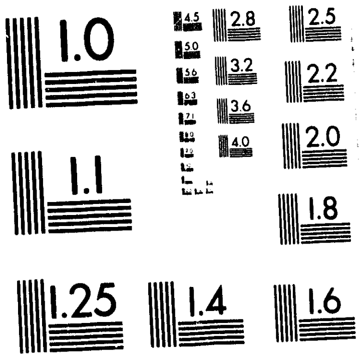

1.0
4.5
5.0
5.6
6.3
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

1 of 1

WHC-SA-1933-FP

Westinghouse Hanford Company Risk Management Strategy for Retired Surplus Facilities

W. E. Taylor
G. A. Coles
M. V. Shultz
R. G. Egge

Date Published
September 1993

To Be Presented at
ER-93 Environmental
Remediation Conference
Augusta, Georgia
October 24 - 28, 1993

Prepared for the U.S. Department of Energy
Office of Environmental Restoration
and Waste Management

Westinghouse Hanford Company P.O. Box 1970
Richland, Washington 99352

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

WESTINGHOUSE HANFORD COMPANY RISK MANAGEMENT STRATEGY FOR RETIRED SURPLUS FACILITIES

William E. Taylor, Robert G. Egge, Garill A. Coles, and Milton V. Shu z
Westinghouse Hanford Company

ABSTRACT

This paper describes an approach that facilitates management of personnel safety and environmental release risk from retired, surplus Westinghouse Hanford Company-managed facilities during the predemolition time frame. These facilities are located in the 100 and 200 Areas of the 1,450-km^2 (570-mi^2) Hanford Site in Richland, Washington. The production reactors are located in the 100 Area and the chemical separation facilities are located in the 200 Area. This paper also includes a description of the risk evaluation process, shows applicable results, and includes a description of comparison costs for different risk reduction options.

The primary motivation for this effort is a commitment from Westinghouse Hanford Company to the U. S. Department of Energy, Richland Operations Office following the fatal accident that occurred in 1992 at the 105-F Reactor Building. This effort is one part of an integrated action plan that addresses the large number of findings, recommendations, and proposed actions related to that accident.

In the past, risk at these facilities has been assumed low because no work activities that produce a product are taking place. However, experience at the Hanford Site has shown that significant risk can exist in these retired facilities.

Significant risk management problems exist at sites where facilities are intended to be demolished and the site restored to preexisting conditions. Although actual demolition activities have an element of risk associated with them, significant risk also exists for the period of time that the facilities must be maintained before demolition takes place. This length of time may exceed 30 years in some cases. Controlling risks during this interim time requires a strategy that ensures risk remains low while continuing to move toward the ultimate goal of removal and site restoration. Identification of facility hazards and their accompanying risk is key in implementing a strategy. Identification of facility hazards is also useful in developing controls to limit risk during demolition activities.

RISK EVALUATION PROCESS

Quantitative risk assessment concepts (likelihood and consequence) are used in this process to facilitate identification of the best risk reduction measures. Expert judgment of likelihood and consequence is based on professional investigations of the retired facilities and augmented by historical surveys and other existing documentation. Full-scope probabilistic risk assessments can be time consuming and expensive. The risk evaluation process is more time and cost efficient and keeps the best features of the risk assessment approach to screen hazards and rank them according to their relative risk. This approach requires only order-of-magnitude estimates of the frequencies and consequences of events.

This risk evaluation process was developed to (1) develop a qualitative basis for establishing the risk to humans and the environment from retired, surplus facilities; (2) identify dominant risk contributors for each facility; and (3) use this common basis for evaluating risk to provide a basis for comparing and prioritizing actions that would reduce facility risks to an acceptable level. This process is explained more thoroughly in Coles et al. (1).

The process includes only risks to human safety and the environment; it also addresses occupational and public risk on a similar basis. Some potential hazardous material releases represent a double threat: exposure to an individual and risk to the environment. Both risks contribute to overall risk. This process does not include quantification of latent cancer effects for onsite or offsite releases of hazardous materials. Risk related to releases to the environment is estimated based on simple size and material considerations rather than regulatory and/or statutory limits.

The hazard evaluation process for determining the risk consists of three parts: (1) a building hazard investigation, (2) a findings evaluation performed in a team meeting format, and (3) an evaluation of results.

Team members conducted walkdown investigations of retired, surplus facilities and recorded findings on evaluation worksheets. The team included WHC and Kaiser Engineering Hanford professionals trained in the structural, electrical, industrial, radiation, and environmental safety disciplines. Walkdowns were augmented by reviews of applicable existing documentation, such as facility drawings, routine surveys, and hazard reports.

During team meetings, members (aided by the Team Risk Evaluation Lead) evaluated and condensed individual findings and recorded them on Risk Evaluation Summary Sheets. The Risk Evaluation Summary sheets are provided for each facility and are organized by hazard categories. Evaluations of results determine risk categories and corresponding risk indexes.

Consequences were divided into four broad categories: catastrophic, severe, unplanned releases, and minor. These categories are designed to be grouping mechanisms into which accidents can be grouped based on outcome similarities. This creates a structure by which differing accident effects can be compared in a normalized basis. The consequence categories are assigned weighing factors that are meant to reflect the societal attitudes concerning the effects of an accident. These weighing factors serve as the normalizing tool and reflect the observed risk-avoidance behavior in a population. No differentiation is made between Site personnel and the uninvolved public in the weighing factors.

After the consequence of an accident resulting from the presence of a hazard is established, it is assigned a likelihood index. Five likelihood categories are used: frequent (1.0), probable (1E-1), occasional (1E-2), remote (1E-4), and improbable (1E-6). The intent in using the likelihood categories is to simplify the likelihood assessment and to encourage consistency in estimating likelihoods. The indices used in this analysis were taken from "System Safety Program Requirements" (2).

Risk is a function of likelihood and consequence. A risk matrix (Table I) was developed to assign risk categories based on likelihood and consequence. The intent in using the risk categories is to simplify the risk determination and encourage consistency in presenting risk. Five risk categories are used: critical (0.1 to 1.0), serious (1E-2 to 0.1), moderate (1E-3 to 1E-2), minor (1E-5 to 1E-3), and negligible (less than 1E-5). The risk index for each facility is the sum of the index values for all the identified risks for that facility.

TABLE I

Risk Matrix Categories

Likelihood index	Consequence categories			
	I	II	III	IV
A	Critical	Critical	1 Serious 2 Moderate 3 Minor	Moderate
B	Critical	Serious	1 Moderate 2 Minor 3 Negligible	Minor
C	Serious	Moderate	1 Minor 2 Negligible 3 Negligible	Minor
D	Minor	Minor	1 Negligible 2 Negligible 3 Negligible	Negligible
E	Negligible	Negligible	1 Negligible 2 Negligible 3 Negligible	Negligible

As shown, the risk of each hazard is a function of both the likelihood and consequence of an undesired event.

RISK EVALUATION RESULTS

Table II provides a rank order of the fifteen surplus facilities with the highest risk index for both the 0 to 5- and 5 to 10-year cases. The rank order for the 5 to 10-year case is different than the longer term case because aging and degradation contribute to risk.

TABLE II

Rank Order of Buildings by Highest Risk

Building			
Order	0 to 5 Years	Order	5 to 10 Years
1	105-F Reactor	1	105-DR Reactor
2	105-DR Reactor	2	105-F Reactor
3	105-H Reactor	3	105-H Reactor
4	105-D Reactor	4	105-D Reactor
5	221-U Canyon	5	105-C Reactor
6	105-B Reactor	6	183-C Water Plant
7	190-KW Pump House	7	1713-H Warehouse
8	202-S Canyon	8	105-B Reactor
9	105-C Reactor	9	224-B Office and Canyon
10	212-R Storage	10	205-A Solvent Handling

Of the hazards identified, falling, electrical shock hazards, and radiation exposure (to smaller degree) are the most significant risk contributors at Hanford Site facilities. Falling hazards are primarily related to deteriorating roof panels, and there is a need for more positive access control to the roofs from interior doors. Table III shows how many risks were identified for a facility by risk category and the resulting risk index.

TABLE III

Hazards per Risk Category

Number of hazards per risk category						
Building	Critical	Serious	Moderate	Minor	Negligible	Risk index
0 to 5 years						
105-F Reactor	3	0	3	4	7	150,837
105-DR Reactor	2	2	2	5	8	103,608
105-H Reactor	1	1	3	6	8	52,378
105-D Reactor	1	1	2	7	6	52,146
221-U Canyon	1	1	0	1	7	51,527
105-B Reactor	1	0	2	7	9	50,649
190-KW Pump House	1	0	1	4	8	50,338
202-S Canyon	0	3	1	2	11	4,801
105-C Reactor	0	2	2	6	9	3,629
212-R Storage	0	2	2	0	2	3,502
224-B Office and Canyon	0	2	1	5	5	3,355
1713-H Warehouse	0	2	0	1	4	3,024
105-KW Reactor	0	1	4	5	9	2,609
105-KE Reactor	0	1	3	6	9	2,379
185-B/190-B Pump Houses	0	1	2	2	3	2,043
5 to 10 years						
105-DR Reactor	3	1	3	5	7	152,357
105-F Reactor	3	1	2	6	6	152,126
105-H Reactor	2	1	3	6	7	102,377
105-D Reactor	2	0	3	7	5	100,895
105-C Reactor	2	0	3	6	8	100,878
183-C Water Plant	2	0	1	3	5	100,315
1713-H Warehouse	2	0	0	3	2	100,062
105-B Reactor	1	1	3	7	7	52,397
224-B Office and Canyon	1	1	2	5	4	52,104
205-A Solvent Handling	1	1	0	4	5	51,585
221-U Canyon	1	1	0	3	5	51,565
105-KE Reactor	1	0	3	6	9	50,879
190-KW Pump House	1	0	3	3	7	50,817
291-S Exhaust Fan	1	0	2	4	3	50,583
292-U Stack Gas Monitor	1	0	1	1	2	50,272

Potential electrical shock is also a significant hazard. Out-of-service electrical distribution systems apparently are being energized for tours, surveillance work, and other activities. These systems are old, degraded, patched together, and in certain cases receive no regular preventative maintenance. Potential radiation exposure risk exists primarily in the 200 Area retired processing facilities where there is a high potential for uptake of radionuclides and external exposure to ionizing radiation. Fig. 1 and 2 show the risk contribution from different hazard types for the 100 and 200 Areas, respectively.

Fig. 1. Production Reactor Facilities Risk Contribution.

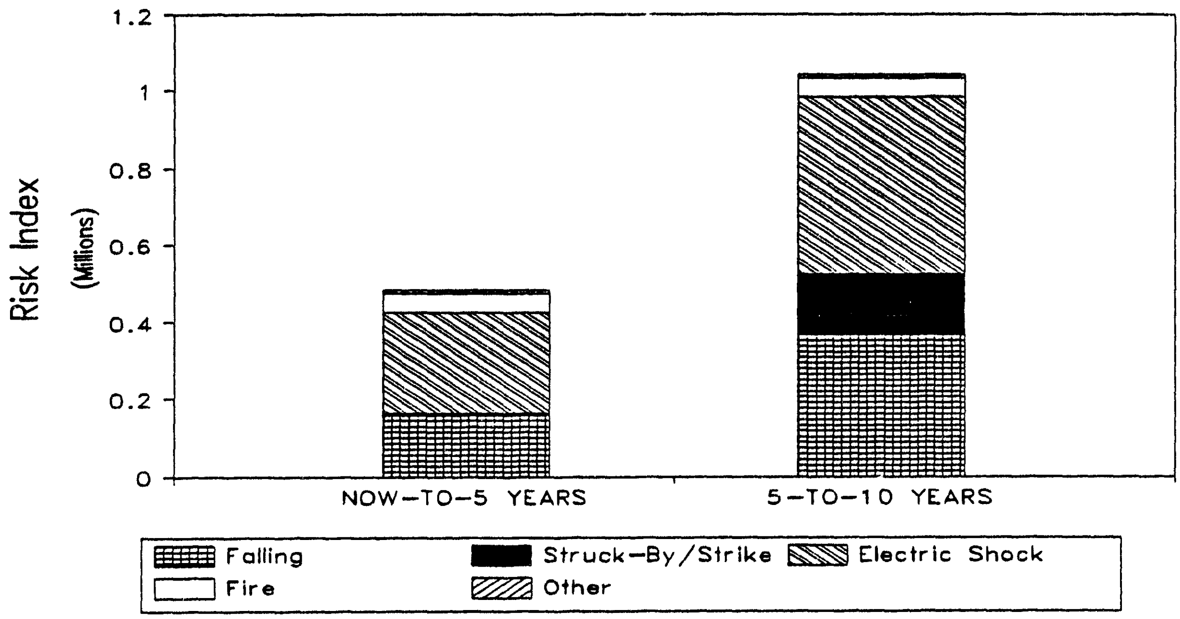
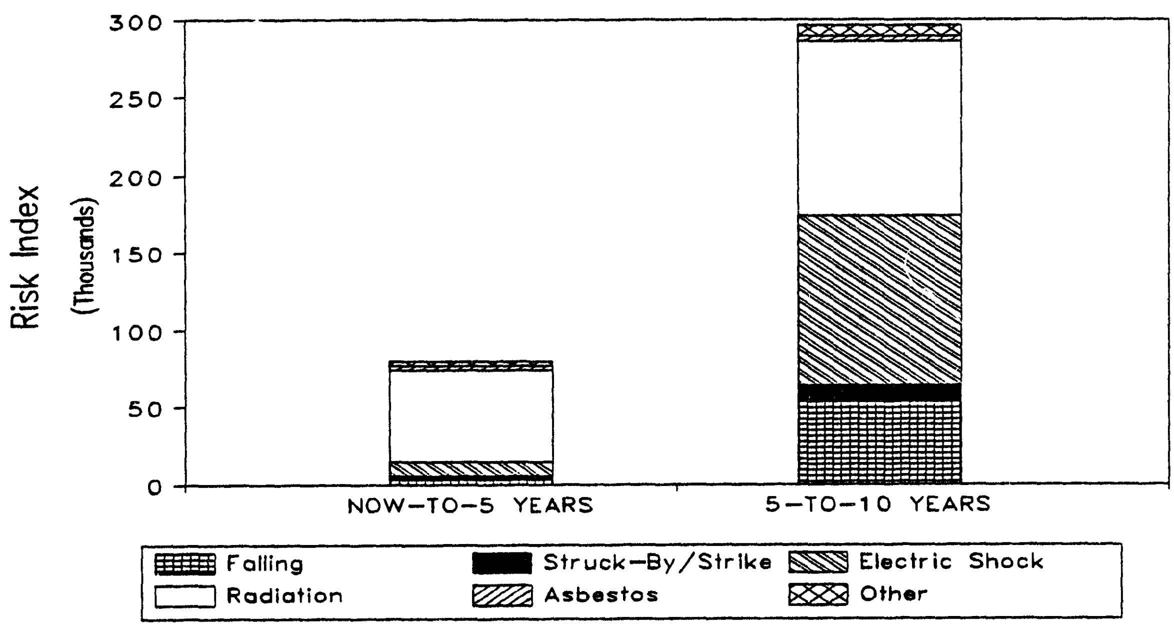


Fig. 2. Chemical Separations Facilities Risk Contribution.



The dominant risks from these facilities are sensitive to factors that could change and should therefore be noted. These are referred to as risk sensitivities. For example, one risk sensitivity is the primary dependency on the amount of human activity in a building; an increase in activity increases human exposure to hazards. A second example is the possibility of increased radiation exposure or release risk when cutting into piping or structures, or uncovering activated materials. For some chemical separation facilities in the 200 Area, ventilation failure might increase the risk of a hazardous or radioactive material release. Two final important factors are changes in administrative controls (such as changes in building access control) and the lack of human awareness to safety rules and potential hazards.

RISK REDUCTION COST COMPARISON RESULTS

Not all risks identified in the risk assessment are significant. However, risks rated as critical, serious, or moderate are considered important risk contributors and candidates for risk reduction. The risk reduction cost analysis builds on the risk analysis results by estimating costs for reducing the risk of the dominant contributors. By comparing costs of the various risk reduction approaches, selection of the most cost-effective reduction method can be made.

Three general ways to mitigate risk contributors were considered: (1) physical repairs or fixes, (2) isolation of the facility from workers while containing the hazard, and (3) demolition of the facility resulting in elimination of the risk.

Of the three options for reducing risk, it is noteworthy that demolition not only reduces risk but also meets the goal of decommissioning facilities. In a similar way, partially isolating a facility fulfills decommissioning goals because much of the hazardous material is removed in the process. Repairing the facilities is, in general, the most expensive option and does little in terms of meeting decommissioning goals.

Examples of overall risk reduction cost by risk category are given in Table IV. This table shows selected facility hazards grouped according to critical, serious, and moderate risks and displays the costs of viable risk reduction options. The nature of the risk reduction option is identified by its corresponding hazard category only. The dashed line in a cell indicates that the corresponding risk reduction option is not considered viable.

TABLE IV

Overall Risk Reduction Option Cost by Risk Category

Facility/section	Hazard	Fix option	Isolation option	Demolition option
Costs for eliminating CRITICAL hazards				
105-DR Storage basin	Falling, electric shock	$834,130	$320,050	a
105-DR Work/valve pit area	Falling, electric shock	$770,990	a	a
105-F Storage basin	Falling	$577,005	$26,631	a
105-F Fan house/valve pit	Electric, fire	a	a	$393,562
190-KW Process water house	Falling	$1,000	a	$2,802,666
221-U Canyon building	Electric shock	$1,000	a	$156,452,000
Costs for eliminating SERIOUS hazards				
Facility/section	Hazard	Fix option	Isolation option	Demolition option
105-C Storage basin	Falling, electric shock	$972,720	$270,972	a
105-C Fan house	Falling, electric shock	$708,400	$197,340	$688,160
105-C Process area	Falling, electric shock	$1,217,230	a	a
105-F Storage basin	Electric shock	$44,385	$0	a
105-F Process area	Falling, electric shock	$575,705	a	a
105-F Work area	Falling, electric	$449,410	a	a
1701-BA Badge House	Electric shock	$1,000	a	$12,000
1702-C Badge House	Electric shock	a	$15,053	$6,000
1714-C Solvent Storage	Electric shock	$1,000	a	$13,398
1713-H Warehouse	Struck-by, electric shock	$5,000	a	$524,000
Costs for eliminating MODERATE hazards				
Facility/section	Hazard	Fix option	Isolation option	Demolition option
183-C Filter Plant Pump Room	Struck-by, biological	$3,000,000[b]	$2,328,654	$235,000
103-D Fresh Metal Storage	Falling	$1,000	$49,125	$49,000
108-F Biology Laboratory	Biological, temp extreme	a, b	$809,362	$4,272,000
183-F Clearwell	Falling	a	$?	$73,803
202-S Canyon Building	Fire	$332,232	a	$0
233-SA Exhaust Filter	Radiation exposure	$768	a	$
291-S Exhaust Fan	Radiation exposure	$660	a	$0
2711-S Stack Monitoring	Falling	a	$16,786	$57,184
271-U Office Building	Fire	$1,000	a	$1,598,000

NOTES:
[a]Not a viable option.
[b]Biological hazards and temperature extreme hazards were rated as moderate in many facilities; however, the cost of mitigation is not included here because the cost for related controls will be included in administrative costs for all facilities.

It is apparent that in the case of several facilities, a high degree of risk reduction can be obtained for minimal expenditures of between $1,000 and $5,000 for eliminating critical, serious, and moderate hazards. The reduction is achieved because the hazards that cause risk are very localized. After these risks have been mitigated, risk reduction costs increase dramatically to the $10,000 and $100,000 range. This increase generally results from the remaining hazards, causing the risk to be more global in nature.

As a final precaution, it should be noted that the actual physical action of reducing risk (e.g., roof repair) can actually introduce new risk. Therefore, all repair, isolation, and demolition actions should be analyzed carefully for risk concerns.

REFERENCES

1. G. A. COLES, M. V. SHULTZ, AND W. E. TAYLOR, 1993, "Risk Management Study for the Retired Hanford Site Facilities - Risk Evaluation Work Procedure for the Retired Surplus Hanford Site Facilities," Vol. 2, WHC-EP-0619, Westinghouse Hanford Company, Richland, Washington.

2. MIL-STD-882B, "System Safety Program Requirements," as amended.

DATE
FILMED
2 / 22 / 94

END