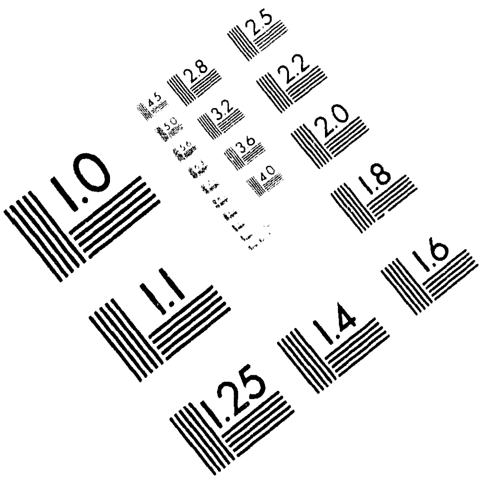

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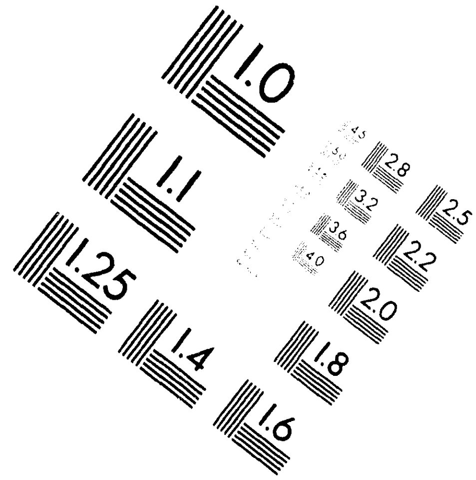

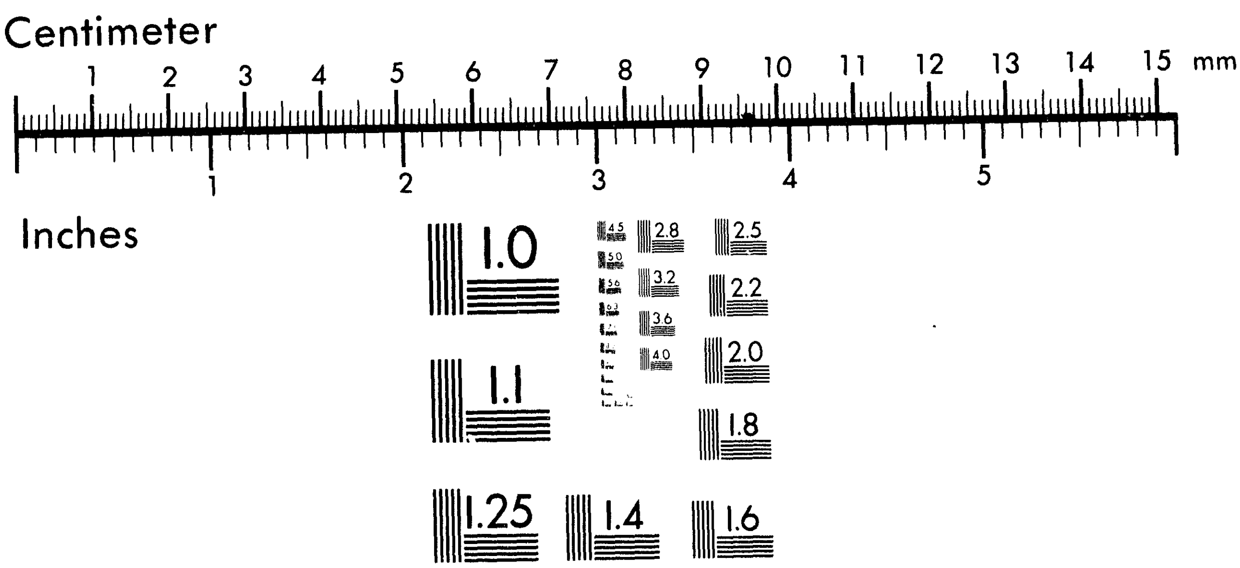

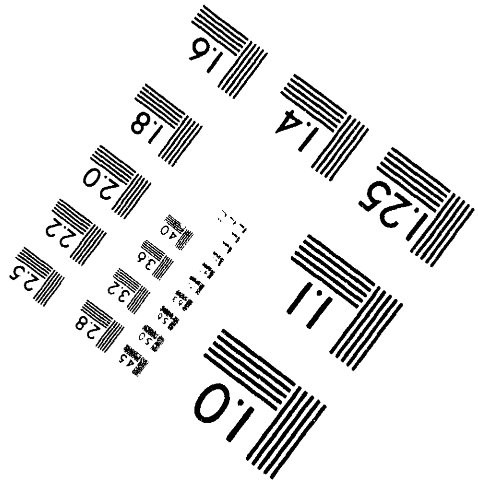

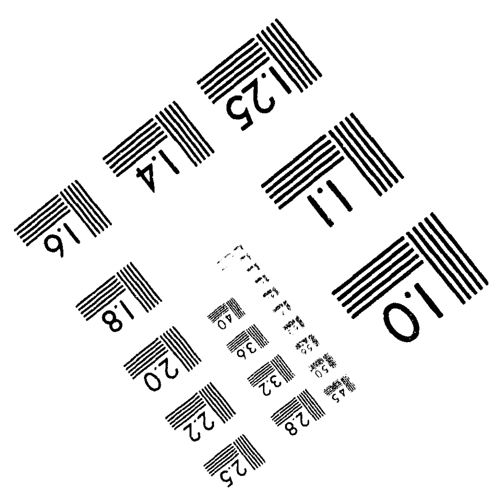

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HANFORD SITE'S INTEGRATED RISK ASSESSMENT PROGRAM NO-INTERVENTION RISK ASSESSMENT

J. A. Mahaffey
R. D. Stenner
C. S. Glantz
L. H. Sawyer
R. L. Buschbom
J. S. Dukelow, Jr.
R. A. Kennedy
C. R. Watson
J. K. Soldat
B. L. Harper

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Pacific Northwest Laboratory
Richland, Washington 99352

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J.A. Mahaffey, J.S. Dukelow, Jr., R.D. Stenner, R.A. Kennedy,
C.S. Glantz, C.R. Watson, L.H. Sawyer, J.K. Soldat, R.L. Buschbom, B.L. Harper
Pacific Northwest Laboratory
P.O. Box 999
Richland, Washington 99532
(509)376-4584

ABSTRACT

The long-term goal of the Integrated Risk Assessment Program (IRAP) is to estimate risks to workers, the public, organizations, and groups with reserved rights to Site access, the ecosystem, and natural resources to aid in managing environmental restoration and waste management at the Hanford Site. For each of these, information is needed about current risks, risks during cleanup, and endstate risks. The objective is three-fold:

- to determine if and when to remediate, and to what extent; to identify information unavailable but needed to make better cleanup decisions
- to establish technology performance criteria for achieving desired cleanup levels
- to understand costs and benefits of activities from a Site-wide perspective.

The no-intervention risk assessment is the initial evaluation of public health risks conducted under IRAP. The objective is to identify types of activities that the U.S. Department of Energy (DOE) must accomplish for closure of the Hanford Site, defined as no further DOE intervention. There are two primary conclusions from the no-intervention risk assessment. First, some maintenance and operations activities at Hanford must be continued to protect the public from grave risks. However, when large Hanford expenditures are compared to cleanup progress, funds expended for maintenance and operations must be put in proper perspective. Second, stakeholder's emphasis on public risks at Hanford, as indicated by remediation priorities, are not in line with those estimated. The focus currently is on compliance with regulations, and on dealing with issues which are visible to stakeholders. These do not always equate to priorities that would achieve greatest risk reduction.

I. INTRODUCTION

The goal of the Integrated Risk Assessment Program (IRAP) is to provide human health and ecological risk assessment input to support making risk-based decisions about cleanup of the Hanford Site. A major goal of cleanup is to reduce risk of effects to human health and the ecosystem from Hanford Site wastes and materials; however, these risks have not yet been quantified consistently and comprehensively at a Site level. In addition, cleanup risks have not been put in perspective with risks from operational, maintenance, monitoring, compliance, and other activities. Thus, a first step in managing environmental restoration, waste remediation, and waste management activities from a Site-level perspective is to compare risks of various activities. This provides information so that priority setting, decision making, and program justification are on a broad, cross-cutting scale. The no-intervention risk assessment results provide initial Site-level information about potential public health risks from Hanford's present wastes and materials using hypothetical scenarios.

The no-intervention option allows us to identify problems at the Hanford Site that might pose the greatest risk to the public in the event that remediation activities are not conducted or are delayed. No-intervention is not considered a viable option for the future of the Hanford Site; however, because of the long period of time over which remediation activities will occur, there is a remote possibility that political or economic upheaval might create a situation in which the government may be unable to continue Hanford activities. As a result, it would make sense that Hanford remediation activities address those problems that, if left untreated, might pose the greatest threat to the environment and public health. The no-intervention risk assessment is also useful in prioritizing risks from various Hanford problems. Results will allow risks to be compared with costs for maintain-

ing waste and materials in a safe manner. Wastes and materials that pose a high risk or have a high maintenance cost may be candidates for expedited remediation.

This no-intervention public health risk assessment drew on existing work including CERCLA, RCRA, NEPA and evaluations, environmental impact statements, and safety analysis reports; it also used data compiled by the Programmatic Environmental Impact Statement, by the Waste Information Data System, and by the Hanford Strategic Analysis study supporting the Hanford Mission Plan. The risk framework prescribed by the Environmental Protection Agency[1] was used (as implemented in existing modeling tools) to develop both quantitative and qualitative results; that is, to estimate contaminant transport and fate, public exposure, and potential cancer and non-cancer impacts on affected populations. Tools used were MEPAS[2] and GENII[3].

II. BACKGROUND

The Hanford Site is located in a rural region of southeastern Washington and occupies an area of 1500 km^2. The Columbia River flows through the northern edge of the Hanford Site and forms part of its eastern boundary. The semiarid land on which the Hanford Site is located has a sparse covering of desert shrubs and drought-resistant grasses. Hanford's climate is dry and mild; the area receives approximately 16 cm of precipitation annually. Land near the Hanford Site is principally used for agriculture and for livestock grazing. The major population center nearest to the Hanford Site is the Tri-Cities area (Richland, Pasco, and Kennewick), which is situated on the Columbia River downstream from the Site. Approximately 340,000 people live within an 80-km radius of the Hanford Site.

Established in 1943, the Hanford project was originally designed, built, and operated to produce plutonium for nuclear weapons. Nine reactors, companion fuel fabrication plants, chemical processing plants, and waste management facilities were constructed and operated. Irradiated uranium discharges from the reactors have been processed to recover uranium and plutonium. This processing has resulted in the accumulation of a wide variety of radioactive and chemical wastes.

III. ASSUMPTIONS OF NO-INTERVENTION RISK ASSESSMENT

At some time in the future, the U. S. Department of Energy (DOE) will have fulfilled its responsibilities to clean up the Hanford Site, and DOE activities at Hanford will cease. The no-intervention risk assessment assumes (hypothetically) that DOE ceases to operate the Site on January 1, 1994 and estimates risks associated with remaining wastes and materials. Site utility services, fire prevention measures, maintenance, and emergency planning are assumed to be discontinued. We also assume that there would be no intervention in events for which intervention would certainly occur, were they to happen. For 300 y, institutional control of the Site is assumed to be maintained to comply with Washington State regulations.

We assume that the existing inventories of wastes and materials remain at their current location. For facilities, on-hand inventories of contaminants are not relocated, with a few exceptions, nor are new contaminants or materials brought on Site. In addition, monitoring, stabilization, and remediation activities are assumed to be discontinued, and infrastructure is assumed to degrade by natural processes.

We also assume that the climate of the region does not change, and that groundwater flow patterns and Columbia River flow characteristics remain as they are currently. Further, Site boundaries are assumed not to change except that the Arid Land Ecology (ALE) reserve and North (Wahluke) Slope are assumed to be released from DOE ownership. ALE is assumed to remain unirrigated, but the North Slope is assumed to be irrigated, at least in part, for agricultural purposes.

We assume that receptor characteristics (numbers, ages, and geographical location and distribution) are unchanged over 300 y, and that receptors spend their entire lifetime in the region. We assume that their food and water consumption patterns do not change over the 300 y. It is also assumed that there is no change over 300 y in disease diagnosis or treatment, so the incidence and survival of cancer victims do not change. It is assumed that accident rates and the proportion that are fatal remain constant over the 300 y. Finally, we exclude groups listed below with reserved rights to Hanford Site access for purposes of this risk assessment and do not evaluate their on-Site risks. Site access is allowed to Native American tribes with treaty rights of access and/or use of the Site, to the Laser Interferometer Gravitational-Wave Observatory and Superconducting Magnetic Energy Storage projects, to the Washington Public Power Supply System, and to the U.S. Ecology leasehold.

IV. APPROACH TO NO-INTERVENTION RISK

No-intervention risk assessment results are highly aggregated and do not provide information at specific waste sites. Results provide a global view of public health risk for selected Hanford Site environmental restoration, waste remediation, and waste management issues. Specific scenarios for which risk is estimated were selected in two ways: 1) bounding cases for similar sources of contamination (e.g., nuclear materials) and for resulting potential public health impacts (e.g., release due to range fire), and 2) specific problems of interest (e.g., grout vaults). Selected public health risks were estimated for four potential sources of risk:

- **environmental transport of existing contamination** due to leaking single- and double-shell tanks, leaking basins associated with the K Reactors that contain spent fuel from the N reactor (N/K fuels), buried wastes, and other contaminated soil and groundwater

- **environmental transport of new environmental contamination** due to degradation of tanks and tank structures, storage structures for nuclear and hazardous materials, and facilities

- **natural disasters** (fires, earthquakes, floods, tornados, high winds) **and major accidents** that result in unplanned releases from tanks and tank structures, buried wastes, facilities, and nuclear materials

- **trespassers** onto the Site and into facilities (retired, active, and transition) that are restricted, and into the Columbia River, islands, and sediments that are unrestricted during the period of institutional control.

Risks of increased cancer fatalities and non-cancer impacts in excess of the hazard index are estimated; risks for genetic impacts and other health endpoints are excluded, since these are expected to affect much lower numbers of people for the no-intervention analysis. No discounting is assigned to risks that occurred during the 300 y; full value is assigned. Cancer fatalities are reported in three ways to facilitate comparison and interpretation of the results: excess numbers of cancer fatalities over a specified time to a given population, increase in annual average cancer fatality rate per 10^5 persons, and percent increase above annual cancer fatality rate. Results are provided for two distinct population groups and two time periods. Population groups considered are 1) the population residing within an 80-km radius of the Site and 2) the population ingesting food products grown within an 80-km radius of the Site, whether within the 80-km radius or not. The 0- to 70-y time period represents risk to the current generation. The 0- to 300-y time period represents risk to the total population over the period of institutional control.

A four-step process is used for risk analysis: 1) identify available waste and material inventory data, 2) define scenarios for contaminant release and establish the probability of occurrence, 3) screen to identify high-impact scenarios for additional analysis, and 4) estimate selected risks using appropriate modeling tools.

V. CONCLUSIONS FROM NO-INTERVENTION RISK ASSESSMENT

Impacts in the 300-y time frame among scenarios analyzed occur as a result of effects from the following sources and in the following order (highest to lowest):

- N/K fuels, Cs/Sr capsules, and range fires causing thousands of excess fatalities

- single- and double-shell tank runaway exothermic reactions causing hundreds of excess fatalities

- trespassers resulting in tens of excess fatalities

- a 200-y flood affecting buried wastes, leaks from the K Reactor east storage basin (105-KE), existing environmental contamination in the 100 and 300 Areas, an earthquake causing waste tank leakage, existing environmental contamination in the 200 Area, and the single existing grout vault, all causing nearly no excess fatalities.

A primary conclusion from the no-intervention risk assessment is that operational and maintenance activities at the Hanford Site are necessary to prevent serious and widespread public health impacts in the region. Activities associated with maintaining nuclear materials protect the public from potentially serious risks and are essential. In addition, activities associated with maintaining Site infrastructure and grounds protect the public from high risks posed by fire.

Moveover, based on the emphasized activities at the current time at Hanford, it is concluded that the currently perceived "highest" public health risks are inaccurate for the no-intervention analysis. For instance, under the no-intervention scenario, public health risks from current environmental contamination will be relatively unimportant for many centuries. Similarly, under the no-intervention analysis, public health risks from tanks are less than risks posed by Cs/Sr capsules and by N/K fuels. Both of these are contrary to the activities currently being emphasized at Hanford.

VI. UNCERTAINTY ANALYSIS

Generally, a risk assessment is incomplete without including a quantitative or semi-quantitative analysis of associated uncertainty of the estimated risks. However, the ranking of risks presented in this report for the no-intervention analysis is not accompanied by quantitative statements of uncertainty. There are several reasons for this approach.

First, one objective of the no-intervention analysis was to demonstrate the use and value of risk estimates to help decision makers prioritize the wide array of activities at Hanford. A rigorous assessment of uncertainty was not needed to achieve that objective.

Second, developing information needed for a formal quantitative uncertainty analysis was a larger effort than available time and resources permitted for the no-intervention analysis. This was particularly true because the analysis required using scenarios based on atypical assumptions. Developing reliable uncertainty information about models and parameters for these scenarios was considered to be an effort that exceeded the scope of work.

Third, the no-intervention analysis was conducted largely as a screening analysis that used available screening tools to identify key contaminants, exposure pathways, and a relative ranking of potential hazards. Such analyses do not generally require formal uncertainty analyses because they are usually considered to be part of the planning process for later, more definitive risk assessments.

VII. FUTURE PUBLIC INVOLVEMENT IN IRAP

This no-intervention risk information was developed to demonstrate the potential role of risk assessment in focusing and managing Hanford activities so that these activities can make a difference to human and ecological health and safety. However, the no-intervention analysis was developed without input from most stakeholders. This must and will change in future risk assessment work being conducted to provide general Site guidance under the IRAP. All Site stakeholders must understand and help direct Hanford's cleanup to achieve what they value.

ACKNOWLEDGMENTS

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