material storage areas are not adequately labeled or lack labeling of specific storage location limits or mass loadings. Until action is taken to identify these HEU materials, a potential for nuclear criticality accidents exists.

A total of 28 Rocky Flats vulnerabilities were identified: 11 facility condition, 5 material/packaging, and 12 institutional. The most significant vulnerabilities, in descending order of priority, are:

- Incomplete implementation of nuclear criticality safety controls for Buildings 707 and 776/777, and insufficient information to verify that stored HEU is within nuclear criticality safety limits. (VAF no. RFETS–MULTIPLE–WGAT–007)

- Collocation in Building 771 of HEU materials and tanks (and associated piping) containing a high-concentration plutonium solution capable of generating hydrogen gas beyond the lower explosive limit. (VAF no. RFETS–771–WGAT–004)

- No preventive maintenance for the past 7 years on eight tanks in Building 886 containing concentrated HEU nitrate solutions, and no inspection of the Raschig Rings in these tanks for many years. (VAF no. RFETS–886–WGAT–004)

- Fire protection program weaknesses in all site buildings. (VAF no. RFETS–MULTIPLE–WGAT–004)

- Potential for earthquake-caused nuclear criticality in the Building 707 H-Vault. (VAF no. RFETS–707–WGAT–001)

- Collocation of 150 drums of uncharacterized waste material with 2 drums containing HEU residues in a Building 881 vault. (VAF no. RFETS–881–WGAT–001)

- Significant amounts of combustible materials in the Main Fan Room of Building 771, presenting an increased fire hazard and a potential for release of plutonium and HEU holdup. (VAF no. RFETS–771–WGAT–002)

FACILITY CONDITION VULNERABILITIES

FIRE AND EXPLOSION VULNERABILITIES

In Building 771, radiolytic hydrogen buildup exceeding the lower explosive limit was detected in four tanks of a high-concentration plutonium solution. The tanks contain 461 grams of plutonium in 779 liters of solution, and are collocated with tanks containing HEU nitrate solutions. The four plutonium tanks and many others have been or are in the process of being purged of hydrogen gas and are then purged continuously to eliminate immediate explosive hazards. However, human error or equipment failures during purging or sampling could result in hydrogen buildup. This vulnerability involves a fire or explosion, resulting in internal facility damage, as well as releases of HEU and collocated plutonium.

Fire protection program vulnerabilities, including inadequate control of combustibles, excessive combustible loadings, overdue updates of fire hazard analyses, excessive system impairments, egress path obstructions, and inadequate emergency lighting, were identified in Buildings 371, 707, 771, 776/777, 779, 883, and 886.

In Building 771, the Main Fan Room (Room 283) contains significant amounts of combustible materials. If these materials are ignited, fire might overwhelm the fire sprinkler system, leading to a loss of ventilation, the dispersion of particulates from filters, and fire spreading to material control areas or the environment.

Although Room 101 of Building 886 contains significant amounts of combustible materials, it has no sprinklers because of nuclear criticality concerns. Fire could destroy the walk-in containment booth and the plastic piping containing HEU in solution. Nuclear criticality is possible. A fire could also spread

Combustible materials in RFETS Building 886

to Room 103, resulting in collapse of the steel deck ceiling and the rupture of storage tanks.

In Buildings 371 and 771, sprinkler systems for the heating, ventilation, and air conditioning (HVAC) plenums have pressure and flow control valves to limit the volume of water introduced into the plenums. These valves, which should be kept locked to prevent mispositioning, were found unlocked in Buildings 371 and 771. This could prevent firewater flow when needed or cause water carrying fissile material to be directed into collection tanks of unsafe geometry, resulting in nuclear criticality. Although the tanks are currently filled with Raschig Rings, the rings have not been inspected and certified.

VENTILATION AND FILTER VULNERABILITIES

In Building 883, negative pressure and balanced airflow cannot always be maintained because of building structural modifications and additions. Potential contamination releases from the facility are possible. The amount of uranium holdup is unknown but is believed to be less than 1 kilogram. The HEPA filters were last tested in 1984.

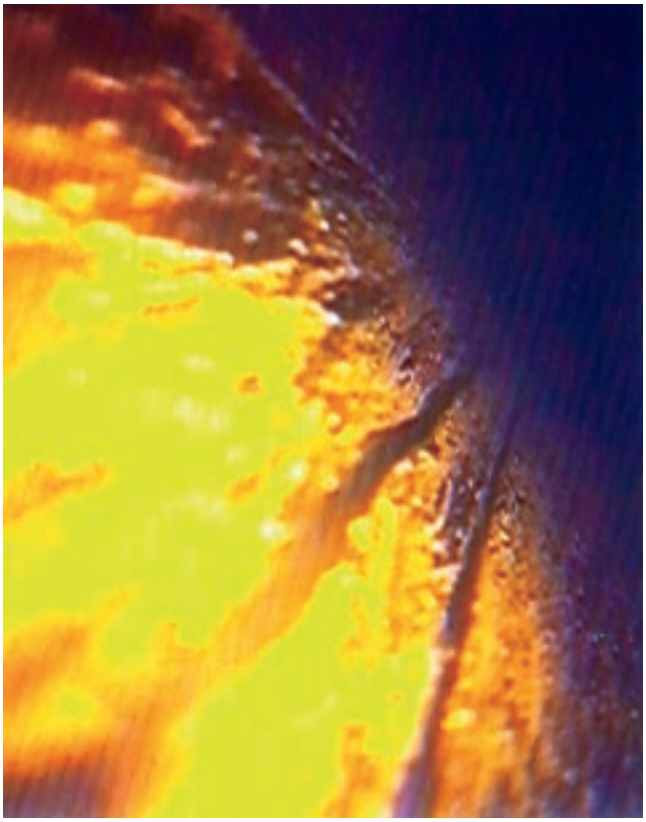
Radiological releases from various sources within Building 881 are possible during fires and other natural phenomena hazard events. Also, the exhaust HEPA filters have not been dioctylphthlate tested since 1987, so their effectiveness is in doubt, and undetected leakage paths may also exist.

SEISMIC VULNERABILITIES

In a vault in Building 707, shelves holding HEU have engineered seismic restraints to prevent hemishells from falling into a critical array. However, nuclear criticality safety limits allow for the storage of pieces smaller than hemishells, which would not be restrained during earthquakes. This scenario was not considered in the nuclear criticality safety evaluation. As noted in the plutonium vulnerability assessment, none of the buildings at RFETS are qualified to modern earthquake and wind criteria.

HOLDUP

Radiological surveys of accessible pipes and ducts in Building 886 disclosed approximately 3 kilograms of HEU in Room 101 and in the piping and transfer lines between Rooms 101 and 103. This is a potential nuclear criticality or exposure hazard. An estimated 212 grams of HEU holdup is contained in building exhaust ducts and in the duct between Building 886 and the tunnel to Building 875. Duct holdup is a contamination hazard.



Uranyl nitrate crystals adhered to internal walls of ducting in RFETS Building 886 (magnified 100 times)

There could be as much as 5 kilograms of HEU holdup in the process piping and ventilation ductwork of Building 881, some of which could be released during a fire or natural phenomena hazard event. The building is not qualified to withstand these events.

MATERIAL/PACKAGING VULNERABILITIES

LABELING AND NUCLEAR CRITICALITY VULNERABILITIES

Buildings 707 and 776/777 contain approximately 1,200 items for which nuclear criticality safety controls are deficient. Rocky Flats uses mass limits to preclude accidental nuclear criticality,

an approach that has proven effective throughout the industry. However, control of the mass on shelves in Building 707 is difficult, as the packages of individual parts are not labeled as to mass. To get information about the mass at a given location, an individual must record each part number (13 characters) and then type that number into the secure data system. Building 776/777 personnel with access to HEU material were found to be unaware that the net fissile mass is not marked on packages.

Containers of HEU are mislabeled as "Pu" or "Pu weight." In some cases, there is conflicting information on a single label; in others, the indicated nuclear criticality limit assumes plutonium weight for conservatism. Unlabeled containers were also observed. Information in the field is insufficient to determine if stored HEU is within nuclear criticality limits, and the system for making such determinations is vulnerable to human error. Administrative controls on mass limits have not been formally implemented.

In Building 881, approximately 150 drums containing unidentified materials are stored within a vault together with 2 drums known to contain HEU. Facility management believes that HEU is present in small amounts in the 150 drums, but this could not be validated by measurement. A fire sprinkler in the vault provides the potential for flooding and accidental nuclear criticality.

Drums of unknown material in RFETS Building 881

SOLUTION VULNERABILITIES

In Building 886, 2,700 liters of nitric acid solution containing 569 kilograms of HEU are being stored in eight tanks filled with Raschig Rings. No preventive maintenance has been performed on the tanks and associated equipment within the last 7 years. The Raschig Rings have not been inspected or tested in many years, but credit is taken for their effectiveness in preventing nuclear criticality.

In Building 771, 10 plastic bottles of plutonium and HEU nitrate solutions are stored in a drum. This form of storage is not stable for the long term due to the radiolytic reaction of plastic. Container failure could result in leakage of the plutonium and HEU solutions within the drum.

METAL VULNERABILITIES

Numerous HEU metal parts contaminated with trace quantities of plutonium are stored in plastic bags on shelves in Building 776/777. Detectable discoloration and distortion of the inner bags are the likely results of radiolysis between the plutonium and the plastics. Further bag degradation poses a threat to workers.

INSTITUTIONAL VULNERABILITIES

NUCLEAR CRITICALITY SAFETY CONTROL VULNERABILITIES

Weaknesses in nuclear criticality safety control were identified in Buildings 707, 776/777, and 881. The nuclear criticality safety group lacks funding for inspections, reviews, and support. Also, a lack of criticality safety responsibility by operations managers results in inadequate support and prevents effective oversight. There are currently 86 open nuclear criticality safety infractions. Corrective actions are typically inappropriate and untimely, and communication between operations and nuclear criticality safety personnel is poor. The lack of classified computing capability and access to classified documents by the nuclear criticality safety group is another example of the low priority accorded nuclear criticality safety.

MANAGEMENT WEAKNESSES

The assessment teams identified weaknesses in Rocky Flats management and integration (M&I) contract implementation directly affecting HEU vulnerabilities. Operating and emergency procedures refer to organizations that either no longer exist or are duplicates. Organizational duplication creates confusion among facility managers and operators as to safety responsibility. Facility managers and shift supervisors are unaware of who is responsible for special nuclear material, hazardous material control, or inventory information. Poor communications were cited by many managers. Safety-related performance measures are not integrated between DOE, the M&I contractor, and the operations subcontractors. This leads to misdirected or conflicting safety priorities.

During WGAT walkdowns of Buildings 776/777, 881, and 991, operating personnel were unable to completely identify HEU storage locations, material forms (e.g., pyrophoric), approximate numbers of containers, or HEU mass. There was also confusion regarding responsibility for nuclear materials storage.

As a result of layoffs and low worker morale, unsafe conditions remain unremediated in Buildings 371, 771, 776/777, and 886. Poor housekeeping, excessive combustible loadings, and hampered emergency egress were observed. Moreover, layoffs are jeopardizing efforts by the nuclear criticality safety and maintenance groups to meet operational commitments. There is currently a backlog of 3,326 corrective maintenance actions and 1,564 preventive maintenance actions.

AUTHORIZATION BASIS VULNERABILITIES

Authorization basis documentation for Buildings 371, 771, 776/777, 881, and 991 does not address current hazards, operations, or HEU storage and handling; thus, potential consequences to workers have not been analyzed. Currently, Buildings 771, 776/777, and 991 operate without an updated final safety analysis report or approved Basis for Interim Operation. A draft safety analysis report for Building 881 was completed in 1979 but was never approved or upgraded to address current hazards or conditions.

REQUIREMENTS CONFLICT

Health physics barriers compromise egress from Buildings 371 and 771. Health physics ropes are strongly tied—not taped or loosely held—across exterior emergency exits, and thus pose injury hazards to workers. Safeguards barriers in Building 886 block emergency egress from the facility.

FIRE SYSTEM MAINTENANCE BACKLOG

In addition to the fire program weaknesses discussed above as facility condition vulnerabilities, the WGAT noted that a low funding priority for fire safety improvements has resulted in 88 backlogged fire system corrective maintenance actions.

LOS ALAMOS NATIONAL LABORATORY

SITE DESCRIPTION

Los Alamos National Laboratory is located on a mesa in Los Alamos, New Mexico. It was established in 1943 as a nuclear weapons laboratory. Since then, its mission has grown from nuclear weapons design, development, and testing and stockpile stewardship to include energy, biomedical, environmental, physical, and nonproliferation research. The laboratory has approximately 3.2 metric tons of HEU within the scope of this assessment. This material is in various physical and chemical forms, including pure metal, fabricated weapons shapes, and compounds. Over 3,000 individual items, with various uranium enrichments, are packaged in approximately 450 categories at 13 separate facilities. The majority of the laboratory's HEU holdings are in three Technical Areas: TA–18, the Los Alamos Critical Experiments Facility; TA–55, the Plutonium Facility; and TA–3/SM–29, the CMR Building.

Activities at TA–18 include critical experiments design, construction, research and development, and application. Highly enriched uranium is used for nuclear criticality experiments in three "kivas" (aboveground concrete structures). It is stored in various forms in kivas, a source shed, and a hillside vault. The purpose of TA–55 is basic special nuclear material research in support of national defense and energy program requirements. The TA–55 complex has several buildings dedicated primarily to plutonium recovery and processing that contain HEU in gloveboxes and vaults. The CMR Building houses analytical chemistry, plutonium metallurgy, uranium metallurgy, uranium chemistry, and engineering design facilities. Its HEU is located primarily in a vault and in facility gloveboxes.

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

A 23-member SAT and a 5-member WGAT conducted the LANL vulnerability assessment. The SAT initially identified 47 potential vulnerabilities. The WGAT visited the site from June 13 to June 21, 1996, and walked down three facilities. Vulnerabilities identified by the SAT were subsequently regrouped into 12, most involving two or more facilities. The WGAT validated these vulnerabilities and identified 7 additional ones.

Local stakeholders were invited to participate in the assessment, but because of the small quantity of HEU at the laboratory, no formal stakeholder briefings were held.

LANL TA–18 Criticality Experiments Facility

SUMMARY OF VULNERABILITIES

A total of 19 LANL vulnerabilities were identified: 14 facility condition, 2 material/packaging, and 3 institutional. The most significant vulnerabilities, in descending order of priority, are:

- No HEPA filtration in the exhaust stack for the TA–18 Hillside Vault, where U-233 is stored. (VAF no. LANL–TA–18–WGAT–002)
- Potential explosion hazard from a natural gas line to the TA–18 Kiva storage vault heater. (VAF no. LANL–TA–18–WGAT–001)
- Potential on-site transportation accidents and material-handling problems. (VAF no. LANL–MULTIPLE–SAT–012)
- Potential glovebox pressurization and failure from clogged HEPA filters. (VAF no. LANL–MULTIPLE–SAT–004)
- Unknown internal material packaging and possible radiolysis effects for U-233 containers. (VAF no. LANL–MULTIPLE–SAT–005).
- Unnecessary worker exposure due to safeguards verification requirements. (VAF no. LANL–MULTIPLE–SAT–003)
- Cross-contamination of work areas. (VAF no. LANL–MULTIPLE–SAT–010)
- Potential explosions in several laboratories from flammable gases. (VAF no. LANL–MULTIPLE–SAT–008)
- Potential earthquake failures of internal structures and safety systems in the CMR Building. (VAF no. LANL–CMR–SAT–001)

FACILITY CONDITION VULNERABILITIES

FILTRATION VULNERABILITIES

At TA–18, the Hillside Vault exhaust stack has no HEPA filters. A fire or earthquake could release U-233 in the vault, and unfiltered contamination could be spread to the outside environment.

If HEPA filters in gloveboxes at the CMR Building and TA-48–1 became clogged, the gloveboxes could pressurize. A weak point in a glove, gasket, or feed-through connection could allow contamination to escape into the laboratory, resulting in facility and worker contamination.

FIRE AND EXPLOSION VULNERABILITIES

The CMR Building, TA–55, and TA–48–1 are vulnerable to gas explosions. Explosions in a laboratory could result from accidents involving flammable gases maintained in cylinders under high pressure. Gas cylinders are often used and stored inside the laboratory buildings. Explosions in a glovebox could be caused by chemical reaction, or by the ignition of materials such as hydrogen, nitrated cellulose, and organic vapors. Cotton rags used to clean up nitric acid spills could be converted to nitrocellulose. Hydrogen is often released from chemical reactions in test equipment. Organic solvents are frequently used in the laboratories. Glovebox ignition sources such as furnaces and spark-generating equipment must be carefully controlled. Any breakdown resulting in a spark source could lead to an explosion. Another explosive hazard at TA–18 is the natural gas supply line to the Kiva 1 storage vault heater. Damage to or leakage from the gas line could lead to fire or explosion with subsequent facility contamination and releases to the environment.

Natural gas supply line to LANL TA–18 Kiva 1

The underground TA–55 fire suppression supply line is uncoated and has no cathodic protection. Over the past 7 years, there have been 27 repairs of leaks in the line. Loss of fire suppression capability due to a main break could lead to various fire/HEU release scenarios.

SEISMIC VULNERABILITIES

The CMR Building was designed to outdated seismic criteria. Under current earthquake evaluation loads, the complete structure might suffer significant damage, fire, and the opening of various pathways for material release from gloveboxes. Earthquakes could also cause fires through the mixing of chemicals and other accelerants, and seismic damage of fire protection systems could allow such fires to spread.

MATERIAL/PACKAGING VULNERABILITIES

HANDLING ACCIDENTS

Storage vault inventories of fissile materials are conducted at LANL semiannually, and fissile material is constantly being moved at various facilities during inventory operations. Materials are also moved between the storage and operations areas of TA–18. Given a breach of administrative controls or safe-handling practices during material-handling operations, containers could be dropped and the cladding, coating, or containment ruptured. This could lead to the release of HEU within a facility and possibly to the environment.

UNKNOWN PACKAGING

Containers holding U-233 at TA–18, TA–55, TA–53–823, and the CMR Building have internal packaging of unknown composition. Pressurization of a container could be caused by the buildup of radiolysis products, chemical reactions, or changes in temperature. Such pressurization could result in the breach of a container that has deteriorated over the years.

INSTITUTIONAL VULNERABILITIES

REQUIREMENTS CONFLICT

At TA–18, TA–55, and the CMR Building, special nuclear material safeguards and verification requirements cause workers to spend excessive time in large storage vaults, resulting in significant annual doses. Strategies for radiation shielding, remote operations, and improvement of safeguards inventory regulation could substantially reduce the workers' annual dose.

CROSS-CONTAMINATION

Contamination of personal protective clothing going undetected through several monitoring stations could spread contamination to other areas, as it has in the past. Movement of contaminated equipment from one location to another could have the same effect.

MAINTENANCE BACKLOG

Support systems for TA–55 and CMR Building facilities have exceeded their life expectancy. At TA–55 alone there are 365 outstanding work orders.

PORTSMOUTH GASEOUS DIFFUSION PLANT

SITE DESCRIPTION

The Portsmouth Gaseous Diffusion Plant is located on a Federal reservation 112 kilometers south of Columbus, Ohio. Historically, the plant enriched uranium for Government programs and commercial nuclear power plants at levels ranging from a few percent to almost 100 percent uranium 235. In 1991, production of HEU was terminated, and the plant mission changed to uranium enrichment for commercial reactors. The Energy Policy Act of 1992 transferred responsibility for Portsmouth from DOE to a newly created entity, the United States Enrichment Corporation (USEC). The enrichment facilities are leased from DOE by USEC.

Approximately 22 metric tons of HEU in various physical and chemical forms, mainly solids, reside at Portsmouth. Significant quantities of HEU also remain as holdup or deposits inside process equipment no longer used for processing. Some 3,148 individual items were covered in the assessment. Over 98 percent of the Portsmouth HEU inventory is in Building X–345 in the forms of uranium hexafluoride, oxides, process residues, and holdup.

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

A 15-member WGAT and an 8-member SAT conducted the Portsmouth vulnerability assessment. Stakeholder representatives attended the public meeting and were given the opportunity to comment on SAT and WGAT preliminary results.

SUMMARY OF VULNERABILITIES

A total of 16 Portsmouth HEU vulnerabilities were identified: 11 facility condition, 4 material/packaging, and 1 institutional. The most significant vulnerabilities, in order of decreasing priority, are:

- Spread of contamination due to rainwater inleakage. (VAF nos. Portsmouth–X–705E–SAT–006 and Portsmouth–X–774–G–SAT–003)

Portsmouth HEU Inventory

Facility	Percent of Total	Physical Form
X–345	98.6	UF_6, Oxides, Process Residues, Holdup
X–744–G	~ 0.04	Process Residues
X–326A	Negligible	Process Residues
X–326	1.3	Holdup
X–326 L-Cage	Negligible	Process Residues
X–705	Negligible	UF_6, Oxides, Process Residues, Holdup
X–705–E	~ 0.04	Holdup
X–710	~ 0.01	Lab Samples in Various Forms

Portsmouth HEU Holdings

Total HEU	22 metric tons
Total No. of Packages	3,148
Package Configurations (Primary)	6
Basic HEU Forms	6
Principal HEU Facilities	8

- Breaching, from mishandling, of metal canisters of uranyl fluoride absorbed on alumina trap material that have been degraded by corrosion due to moisture and hydrogen fluoride. (VAF no. Portsmouth–X–774–G/X–345–SAT–002)

- Breaching, from mishandling, of unsealed metal canisters of HEU oxide. (VAF no. Portsmouth–X–345–WGAT–007)

- Spread of contamination from fire and activation of the fire suppression system for Building X-744-G. (VAF no. Portsmouth–X–774–G–WGAT–002)

- On-site transportation accident involving canisters carried in the bed of a pickup truck. (VAF no. Portsmouth–MULTIPLE–WGAT–006)

FACILITY CONDITION VULNERABILITIES

CONTAMINATION

Gaps in doorways, roll-up doors, and walls in Building X–744–G could allow rainwater to enter. Water could spread existing HEU contamination, resulting in worker exposures and releases to the environment.

The spread of HEU contamination in the X–705E Area due to rain or surface water inleakage is possible due to gaps around doorways and roll-up doors. Inleakage could spread existing contamination to other areas inside or outside the facility.

FIRE VULNERABILITY

Building X–744–G is the interim storage site for spent alumina trap material, some of which is loaded with HEU. The buildup of combustible trash and the lack of annual fire inspections create the possibility for fires and a subsequent spread of contamination.

TRANSPORTATION ACCIDENTS

Alumina trap material with absorbed uranyl fluoride is shipped locally in the bed of a modified pickup truck. Vehicular accidents could damage the canisters holding the trap material and spread contamination on-site.

Truck transport of HEU canisters at Portsmouth

MATERIAL/PACKAGING VULNERABILITIES

Metal canisters containing uranyl fluoride absorbed on alumina trap material in Building X–744–G and X–345 are susceptible to corrosion. Corrosion results from the inleakage of moisture and the internal generation of hydrogen fluoride gas from trace amounts of uranium hexafluoride reacting with water of hydration contained with the alumina. Hydrogen fluoride also embrittles plastic inner liners. Dropping a container could lead to a breach of packaging, resulting in the spread of contamination to workers and the buildings.

In Building X–345, some metal HEU oxide storage containers have been opened and not resealed with a new lid. Material could be released if the can were dropped and plastic bags enclosing the canister and inner liner damaged.

Floor mount array of typical canisters containing enriched uranium, including HEU, in Portsmouth Building X–744–G

IDAHO NATIONAL ENGINEERING LABORATORY

SITE DESCRIPTION

The Idaho National Engineering Laboratory is located on a 2,278-square-kilometer site 48 kilometers west of Idaho Falls, Idaho. Its original mission was to test nuclear reactor prototypes, recover HEU from spent fuel, and then return the HEU to the stockpile. The mission has shifted to the interim storage of HEU, facility decontamination and decommissioning, and environmental restoration.

Several metric tons of HEU are present, mostly in the form of oxides, unirradiated and irradiated reactor fuel elements, residues, sources, and unirradiated and irradiated U-233 reactor fuel in waste forms. Most of the HEU and U-233 is being stored pending a final decision on disposition. It is in 2,800 packages (metal cans, drums, bottles, and plastic bags) in various packaging configurations. A significant amount of low-level transuranic and mixed waste is collocated with the U-233. The spent nuclear fuel vulnerability assessment addressed the irradiated reactor fuel elements stored in various INEL facilities and the majority of facility vulnerabilities.

Sixteen INEL facilities with HEU holdings were evaluated, including facilities with spent nuclear fuel that had been received since the spent nuclear fuel vulnerability assessment was completed.

INEL HEU Items

Metal	653
Oxide	64
Standards, Sources	100
Solutions	31
Reactor Fuel	1,669
U-233 Drums	215
Residues	65

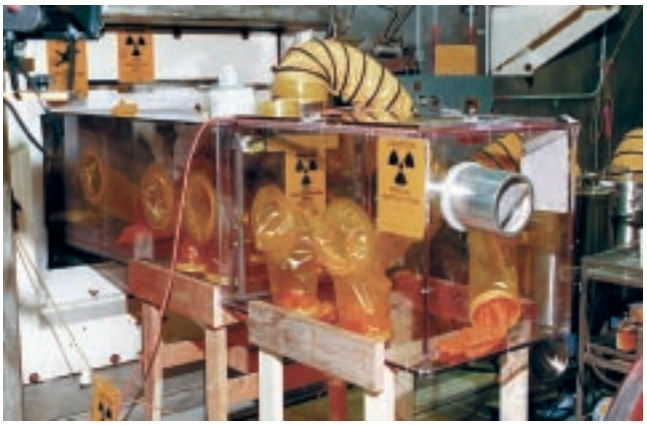
ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

An 8-member WGAT and a 54-member SAT conducted the INEL vulnerability assessment. Stakeholder involvement included a Site Specific Advisory Board (SSAB) briefing on May 21, 1996, on the basis and purpose of the assessment. On June 11, 1996, a public meeting was held during which the WGAT was briefed on preliminary SAT findings; stakeholder input was solicited. Present at the in-briefing were news media representatives, an SSAB member, a State of Idaho representative, and members of the general public. Another public meeting was held on June 20, 1996, for the WGAT exit briefing, at which media representatives, SSAB members, and State of Idaho representatives were present.

SUMMARY OF VULNERABILITIES

A total of 10 INEL vulnerabilities were identified: 9 facility condition and 1 institutional. The most significant INEL vulnerabilities, in decreasing order of priority, are:

- Fire involving combustibles on the operating floor of the ROVER Fuel Processing Facility, and subsequent spread of contamination and potential nuclear criticality from manual firefighting. (VAF no. INEL–CPP–640–WGAT–001)



Wooden glovebox supports, a fire hazard at INEL CPP–640 ROVER Fuel Processing Facility

- Potential degradation of 53 U-233 drums in cargo containers stored in an open yard of the Radioactive Waste Management Complex that cannot be inspected due to concrete block shielding, and subsequent spread of contamination and potential nuclear criticality. (VAF no. INEL–RWMC–ILTSF–SAT–006)

- Corrosion of approximately 150 U-233 drums buried with thousands of transuranic waste drums, and subsequent spread of contamination and potential nuclear criticality. (VAF no. INEL–RWMC–TSA–SAT–007)

FACILITY CONDITION VULNERABILITIES

NUCLEAR CRITICALITY AND CONTAMINATION FROM HOLDUP

The ROVER Fuel Processing Facility in Building CPP–640 was designed as a pilot-scale demonstration of the reclamation of HEU from unirradiated and irradiated graphite fuels. This facility, shut down in 1984, contains an estimated 160 kilograms of HEU ash and burner bed material held up in process vessels of unsafe geometry. These vessels will be intentionally opened during planned decommissioning operations. The inadvertent addition of a moderator (such as water) to these vessels could cause a nuclear criticality accident.

Water leakage through the Building CPP–640 roof has been a recurring problem. Building sprinkler systems have been disconnected, resulting in reliance on potentially uncontrolled manual fire protection measures. The facility operating floor contains significant quantities of combustible materials.

Temporary plastic cover over INEL CPP–640 ROVER Fuel Processing Facility hot cell to prevent rainwater inleakage onto nuclear material

STORAGE VULNERABILITY

The Radioactive Waste Management Complex stores over 200 drums of U-233 that are, or might be, corroding but cannot be thoroughly inspected. Further drum degradation could result in a loss of contents, a spread of contamination, and nuclear criticality events. An estimated 40 kilograms of U-233 in the RWMC is in the form of pellets and rods from

the Bettis Atomic Power Laboratory Light Water Breeder Reactor Program. The U-233 is in U.S. Department of Transportation–approved 6M drums with inner 2R containers and fiberboard spacing for nuclear criticality safety. However, many of the drums have been stored for over 11 years with no inspection or monitoring.

Thousands of drums of transuranic waste are buried with 150 drums of U-233 under the TSA pad. These drums would have to be unearthed to be examined. Fifty-three U-233 drums outside on the ILTSF pad are contained in metal cargo containers, which are exposed to the elements. The surrounding concrete shielding hinders inspection of the cargo containers, and the containers prevent inspection of the drums.

INEL U-233 storage drums exposed to the environment, susceptible to corrosion, and inaccessible for inspection because of concrete shield blocks

Twelve U-233 drums in Air Support Building II show signs of corrosion, but their being stacked five-high with other thousands of transuranic waste drums makes complete inspection difficult. Degraded conditions attributable to loss of container spacing could lead to nuclear criticality during eventual recovery and relocation operations. Drum breaching or mishandling could also lead to worker contamination.

Some of the most hazardous drums containing U-233 at INEL Air Support Building II, arranged in a manner that precludes inspection

Numerous aging INEL facilities store HEU sealed sources, calibration standards, and samples distributed such that less than 350 grams of HEU are present at each storage location. These materials are in solid, liquid, and powder forms and are stored in various storage cabinets and safes. Most of the items have been stored in their original packaging for 10 to 20 years and do not have an identified mission or use. Due to facility aging, neglected maintenance, and the number of storage locations, there is a potential for increased worker exposure from package degradation and mishandling.

SEISMIC VULNERABILITIES

Building CPP–640, the ROVER Fuel Processing Facility, and the inner structure of Building CPP–651, the Unirradiated Fuel Storage Facility, were not qualified to withstand a design basis earthquake. Seismic failures within Building CPP–640 could compromise confinement and lead to a localized spread of contamination and possible loss of moderator control.

Building CPP–651 provides vault storage for unirradiated materials containing large amounts of HEU. A design basis earthquake could lead to failure of the inner building and damage to fuel storage racks, resulting in a loss of safe geometry and a nuclear criticality accident.

INSTITUTIONAL VULNERABILITY

Poor housekeeping conducive to a fire hazard at various facilities is the only institutional vulnerability identified at INEL.

SAVANNAH RIVER SITE

SITE DESCRIPTION

The 768-square-kilometer Savannah River Site is near Aiken, South Carolina. It was constructed in the early 1950s to produce, separate, and purify plutonium and tritium. Savannah River has 15 major processing and storage facilities containing HEU and collocated transuranic elements (e.g., plutonium, neptunium, americium, curium). The site operated continuously for nearly 40 years as one of the primary producers and processors of nuclear materials. Highly enriched uranium was a major feedstock for production processes. At present, most HEU operations are shut down. Savannah River has about 22.1 metric tons of HEU, of which about 8.3 metric tons were assessed in the earlier spent nuclear fuel and plutonium vulnerability assessments. Of the 13.8 metric tons of HEU reviewed in this assessment, about 99 percent is in the form of unirradiated reactor fuel assemblies, cast HEU and aluminum alloy ingots, process residues, and HEU–nitric acid solutions. Small quantities of HEU are present as sources, calibration standards, and laboratory samples, and HEU is present as holdup in several shut-down facilities.

Assembly Building 105–K contains unirradiated reactor fuel assemblies, cast HEU and aluminum alloy ingots, and some residues awaiting disposition since the shutdown of SRS reactor operations. Large amounts of HEU solutions are in H-Canyon tanks, and small quantities of HEU in other

Savannah River Site HEU Facilities and Forms

Facility	Material Forms: Unirradiated Fuel Elements	Spent Fuel	Metal	Solutions	Oxides	Sources, Samples, Standards	Residue Scrap	Holdup
FB-Line			X*		X*	X*	X*	
235–F	X		X**		X**	X	X**	X**
247–F						X		X
H-Canyon		X*		X				X
HB-Line						X		
321–M						X		X
105–K Assy	X		X				X	
105–K Dssy		X*						
105–L Dssy		X*						
105–P Dssy		X*						
RBOF		X*,U						
SRTC (773–A, 735–A)						X**		
772–F, 772–IF						X**		

* *All assessed in spent nuclear fuel or plutonium vulnerability assessments.*

** *Portions assessed in plutonium vulnerability assessment.*

U *Receipts since spent nuclear fuel vulnerability assessment assessed in HEU vulnerability assessment.*

facilities. Building 235–F contains a large quantity of HEU, in a wide variety of forms and packages, for which there is no future mission. The Receiving Basin for Off-site Fuel (RBOF) contains spent HEU fuel received from off-site facilities since the spent nuclear fuel vulnerability assessment. This fuel, containing 89.4 kilograms of U-235, was reviewed in the current assessment. However, the majority of irradiated HEU fuel in the SRS reactor disassembly areas (105–K, –L, –P) and RBOF was previously assessed during the spent nuclear fuel vulnerability assessment. Additionally, FB-Line and Building 235–F contain HEU that was assessed during the plutonium vulnerability assessment. Previously assessed HEU was not reviewed in this assessment.

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

A 13-member WGAT and a 20-member SAT conducted the SRS vulnerability assessment. Stakeholders were involved in the WGAT public in-briefing and exit briefing. Some expressed concern about the disposition of HEU, a material they consider a valuable national resource. This issue is being addressed through separate studies. Stakeholders also expressed interest in worker safety, as well as public safety and environmental issues. The assessment process was discussed, including how facilities were chosen for evaluation, and why safeguards and security issues were excluded. Stakeholders who attended the meetings expressed disappointment that so few people were in attendance. Members of public interest groups had been invited, as well as the general public, through the local press; only a few attended.

SUMMARY OF VULNERABILITIES

A total of nine SRS vulnerabilities were identified: five facility condition, three material packaging, and one institutional. The most significant vulnerabilities, in decreasing order of priority, are:

- Potential nuclear criticality in a large enriched-uranium storage tank outside H-Canyon due to freezing. (VAF no. SRS–HCO–WGAT–001)
- External corrosion of containers in the Building 235–F vault from a leaky roof and rainwater. (VAF no. SRS–235–F–WGAT–001)
- Uncertainty about material and packaging within containers in Building 235–F, and possible radiolysis, hydrogen generation, and internal corrosion. (VAF no. SRS–235–F–SAT–001)
- Long-term storage of uranyl nitrate solutions in the H-Canyon and outside facilities (211–H) tanks. (VAF no. SRS–H–CANYON–SAT–001)

FACILITY CONDITION VULNERABILITIES

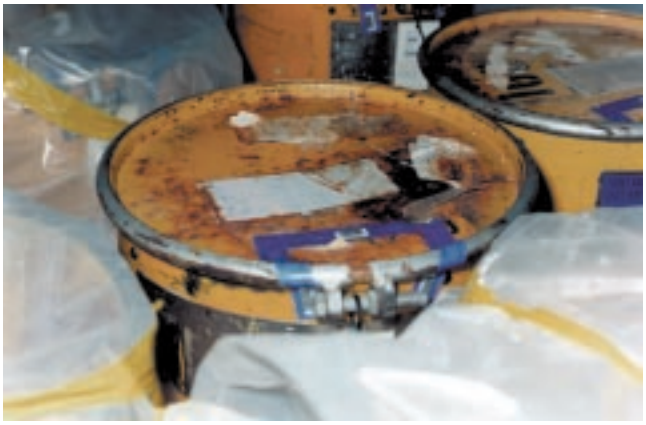
STORAGE TANK NUCLEAR CRITICALITY

A storage tank outside H-Canyon contains 265,000 liters of HEU in solution. The tank is new, double-walled, stainless steel, and meets current design standards. However, in the event of a prolonged loss of electric power to the tank's recirculation pumps, and an extended period of subfreezing weather, the uranyl nitrate could freeze, possibly resulting in HEU overconcentration and a potential nuclear criticality accident. The current probabilistic risk assessment for this tank does not adequately address nuclear criticality, an event with high worker safety consequences.

HEU storage tank in H-Area, SRS, susceptible to freezing during cold weather and extended power loss

LEAKY ROOF

The Building 235–F vault stores HEU in 55-gallon drums and in shipping containers of different sizes. The vault roof leaks in several locations, and rainwater has fallen onto several shipping containers and metal pails containing HEU. The shipping containers are rusted and, if the leaking roof is not repaired, continued exposure to rainwater could cause additional corrosion, loss of container integrity, and wetting of the packages of HEU inside. Pending such repairs, facility staff have covered affected containers with plastic sheets; other containers have been moved.



Corroded HEU drums in SRS Building 235–F vault

COMBUSTIBLE CONTAMINATED WASTE

Various HEU facilities (e.g., Building 321–M, RBOF, K-Assembly Area) have significant accumulations of combustible, HEU-contaminated waste. The accumulations add to the risk of fire, which could lead to increased worker exposure and environmental contamination. The accumulation of materials in these facilities is the result of a sitewide, temporary shutdown of waste disposal activities. The likelihood of fires is considered high in Building 321–M, since there is no operational fire suppression system in the building and combustible loadings are considerable. The consequences would be low, however, even if the building's entire HEU inventory were involved.

HEU-contaminated combustible waste in SRS Building 321–M

SEISMIC AND TORNADO VULNERABILITIES

Building 247–F, the Fuel Manufacturing Facility, produced fuel material for the DOE Naval Reactors Program but has been shut down since 1989. There may be as much as 34 kilograms of HEU tightly adhered as holdup in vessels, piping, process cabinets, and ventilation ductwork. Although only 15 years old, the facility is vulnerable to large earthquakes and tornadoes. If the integrity of the building were lost, HEU holdup could be released to the surrounding environment and possibly affect a worker conducting building tours.

HOLDUP

Highly enriched uranium fuel assemblies were fabricated in Building 321–M, which is no longer in use and has been cleaned up. However, there may be as much as 1.2 kilograms of HEU holdup adhered to the inside of ventilation ducts or deposited on equipment. In the event of high winds (>64 mph), earthquake, or fire, this HEU holdup could be released, resulting in worker exposures and environmental impacts.

MATERIAL/PACKAGING VULNERABILITIES

OXIDE/METAL VULNERABILITIES

Building 235–F has 91 packages containing HEU materials, including oxides, metals, unirradiated fuel materials, and scrap,

in unknown or known-to-be-suspect packaging. Some packages are more than 20 years old, and some materials are mixed or contaminated with plutonium. Because of the plutonium, the plastic packages are vulnerable to degradation or to the generation of hydrogen gas.

Unknown source/standard packaging was identified in a safe in HB-Line.

EXTENDED STORAGE OF HEU SOLUTIONS

Various H-Canyon tanks hold from 2,000 to nearly 265,000 liters of uranyl nitrate/nitric acid solutions. Uranyl nitrate solution is not suitable for extended storage because HEU liquids are more susceptible to adverse change than HEU solids, and are more difficult to control. With solutions, for example, there is the potential for the following: loss of liquid through evaporation and thus the concentration of chemicals in solution; generation of hydrogen gas as a product of radiolysis; loss of water chemistry control due to human error; loss of heating or heat removal capability; leakage caused by vessel, piping, component, fitting, or seal corrosion or failure; spills or potentially violent chemical reactions resulting from inadvertent transfers; or changes in those parameters affecting nuclear criticality, such as geometry, moderation, reflectivity, fissile material concentration, and neutron poison concentration. As a result, uranyl nitrate tanks require continuous monitoring for tank level, hydrogen buildup, proper water chemistry, solution temperature, material condition of systems and components, valve lineups or jumper configuration, and criticality safety. Breakdown of the barriers that affect these monitored parameters could adversely impact packaging or container integrity and lead to worker exposure or contamination, or to environmental releases.

INSTITUTIONAL VULNERABILITIES

Highly enriched uranium sources and standards have been prepared at SRS for a variety of purposes over the years. Although each contains only a small amount of HEU (no more than tenths of grams), all sources and standards taken together account for approximately 25 kilograms. Some facilities have done a good job of controlling and accounting for sources and standards; others have not. Because of a breakdown of administrative barriers, such items could be encountered in unexpected locations, resulting in increased exposure of workers and the public.

OAK RIDGE K–25 SITE

SITE DESCRIPTION

The Oak Ridge K–25 Site is located about 13 kilometers west of the populated area of Oak Ridge, Tennessee. It includes over 300 buildings. The site was constructed during World War II, as part of the Manhattan Project, to produce enriched uranium used in the first nuclear weapons. Its facilities were also used for the enrichment of uranium for commercial reactor fuel until 1985. Since the shutdown of uranium enrichment activities, scientific research and development have been carried out in the areas of environmental restoration and waste management.

K–25 HEU Holdings

K–25	About 1,500 kg holdup in cascade piping and equipment
K–1420	19.3 kg: 7.8 kg loose material, 11.5 kg holdup in piping and process equipment
K–1030	<500 g, mostly UF_6 in sample cylinders
K–1423	<180 g in four sealed sources
K–31	20-g heel in UF_6 sample cylinder
K–1004–A	<5 g in four glass vials
K–1652	<2 g in two sealed sources
TOTAL	~ 1.5 Metric Tons

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

A six-member WGAT and a nine-member SAT conducted the K–25 vulnerability assessment. Stakeholders were involved in a combined Y–12 in-briefing and K–25 exit briefing, at which potential vulnerabilities were discussed. No K–25 stakeholder concerns were raised.

SUMMARY OF VULNERABILITIES

A total of nine K–25 vulnerabilities were identified: eight facility condition and one material/packaging. The most significant vulnerabilities, in decreasing order of priority, are:

- Roof and building leakage or failure of sprinkler systems resulting in the spread of loose HEU contamination by water. (VAF no. K–25–K–1420–SAT–001)
- Spread of contamination from tornado or earthquake. (VAF no. K–25–K–1420–SAT–003)
- Large fire in Building K–25 breaching process equipment, and release of HEU. (VAF no. K–25–K–25–SAT–002)
- Earthquake or severe wind (e.g., tornado) damage to piping and components in Building K–25, and release of HEU material. (VAF no. K–25–K–25–SAT–003)
- Forklift truck accident rupturing packaging or equipment or starting a fire. (VAF no. K–25–K–25–SAT–001)

FACILITY CONDITION VULNERABILITIES

FIRE VULNERABILITIES

Units K–305–7 and K–305–8 in Building K–25 contain large amounts of combustibles and about 31 kilograms of HEU. A fire of sufficient intensity to cause structural damage could breach process equipment and result in HEU releases.

In Building K–1420, a fire involving combustible material could release up to 7.8 kilograms of loose HEU held up on the fluorination tower, creating an airborne contamination hazard. In addition, activation of the sprinkler systems could result in the spread of the HEU through adjoining rooms and outside the facility.

SEISMIC VULNERABILITIES

A large earthquake or tornado could damage structures, process piping, and equipment in Buildings K–25 and K–1420, and release a fraction of the 1,500 and 19.3 kilograms of HEU held, respectively, in these buildings. Water from damaged fire suppression systems or from rain could carry HEU material outside buildings. Equipment containing HEU exceeding the minimum critical mass (for a stated assay) could be breached, or water from rain or fire suppression systems could entrain HEU, either of which could result in a nuclear criticality accident.

HOLDUP

Building K–1420, originally designed and built for radiological decontamination, uranium recovery, and metal-plating operations, was shut down in 1988. The facility does not constitute an adequate barrier to the estimated 19.3 kilograms of HEU holdup because of its numerous glass windows, roll-up doors, roof leaks, and through-roof ventilators. It is not seismically qualified.

Removal of pipe section with HEU holdup in Building K–25 at Oak Ridge K–25 Site

Building K–25 began operation as a gaseous diffusion uranium enrichment facility in 1945. Enrichment operations were terminated in 1964, and the volatile uranium hexafluoride material in the process equipment was removed. However, the building still contains about 1.5 metric tons of HEU holdup. Repairs are frequently performed to stop roof leaks. It is not a seismically qualified structure and might not withstand high winds.

MATERIAL/PACKAGING VULNERABILITIES

In Building K–25, a forklift truck accident caused by human error could rupture material packaging or equipment and start a fire.

Human error could result in the dropping and breaking of an HEU standard (with less than 1 gram of HEU) and worker contamination in Building K–1004 or Building K–25.

OAK RIDGE NATIONAL LABORATORY

SITE DESCRIPTION

The Oak Ridge National Laboratory in Oak Ridge, Tennessee, one of the original World War II Manhattan Project sites, was built to develop and demonstrate processes for separating plutonium from uranium. Since the early 1950s it has served as a multipurpose national laboratory. Nearly all (99.8 percent) of the HEU within the scope of this site's assessment is within one facility, Building 3019. A section of that building has been designated as the national repository for U-233. The building has 796 kilograms of HEU and 424 kilograms of U-233 (primarily in oxide form) stored in sealed metal cans in storage wells. The remaining ORNL highly enriched uranium, approximately 1.5 kilograms, is distributed among 12 other facilities.

ORNL Building 3019, U-233 storage facility

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

A 6-member WGAT and a 12-member SAT conducted the ORNL vulnerability assessment. Stakeholders were involved in a combined Y–12 in-briefing and K–25 exit briefing, during which potential vulnerabilities were discussed. No stakeholder concerns were raised about ORNL vulnerabilities.

ORNL HEU/U-233 Holdings (in grams)

Building	HEU	U-233
3019	796,410	423,605
3027	633	16
3036 & 7001A	0	
3500	71	
3508	97	
3525	427	24
4501	2	<<1
5505	27	3
6010	236	
7710	20	
7824	18	
7930	16	
9201–2	48	
9204–3	242	
TOTAL	~798 kg	~424 kg

SUMMARY OF VULNERABILITIES

A total of six ORNL vulnerabilities were identified: three facility condition, two material/packaging, and one institutional. The most significant vulnerabilities, in order of decreasing priority, are:

- Failure of cans of U-233 oxide in Building 3019 during inspection, handling, and repackaging (VAF no. ORNL–B3019–WGAT–001)
- Earthquake and wind failures in Building 3019. (VAF no. ORNL–B3019–SAT–002)
- Potential leakage of solutions during transfer from Tank P–24 in Building 3019. (VAF no. ORNL–B3019–SAT–003)

FACILITY CONDITION VULNERABILITIES

The Building 3019 Laboratory Area has 169 grams of U-233 at risk of release to the environment from earthquakes or high winds. Such a release would occur if HEPA filter equipment and the building's brick exhaust stack failed.

A single-shell tank (P–24) located in a below-grade concrete bunker outside Building 3019 contains about 15,000 liters of thorium nitrate solution together with 130 grams of U-233. That tank could be breached by an earthquake and release U-233. Moreover, since the tank and its contents are inaccessible, leakage from a valve, pump, or piping could occur unobserved during transfer, resulting in releases to workers and the public.

MATERIAL/PACKAGING VULNERABILITIES

In Building 3019, approximately 1,000 containers of U-233 are stored in ventilated dry wells. Half of these containers hold about three-fourths of the stored HEU with the highest level of radioactivity (because of the higher contamination levels of the high specific activity, and the highly energetic gamma emissions from U-232 and its decay daughters). These materials are packaged in welded, corrosion-resistant (i.e., stainless steel) cans that contain up to 4 kilograms of U-233 oxides.

The remaining material is packaged in nominal 1-kilogram (or smaller) batches in a variety of containers of unknown condition. Some of the containers are over 30 years old, and their condition has not been reviewed since initial storage. These containers could have deteriorated and might breach during handling, resulting in releases of U-233. Although storage wells provide a robust barrier to releases, the opening of a well for package removal could cause releases in the work area.

U-233 storage wells in Building 3019

INSTITUTIONAL VULNERABILITIES

No ORNL building structures have been evaluated against modern DOE seismic and wind criteria.

PANTEX PLANT

SITE DESCRIPTION

The Pantex Plant is located in the Texas Panhandle 27 kilometers northeast of Amarillo. It was originally constructed in 1942 for conventional weapons manufacture. In 1952, the plant began nuclear explosives operations. Its current mission is to assemble nuclear weapons for the nation's stockpile; evaluate, repair, and retrofit nuclear weapons in the stockpile; disassemble weapons being retired from the stockpile; and demilitarize and sanitize components of dismantled nuclear weapons. The facility also provides interim storage for plutonium pits from dismantled nuclear weapons, and develops, fabricates, and tests chemical explosives and explosive components for nuclear weapons. The Pantex Plant has 16.7 metric tons (including planned dismantlement) of HEU within the scope of this assessment, all in the form of solid metal. That HEU is handled and stored in three principal facilities: assembly/disassembly cells, assembly/disassembly bays, and magazines. Except for Building 12–2, all stored HEU is in the form of weapons components. Forms of HEU in Building 12–2 include oxides, sources, samples, and standards.

Pantex Plant

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

A 14-member WGAT and a 14-member SAT conducted the Pantex Plant vulnerability assessment. Stakeholder representatives and news media attended the WGAT public in-briefing and exit briefing. Stakeholders included representatives from the Pantex Plant Citizens Advisory Board, the Amarillo National Resource Center for Plutonium, and regulators from the Texas Bureau of Radiation Control and the Texas Natural Resource Conservation Commission.

SUMMARY OF VULNERABILITIES

A total of five Pantex Plant vulnerabilities were identified: one facility condition and four institutional. The most significant vulnerabilities, in decreasing order of priority, are:

- High-explosives detonation without filtering of dispersed HEU by "Gravel Gertie" collapse, resulting in exposures of workers, the public, and the environment. (VAF no. PANTEX–CELLS–SAT–002/WGAT–002)
- Fire or high-explosives detonation caused by an aircraft crash into Zone 4 or Zone 12, resulting in HEU release. (VAF no. PANTEX–MAGAZINES–SAT–001/WGAT–001)
- Incomplete safety analyses of canned subassembly drops, fires, and transportation accidents. (VAF no. PANTEX–MULTIPLE–WGAT–003)

FACILITY CONDITION VULNERABILITY

There is a potential for the detonation of bare (uncased) high explosives in the presence of one or more canned subassemblies containing HEU in assembly/disassembly cells. If detonation were to occur in a cell and the amount of high explosives were insufficient to collapse the energy-absorbing "Gravel Gertie" roof, leakage through personnel door gaps or blast valves that failed to latch could result in increased radiological exposures of workers and contamination of the environment.

"Gravel Gertie" roof at Pantex, designed to collapse during bounding high-explosive accidents but not lesser explosions

INSTITUTIONAL VULNERABILITIES

AIRCRAFT CRASH

The crash of an aircraft into Zone 4 or Zone 12 could result in the detonation of high explosives in a weapon and the release of HEU. A fuel fire following an aircraft crash could also cause HEU dispersal.

AUTHORIZATION BASIS DEFICIENCIES

Neither authorization basis documentation nor related hazard analyses reflect evaluation of the likelihood and consequences of the dropping of HEU weapons components or the subjection of such components to fires and transportation accidents.

AIR-MONITORING DEFICIENCIES

Performance issues were raised concerning the alpha continuous air monitor testing, maintenance, and calibration program.

HANDLING VULNERABILITY

Unnecessary handling of canned subassemblies, currently unshippable due to a shortage of shipping containers, entails a small, unnecessary worker dose and an increased risk of industrial accidents.

Pantex Plant HEU Material Forms

Facility	Oxides	Sources, Samples, Standards	Weapons Components
12–2	X	X	
12–64			X
12–44			X
12–99			X
12–58			X
12–60			X
12–84			X
12–85			X
12–96			X
12–98			X
12–104			X
Magazines*			X

* Magazines 101–103, 105, 108, and 110–112.

SANDIA NATIONAL LABORATORIES

SITE DESCRIPTION

Sandia National Laboratories, located on Kirtland Air Force Base in Albuquerque, New Mexico, was created in 1945 to be the production-engineering arm for weapons designed at Los Alamos, New Mexico.

The facility manages several programs relative to the development and stewardship of the evolving nuclear weapons stockpile; implementation of new and streamlined approaches to meeting nuclear weapons requirements; development of arms control, nonproliferation, and counterproliferation technologies; and the restoration of contaminated SNL sites.

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

A five-member WGAT and an eight-member SAT conducted the SNL vulnerability assessment. Their focus was 93 kilograms of unirradiated fuel and fuel samples and 38 kilograms of other unirradiated HEU. Previous vulnerability assessments addressed approximately 389 kilograms of HEU in irradiated reactor fuels, and 74 kilograms in other reactor-irradiated nuclear materials and transuranic inventories. Five SNL locations contain documented, accountable quantities of HEU. Many other facilities contain small quantities in sealed sources used for instrument calibration, radiation measurements, or targets for experiments.

The DOE Kirtland Area Office issued a press release to announce the WGAT visit and solicit public comment, but there was little response. Neither a formal in-briefing nor an exit briefing of the public was deemed necessary.

SUMMARY OF VULNERABILITIES

One institutional vulnerability was identified for SNL: loss of experience and resulting dependence on subcontractor personnel for radiation safety. (VAF no. SNL–MULTIPLE–WGAT–001)

Internal view of SNL Building 37055 Manzano Vault

The WGAT identified a vulnerability involving loss of corporate memory, a lack of long-term experience in radiation safety, and dependence on inexperienced personnel for the maintenance of contamination control at the Manzano Vaults.

ARGONNE NATIONAL LABORATORY–WEST

SITE DESCRIPTION

Argonne National Laboratory–West is on the INEL site 56 kilometers west of Idaho Falls, Idaho. The University of Chicago operates ANL–W in researching civilian uses of special nuclear material for DOE. Originally, the facility developed advanced power reactor systems. Its current mission is to decommission site facilities and to store and condition materials for ultimate disposal. At ANL–W there are several metric tons of HEU, primarily in the form of spent nuclear fuel. All holdings of spent fuel were reviewed in the spent nuclear fuel vulnerability assessment. Highly enriched uranium within the scope of the current assessment is in various forms and is collocated or commingled with other substances.

ASSESSMENT PROCESS AND STAKEHOLDER INVOLVEMENT

A 10-member SAT and an 8-member WGAT conducted the ANL–W vulnerability assessment. The DOE Chicago Operations Office, Argonne Group–West, notified 210 instate stakeholders about the June 10–20, 1996, WGAT visit to INEL. Stakeholders were invited to the June 11 in-briefing and the June 20 exit briefing. None of the stakeholders took part in facility tours. No concerns were expressed over the missions of ANL–W and INEL or with respect to HEU itself.

ANL–W HEU Items

Metal	952
Oxide	113
Standards, Sources	2,288
Solutions	43
Reactor Fuel	7,088
Residues	32

SUMMARY OF VULNERABILITIES

One facility condition vulnerability was identified for ANL–W: earthquake-caused failure of an unanchored glovebox in the Analytical Laboratory. (VAF no. ANL–W–AL–SAT–001)

The vulnerability concerns an Analytical Laboratory glovebox that contains alpha-emitting materials. Most prominent among those materials are standards used to calibrate

various instruments used in the laboratory. There are also samples being analyzed and alpha-emitting waste. The glovebox rests on a pedestal that is not seismically anchored to the laboratory floor. Ventilation piping extends through the floor to the ventilation piping for the building.

During a seismic event, the glovebox or its ventilation system could rupture, releasing materials into the room and contaminating workers. Given the limited amount of material (less than 200 grams of HEU), however, the environment and the public would not be affected. Anchoring the glovebox assembly to allow it to withstand design basis earthquakes would mitigate the vulnerability.

Unanchored glovebox in ANL–W Analytical Laboratory

SITES WITH SMALL HEU HOLDINGS

Eleven of the 22 sites involved in the HEU vulnerability assessment were reviewed by a special WGAT, the Home Team, consisting of members of the project support staff. In general, these 11 sites have small quantities of HEU with a low potential for ES&H vulnerabilities.

All 11 sites submitted a SAT Report, which included written responses to the assessment plan questionnaire. The Home Team reviewed each report to confirm in-scope/out-of-scope determinations and the potential for ES&H vulnerabilities. It also held telephone conferences with each site to clarify information provided and to obtain additional information.

It was initially planned that these sites not be visited by a WGAT unless issues arose during reviews of SAT Reports. On this basis, three of the sites—Lawrence Livermore National Laboratory (LLNL), New Brunswick Laboratory (NBL), and Argonne National Laboratory–East (ANL–E)—were visited.

For all 11 sites, the combined HEU inventory within the scope of this assessment is approximately 350 kilograms. Materials include weapons-grade metal and pits, fuel plates, pure and impure oxides, solutions, calibration standards, sources, and other items. Site inventories range from 31 grams at Ames Laboratory to approximately 200 kilograms at LLNL. A summary of the 11 sites, their HEU holdings, and vulnerabilities follows.

SITE INVENTORY SUMMARIES AND VULNERABILITIES

LAWRENCE LIVERMORE NATIONAL LABORATORY

Lawrence Livermore National Laboratory is 64 kilometers east of San Francisco, California. Part of LLNL's mission is to conduct research, development, and testing to support nuclear weapons design. The laboratory has approximately 200 kilograms of HEU (1,100 specific items), mostly in the form of metal. Other forms are pure and impure oxides, sources, samples, and standards (150 items), and U-233. Ninety-nine percent of LLNL's holdings are in Building 332, the Plutonium Facility, which is located in the laboratory Superblock. Minor holdings (sources, samples, and standards) are in Buildings 231, 251, and ancillary facilities.

Every LLNL facility with HEU except Building 177, which has one calibration standard, was evaluated during the earlier plutonium vulnerability assessment.

A five-member WGAT conducted the LLNL vulnerability assessment. Following Home Team review of the LLNL Site Assessment Team Report, five members of the Home Team visited the site for 3 days. The SAT and a Home Team representative held a public meeting to discuss the results of the assessment on July 26, 1996.

The SAT identified only one vulnerability: inadequate knowledge about the packaging of some HEU items in storage in Building 332. (VAF no. LLNL–B332–SAT–001)

HEU containers with missing packaging information in Building 332 storage lockers at LLNL

Some HEU materials are in packaging that meets older LLNL internal standard practices. This could become an issue if new standards were developed for off-site transportation, since replacing existing packaging could lead to worker exposures.

Building 332 vaults hold eight packages containing approximately 11 kilograms of pure HEU oxide. These packages are overpacked in plastic bags and cans. The items met standards

at the time they were packaged, but the specific packaging configuration is currently unknown. When these items are repackaged, planning will be complicated due to uncertainty of the packaging configurations.

NEW BRUNSWICK LABORATORY

The New Brunswick Laboratory is on the ANL–E site near Chicago, Illinois. The laboratory occupies Building 350, which contains about 7,500 square meters of laboratory and support areas. It serves as the U.S. Government's Certifying Authority for nuclear reference materials and measurement calibration standards. It also provides independent Federal technical staff and laboratory resources for nuclear material measurement, safeguards, and nonproliferation functions in support of multiple program sponsors.

An eight-person SAT conducted the NBL highly enriched uranium vulnerability assessment. Following Home Team review of the NBL Site Assessment Team Report, three members of the Home Team visited the site for 1 day. The team met with the SAT, discussed the results of the SAT assessment, and walked down the facility. Highly enriched uranium at NBL consists of 3.351 kilograms of U-235 in 3,161 packages. Due to the small amount of HEU, stakeholder involvement was not solicited.

The SAT initially identified two vulnerabilities. However, one involving a fire caused by an airplane crash was rejected by the Home Team as not credible. The other vulnerability is the potential failure of several containers of nondestructive analysis standards due to improper handling. (VAF no. NBL–Bldg 350–SAT–001)

Most of the 3,161 HEU packages at NBL are small packages of Certified Reference Materials; the rest are nondestructive analysis standards. These standards were made by absorbing uranyl nitrate onto vermiculite, which was then placed in metal cans or fiberboard drums. Owing to incomplete record-keeping, the presence or absence of liner material within these standards cannot be established at this time. Since uranyl nitrate is corrosive, the lack of a liner creates the potential for a breach of containment and a subsequent worker contamination/exposure incident. There is no risk of exposure of the environment or the public. Human error or mishandling could also cause packages to break leading to contamination. In order to mitigate this vulnerability, NBL will have all potentially unlined metal cans containing uranyl nitrate in the Nondestructive Assay Laboratory disposed of as waste.

HEU standards at New Brunswick Laboratory

ARGONNE NATIONAL LABORATORY–EAST

Argonne National Laboratory–East is 35 kilometers southwest of downtown Chicago, Illinois. It is a multipurpose research institution whose mission includes basic research, energy and environmental technology, industrial and manufacturing technology, and technical evaluations in support of DOE projects and technologies.

There are three general groups of HEU at ANL–E: materials in semipermanent storage (673 grams), calibration standards and sources (369 grams), and materials used for ongoing work (117 grams). The material in storage is seldom handled, except for inventory purposes; the rugged standards and sources and the material used for ongoing work are handled occasionally. The assessment included review of 1.428 kilograms of HEU in spent nuclear fuel received at ANL–E since the spent nuclear fuel vulnerability assessment. The total HEU inventory is approximately 2.6 kilograms, located in 10 buildings (15 rooms).

Three Home Team members visited the laboratory. During this 1-day visit, the team interviewed ANL–E personnel and conducted facility walkdowns. Due to the small quantities of HEU involved, no stakeholder involvement was sought and no briefing held. The team reviewed the status of ongoing upgrades in sitewide fire suppression systems and suggested improvement in some packaging and handling practices. It concurred with the SAT conclusion that no vulnerabilities exist at ANL–E.

HANFORD SITE

The Hanford Site was established in 1943 as part of the Manhattan Project. Its mission was to produce plutonium in support of the wartime defense program. The site occupies some 1,434 square kilometers of semiarid land in southwestern Washington State. Richland, Washington, approximately 7 kilometers south, is the nearest population center.

All HEU at Hanford is stored by Westinghouse Hanford and by Pacific Northwest National Laboratory (PNNL). The combined inventory at the two sites is approximately 86 kilograms of HEU, 198 kilograms of commingled plutonium and HEU, and 86 grams of U-233.

Westinghouse Hanford

The total Westinghouse Hanford inventory is 79 kilograms of HEU, 198 kilograms of commingled plutonium and HEU, and 37 grams of U-233. Three site facilities contain HEU materials within the scope of this assessment: the Fast Flux Test Facility (FFTF), the Plutonium Finishing Plant (PFP), and the 222–S Laboratory.

Highly enriched uranium holdings at FFTF include approximately 42.7 kilograms in one stainless steel fuel test assembly in Building 405, and 24 grams within 12 fission chambers in Build-

ing 4713–C. Holdings at PFP include approximately 36.3 kilograms of U-235 and 37 grams of U-233. These are in the form of stable powder, pellets, or pins encased in triple-containment packages. This facility also contains 198 kilograms of commingled plutonium and HEU that is the object of a scheduled stabilization program in response to DNFSB 94–1 and the plutonium vulnerability assessment. Holdings of the 222–S Laboratory consist of 7 grams of HEU in three samples.

The Westinghouse Hanford SAT identified no ES&H vulnerabilities. In its review of the SAT Report and subsequent discussions with SAT personnel, the Home Team did not identify any vulnerabilities.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory is located on the Hanford Site. All HEU and U-233 holdings—6.9 kilograms and 49 grams, respectively—are located in six facilities.

Most (6.1 kilograms) of the HEU is contained in HEU and aluminum fuel rods stored in a 4.6-meter-deep water-filled pit in Building 329. The remainder comprises 53 separate items: sources and standards, solutions, metal pellets, oxides, and one metal sphere. The U-233 is contained in five calibration standards.

The PNNL Site Assessment Team identified no vulnerabilities. In its review of the SAT Report and subsequent discussions with SAT personnel, the Home Team did not identify any vulnerabilities.

BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory (BNL) is in Upton, Long Island, New York, approximately 95 kilometers east of New York City. The laboratory conducts research in high-energy physics, chemistry, biology, nuclear waste, nuclear materials production, nuclear safeguards and security, and verification and control technologies.

Three BNL facilities contain HEU material within the scope of this assessment: the High Flux Beam Reactor (HFBR) New Fuel Vault, the HFBR Special Nuclear Materials Vault, and the HFBR Spent Fuel Canal.

There are approximately 41.6 kilograms of HEU: 35.6 kilograms of spent nuclear fuel; 5.6 kilograms of new fuel; and 400 grams of oxides, solutions, sources, and samples. Another 220.8 kilograms of spent fuel, currently stored in the HFBR Spent Fuel Canal, were evaluated during the spent nuclear fuel vulnerability assessment.

The BNL Site Assessment Team identified no ES&H vulnerabilities. In its review of the BNL Site Assessment Team Report and subsequent discussions with SAT personnel, the Home Team did not identify any vulnerabilities.

NEVADA TEST SITE

The Nevada Test Site (NTS) is a 4,100-square-kilometer Federal reservation designated for testing nuclear explosive devices, although no testing has occurred since October 1992.

Two NTS facilities were identified by the SAT as having in-scope HEU: the Super Kukla Reactor Facility in NTS Area 27, and the Radioactive Materials Control Facility in NTS Area 23. Three additional sites, not located on the NTS, contain in-scope HEU. These include the Atlas Facility and the Remote Sensing Laboratory at Nellis Air Force Base in Las Vegas, Nevada, and the Washington Aerial Measurements Office at Andrews Air Force Base near Washington, D.C.

Combined HEU at the five sites is 217 grams: 203 grams of metal alloy (five thermocouple probes) at the Super Kukla Reactor Facility, and 14 grams in sealed sources (10 items) at the remaining four facilities.

Certain holdings of U-233 and U-235—95.6 and 60.3 grams, respectively—in NTS Area 5 on the Transuranic Waste Pad were outside the scope of this assessment. This material has been officially declared waste and is awaiting permanent disposal at the Waste Isolation Pilot Plant in Carlsbad, New Mexico.

The NTS Site Assessment Team identified no vulnerabilities. In its review of the NTS Site Assessment Team Report and subsequent discussions with SAT personnel, the Home Team did not identify any vulnerabilities.

MOUND PLANT

The Mound Plant, near Miamisburg, Ohio, produced weapons components until the late 1980s. The site is currently involved in nuclear safeguards and security research and development, and in decontamination and decommissioning activities.

Two facilities were identified by the SAT as having in-scope material: Building 59 (CfX Facility) and the Technical Building (T-Building). Building 59 HEU consists of 188 very highly enriched uranium and aluminum alloy fuel plates (the core of the CfX subcritical facility) with a combined mass of 1.953 kilograms. T-Building HEU consists of 3.5 kilograms of U-233 in the form of U_3O_8, 199 grams of U-235 and Pu-239 mixed oxides, and 62 grams of U-235 metal used as a calorimetry source. The total Mound Plant HEU inventory is approximately 2.2 kilograms of HEU and 3.5 kilograms of U-233.

Plans call for repackaging and shipping all HEU holdings offsite by the end of fiscal year 1996. Receiver sites for the HEU materials have been identified, and repackaging operations are under way.

The Mound SAT identified no vulnerabilities. In its review of the Mound SAT Report and subsequent discussions with SAT personnel, the Home Team did not identify any vulnerabilities.

AMES LABORATORY

Ames Laboratory is approximately 5 kilometers northwest of Ames, Iowa. The laboratory conducts fundamental research in physical, chemical, materials, mathematical, and engineering sciences.

The entire HEU inventory, 31 grams of 51.203-percent–enriched HEU, is in a glovebox at the Alpha Operations Facility within the Applied Science Center. The 31 grams consists of solutions within 14 packages, most of which are plastic or glass vials. Potential problems from the deterioration of plastic containers will be mitigated by repackaging the materials in overpack containers.

The Ames SAT identified no vulnerabilities. In its review of the SAT Report and subsequent discussions with SAT personnel, the Home Team did not identify any vulnerabilities.

BETTIS ATOMIC POWER LABORATORY

Bettis Atomic Power Laboratory is a DOE Office of Naval Reactors facility near Pittsburgh, Pennsylvania. Bettis performs operations in support of the U.S. Navy's nuclear power propulsion program, including fuel fabrication, assembly, processing, examination, and testing. Bettis also operates the Naval Reactors Facility (NRF) at INEL.

Four Bettis facilities contain HEU material: the Materials Evaluation Laboratory, G-Building, L-Building, and the NRF in Idaho.

The total Bettis HEU inventory is approximately 5.5 kilograms. The exact quantity at each location is classified. However, the largest amount (less than 3 kilograms) is contained in a G-Building vault. In general, HEU is stored in metal cans, plastic wrap, and polyethylene bottles within hot cells, gloveboxes, or vaults. The NRF highly enriched uranium consists of metal-clad, unirradiated reactor fuel samples that are stored in drums.

The Bettis SAT identified no vulnerabilities. In its review of the SAT Report and subsequent discussions with SAT personnel, the Home Team did not identify any vulnerabilities.

KNOLLS ATOMIC POWER LABORATORY

Knolls Atomic Power Laboratory (KAPL) is a DOE Office of Naval Reactors facility near Schenectady, New York. The laboratory performs research and development activities in support of the U.S. Navy's nuclear propulsion program.

Five KAPL facilities have in-scope HEU: the Advanced Test Development Laboratory, the Ceramics Development Laboratory, the Chemical Analysis Laboratory, the Nuclear Materials Storage Facility, and the Radioactive Materials Laboratory.

The total KAPL highly enriched uranium inventory is approximately 5.5 kilograms. Most of it (approximately 4.4 kilograms) is stored in the Nuclear Materials Storage Facility vault in the form of metal alloys and oxides. Packaging for the HEU materials is primarily plastic bags, metal cans, polyethylene bottles, and glass vials. The materials are stored in safes, vault areas, and, in the case of the Radioactive Materials Laboratory, hot cells.

The KAPL Site Assessment Team identified no vulnerabilities. In its review of the SAT Report and subsequent discussions with SAT personnel, the Home Team did not identify any vulnerabilities.

SUMMARY OF VULNERABILITIES

Two vulnerabilities were identified at the 11 sites with small HEU holdings. Both were material/packaging vulnerabilities, one at LLNL the other at NBL, and they were identified by the respective SATs. Reviews of responses to questionnaires, follow-on discussions, and analysis of additional information resulted in the identification of no additional vulnerabilities for these 11 sites and their facilities.