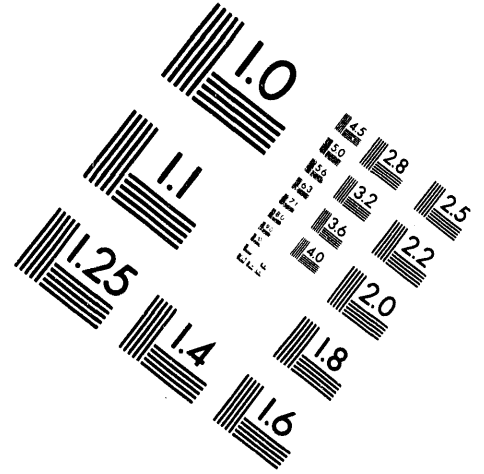
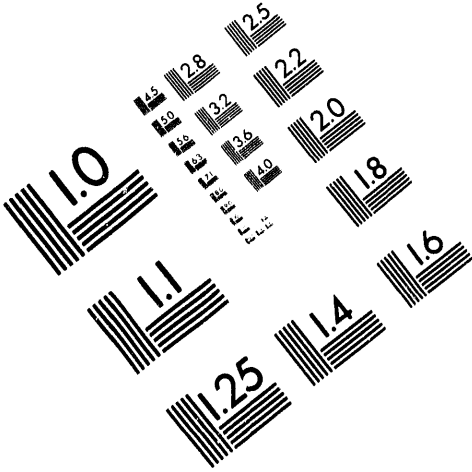




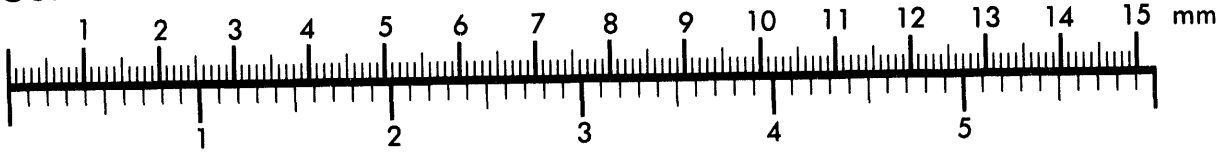
**AIM**

**Association for Information and Image Management**

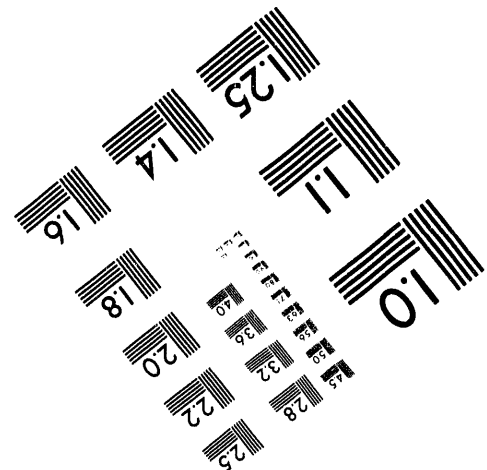
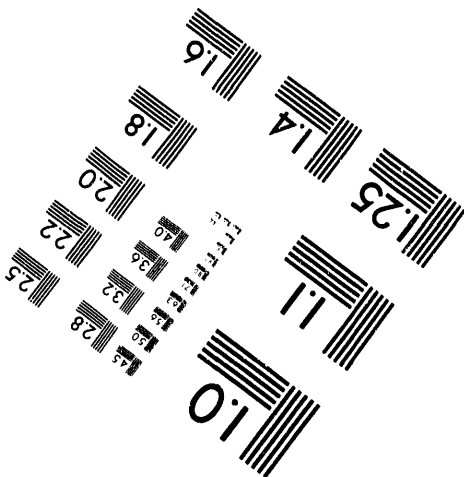
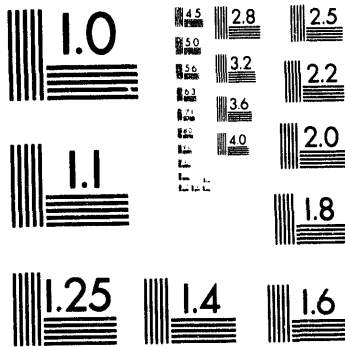
1100 Wayne Avenue, Suite 1100  
Silver Spring, Maryland 20910  
301/587-8202



Centimeter



Inches



MANUFACTURED TO AIM STANDARDS  
BY APPLIED IMAGE, INC.

**1 of 1**

# A Tool for Designing Pollution Prevention into U.S. Department of Energy Facilities

J. A. Dorsey  
Kaiser Engineers Hanford

E. A. Raney  
J. K. Whitehead  
Westinghouse Hanford Company

Date Published  
January 1994

To be presented at  
The Annual Air and Waste  
Management Conference  
Cincinnati, Ohio  
June 19-24, 1994

RECEIVED  
FEB 09 1994  
OSTI

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

**Copyright License** By acceptance of this article, the publisher and/or recipient acknowledges the U.S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper.

Approved for Public Release

**MASTER**

87B

**LEGAL DISCLAIMER**

---

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

---

This report has been reproduced from the best available copy.

*Printed in the United States of America*

DISCLM-2.CHP (1-91)

"A Tool for Designing Pollution Prevention into  
U.S. Department of Energy Facilities"

Judy A. Dorsey  
Kaiser Engineers Hanford  
P.O. Box 888, MSIN E6-50  
Richland, WA 99352

Elizabeth A. Raney  
Westinghouse Hanford Company  
P.O. Box 1970, MSIN H4-21  
Richland, WA 99352

Judith K. Whitehead  
Westinghouse Hanford Company  
P.O. Box 1970, MSIN G6-64  
Richland, WA 99352

## INTRODUCTION

Historically, pollution prevention activities within the Department of Energy (DOE) have focused on existing process waste streams. However, the DOE estimates that 70 percent of the opportunity to reduce or eliminate pollutants is gained or lost during design.<sup>1</sup> Design is considered a critical component of the DOE's operations, products and services, as evidenced by the numerous new facilities planned to support the cleanup mission of the complex. Pollution prevention during design: (a) significantly reduces the potential generation of waste and environmental releases, (b) promotes the use of energy efficient materials, (c) minimizes resource consumption, and (d) lowers life-cycle costs. Life-cycle cost considerations during design can include construction, operation, and eventual decommissioning of the facility.

DOE procedures mandate employees to consider, on a limited basis, waste minimization during design. However, the procedures do not give any clear guidance on the methods to use when implementing this requirement. To assist engineers in considering pollution prevention during facility design, a guideline was developed to list potential pollution prevention opportunities. The opportunities are sorted into the sixteen divisions of DOE Order 6430.1A "General Design Criteria". Each division represents a major building system or engineering specialty.<sup>2</sup> Within each division, options are further sorted by the Environmental Protection Agency's (EPA) pollution prevention hierarchy: source reduction, recycling, treatment, and environmentally safe disposal.<sup>3</sup> The guideline is not intended to be all-inclusive of pollution prevention opportunities, but rather to stimulate awareness of areas for pollution prevention that may not have been previously considered. The guideline also includes known regulatory drivers or other information sources, pertaining to each option presented. The guideline contains over 300 opportunities gathered from pollution prevention literature, industrial design personnel, and federal, state and DOE sources.<sup>4-30</sup>

In order to gain the most from the guideline, a training program has been developed for designers and engineers to explain why pollution prevention should be incorporated into the design of facilities and how to use the guideline to achieve this goal. The training emphasizes pollution prevention as a design philosophy rather than as a discrete step in the design process. The training also covers federal, state, local, and DOE-specific pollution prevention requirements as well as the social and economic benefits gained from pollution prevention.

This paper highlights: (1) the development of the guideline, including specific examples of the guideline's content and intended use, (2) a discussion on the philosophy and content of the training module, (3) a strategy for integrating the guideline's use into the existing DOE design process, and (4) future plans for enhancing the guideline and training class while continuing to integrate pollution prevention into the DOE design process.

## DEVELOPMENT OF THE DESIGN GUIDELINE

### Generating the List of Design Opportunities

The design guideline is a list of pollution prevention opportunities to be considered during the design or modification of DOE facilities. The opportunities were extracted from waste minimization texts, EPA guidance documents, regional and national pollution prevention newsletters, discipline-specific texts, vendor manuals, and national standards. In some cases, the opportunities were directly

extracted from environmental statutes, regulations, and Executive Orders. The opportunities list contains approximately 300 entries.

#### Organizing the List into the Design Guideline Table

As the number of identified opportunities grew, the list needed to be sorted into some logical sequence, and organized into a user-friendly format. Reference and comments columns were needed to provide the guideline user with more information to investigate implementation of the opportunities, and a mechanism to document the opportunities reviewed and implemented. The design guideline table satisfies each of these requirements. Table 1, which is depicted in the guideline table format, contains specific pollution prevention opportunities extracted from the design guideline. The use of each column is described in detail below.

**Column 1: Pollution Prevention Design Opportunity.** The guide has been divided into the sixteen divisions of DOE Order 6430.1A, "General Design Criteria":

- 1) General Requirements,
- 2) Site and Civil Engineering,
- 3) Concrete,
- 4) Masonry,
- 5) Metals,
- 6) Wood and Plastic,
- 7) Thermal and Moisture Protection,
- 8) Doors and Windows,
- 9) Finishes,
- 10) Specialties,
- 11) Equipment,
- 12) Furnishings,
- 13) Special Facilities,
- 14) Conveying Systems,
- 15) Mechanical, and
- 16) Electrical.

DOE Order 6430.1A provides the minimally acceptable design criteria required for new facilities or modifications to existing facilities. Virtually all design projects are required to use DOE Order 6430.1A, making the Order a familiar design requirements document for engineers designing DOE facilities. The intent of formatting the pollution prevention guideline to parallel DOE Order 6430.1A, was to facilitate guideline integration into the DOE design process. In addition, engineers can quickly turn to the particular divisions applicable to the project under consideration.

Within each division, pollution prevention opportunities are subdivided in order of priority according to the pollution prevention hierarchy: (A) source reduction, (B) recycling, (C) treatment, and (D) environmentally safe disposal. Within each subdivision, individual opportunities are numbered sequentially as they were added to the table. The numbering system is not meant to imply a rank within the subdivision. At the end of each division, blank rows labeled *Other* are provided to record any additional opportunities that the project is considering. These rows are intended to encourage creative ideas and to emphasize that the list presented is not exhaustive of pollution prevention opportunities.

Many of the opportunities listed are techniques for energy conservation. Although energy conservation may or may not directly prevent or minimize wastes in the facility being designed, energy conservation is universally recognized as a form of pollution prevention because of the environmental costs of electric power

generation. The use of electronic ballasts and fluorescent bulbs are good examples of energy conservation and reduced hazardous waste generation.

Additionally, the following are examples of viable source reduction strategies: spill prevention, preventative maintenance, inventory control, good housekeeping, product substitution/toxics use reduction, and resource conservation.

Some opportunities listed may result in early payback (i.e. during construction), whereas other opportunities will not prevent or minimize waste until the facility is operated or is decommissioned. Similarly, some opportunities will prevent pollution at the facility being designed, while others will impact off-site vendors or waste management units. For example, the use of construction materials with recycled content (e.g. cement and building insulation products) will not always directly benefit the DOE, but provides economic and environmental benefits to the community. The benefit of using such materials occurs when the materials are purchased during construction. On the other hand, designing equipment to facilitate recycling upon dismantlement will not produce an environmental benefit until equipment failure or facility decommissioning.

Division 13 covers nuclear facilities. Many of the opportunities presented in this division prevent pollution by limiting contamination spread or cross-contamination. Opportunities required for a nuclear facility are useful to consider for all other facilities. Many of the opportunities presented in the table are also decontamination and decommissioning (D&D) or As Low As Reasonably Achievable (ALARA) considerations. DOE Orders require that D&D and ALARA be considered during the design process.<sup>31</sup>

**Column 2: For More Information.** This column contains references for the reader to obtain more information on the particular opportunity being presented. If the reference is a DOE Order or an environmental regulation, the specific paragraph within the Order or regulation is provided in this column. In these cases, the reader is cautioned that the opportunity may actually be a design requirement for the project under consideration. The reader is responsible for obtaining the reference to determine applicability on a case by case basis. A reference list and bibliography are provided at the end of the design guideline.

**Column 3: Will Consider.** This column provides a mechanism for recording opportunities that are applicable to the facility being designed and that will be considered for implementation.

**Column 4: Remarks.** The guideline instructions direct the user to record a comment for each opportunity, indicating that the opportunity has been reviewed. If Column 3, *Will Consider*, is not checked, the remark should include the reasons the opportunity will not be considered. If the opportunity does not apply to the project under consideration, not applicable or N/A should be recorded. If Column 3, *Will Consider*, is checked, the remarks should indicate how the opportunity has been implemented or when, during subsequent design phases, the opportunity will be implemented.

#### **Limitations of Guideline Use**

The opportunities presented in the design guidelines table are strictly design issues. Techniques for pollution prevention through operational practices such as maintenance or inventory control are not explicitly included. Such opportunities may be suggested indirectly; for example, space allocation for hazardous materials storage, or recycling equipment.

This guideline stimulates thinking in pollution prevention and provides a method to document opportunities that are being considered for a specific project. Implementing pollution prevention measures will require consideration of such impacts as economics, technical feasibility, availability of required materials (particularly for recycled-content products), and life cycle cost. Opportunities listed in the table are not mutually exclusive. Several opportunities present different methods or technologies for achieving the same objective. This does not preclude every opportunity from being evaluated, but it will be impossible to implement every opportunity.

## **POLLUTION PREVENTION TRAINING FOR ENGINEERS**

A training module was created for design engineers and project managers to emphasize the importance of preventing pollution during design and, to describe table methodology. The vision, at the concept stage, created an "orientation session" as the best alternative to assuring an adequate introduction to pollution prevention and consistent subsequent use of the Guideline. A written plan for the orientation session was developed, and feedback from a pilot presentation of the training was incorporated into the plan. The long-term goal is for the training to be offered through the Quality Training and Resource Center (QTRC) at the Hanford Site.

The recommended course size is 24 participants per session. The course targets facility design engineers and project engineers as potential participants. The course length is two hours.

### **Course Objectives**

The orientation session provides a learning environment that will introduce the design guideline - its philosophy and application. Participants are encouraged to embrace the pollution prevention philosophy in their own design projects, and to acknowledge the role that each individual plays in supporting pollution prevention. The belief that pollution prevention should be applied throughout the life of a design project is also promoted. The training session seeks to dispel the belief that pollution prevention is a "line item" to be checked off only once.

Two aspects of learning are included in this orientation: knowledge-based recognition and the more difficult-to-influence, affective domain. Training goals for knowledge-based recognition for the participants are to learn the regulations and policies driving pollution prevention, to recognize the terms that describe and define the various aspects of pollution prevention, and to understand the Design Guideline Table. Affective domain goals are for the participants to successfully use the table in the actual workplace, and to perceive the value that the Design Table offers them.

### **Pre-test**

To assess how participants feel about designing for pollution prevention, before the session, an attitudinal survey is sent to each participant to complete. The facilitator can then adjust the emphasis of the session appropriately. This same survey is administered soon after the session to ascertain whether any change of attitude has occurred as a result of the session.

### **Course Modules**

The course was developed by considering the learning objectives in relationship to the assumed knowledge base of the participants (engineers). Three distinct learning segments emerged: (a) definitions and terms, (b) pollution prevention concepts with

actual examples, and (c) format and use of the design guideline. Each segment is designed for maximum interactive learning opportunities and intellectual challenge.

**Definitions and Terms.** The course begins with introductory remarks on the background of pollution prevention as a national effort with recent trends on preventing pollution during design. The pollution prevention hierarchy, as presented in the Pollution Prevention Act of 1990 is presented. The discussion then narrows to the Department of Energy's pollution prevention missions and strategies. Terms are introduced as necessary to facilitate the discussion, emphasizing the subtle distinctions between terms that lead to common misuse. Rather than the usual lecture, a challenge game presents the laws, regulations, and policies that drive pollution prevention practices.

Named a "Collective Recall Exercise", participants are directed to form small groups and collectively identify the full names for selected acronyms. Participants share responses with the group, and the facilitator elaborates on the scope of an item or answers questions from the group. The objective is to draw upon (or "re-activate") past learning that is applicable to pollution prevention. This exercise also gives the session facilitator an opportunity to gauge the groups' knowledge base.

**Concepts and Case Studies.** An instructor-led slide presentation comprises the second segment. Participants have a booklet containing replicas of the text slides, case study data, and space for taking notes. Using slides containing text and data, the facilitator outlines the basic principles of pollution prevention: what it is, why it is significant, and when it is appropriate to incorporate into a design project. The presentation is interspersed with actual case studies and photographs of Hanford Site pollution prevention successes. Participants are encouraged to discuss the case studies in the context of how the outcome might have been different if the pollution prevention opportunity had been considered during design. The objective is to lead the participants to realize that lessons learned from existing facilities can be incorporated into their current design projects.

**Using the Guide.** The last segment allows session participants to see the design guideline table; the participant's booklet contains a copy of the whole document. The participants are instructed to follow along in the guideline as the facilitator highlights how to use the table for optimum effectiveness. The table format is reviewed on a column by column basis, with the facilitator asking participants to identify why opportunities are applicable to pollution prevention.

After reviewing the table, participants form small groups for a participatory exercise. The objective is to provide a challenge that will show how the guide is to stimulate thinking along pollution prevention lines. Given the background of an actual project on the Hanford Site, the groups use the Design Table to identify applicable divisions and to select opportunities for possible consideration. Participants identify the specific opportunities within the applicable divisions that should be considered for implementation. New ideas are welcome and encouraged. Each group is allowed to present their findings. The class responses are compared to the actual pollution prevention opportunities the project employed.

#### **INTEGRATION OF POLLUTION PREVENTION INTO THE DOE DESIGN PROCESS**

The purpose of the project was to create tools that would aid design engineers in preventing pollution during the design of new or modified facilities for the DOE. The results of the project were the design guideline and the training program. The development of these tools however, does not ensure their use within the DOE

complex. To completely incorporate pollution prevention into the DOE design process, an infrastructure needs to be established. The infrastructure includes: pollution prevention policy development at national and local levels; revision of contractor policies and procedures to incorporate use of the guideline; and easy accessibility to the guideline and training information at the working level.

Typically, guidance, policy, and requirements within the DOE community are issued at a national level from Headquarters. The local DOE Operations Office will then issue a corresponding statement to its contractors directing them to take specific action. The contractors, in turn, revise company policies and procedures, and finally the guidance or requirement is implemented in the field at a working level.

The DOE currently mandates the minimization of waste through general policy statements and DOE Orders such as 5400.1, "General Environmental Protection Program;" 5820.2A, "Radioactive Waste Management;" and most importantly 6430.1A, "General Design Criteria." These policy statements and Orders, for the most part, only address waste generated during the operation of a facility and do not account for the minimization of waste during design, construction, and decontamination and decommissioning of a facility. It is important for the DOE to revise and reissue policy statements that emphasize minimizing waste during the entire life, from design to demolition, of a facility. The review and revision of DOE Orders on a national level will be completed at the end of fiscal year 1994.

On a local level, the incorporation of pollution prevention into the design of facilities will be expressed in a corresponding policy statement issued from the DOE operations office to the contractors. This policy statement is not intended to mandate use of the Guideline and training program, but rather to require preventing pollution during the design process. The contractors would be encouraged to use the job aids developed during this project to meet the requirement. This is an important issue to consider as design projects vary in cost and size. Requiring full completion and consideration of the design guideline would not only be expensive, but time consuming. A brief example of a locally issued policy statement, derived from the "Hanford Site Waste Minimization and Pollution Prevention Awareness Program Plan", is found below.<sup>32</sup> A corresponding statement from private industry could be issued from a corporate or headquarters office.

"...It is the policy of the Department of Energy, Richland Operations Office (RL), as an operation unit of the Department of Energy (DOE), to conduct its operations in a manner that eliminates or minimizes pollutant releases to all environmental media from all aspects of the Hanford Site's operations. This will include the prevention of pollution during the design, construction, operation, and decontamination and decommissioning of a facility...

...RL encourages the use of the "Pollution Prevention Design Guideline" throughout the design process as a means to meet the intent of this requirement. Contractor policies, procedures, and engineering practices shall be revised to incorporate pollution prevention into all phases of the design process."

Once the local DOE operations office issues a policy statement, it is up to the contractors to implement it at a working level. This may entail revising company environmental policies; developing corresponding work procedures and desk instructions directing the minimization of waste during design; and encouraging use of the Guideline and corresponding training program. It is important at this stage

to introduce the Guideline to design engineers and project managers. Their input and assistance in incorporating pollution prevention into their work processes is an essential element initiating and sustaining its use.

An important aspect of this phase of implementation is making the design guideline readily available and accessible to company personnel. Increasing the user-friendliness of the design guideline is discussed in the following section. It is important to note here that use of the Guideline will be facilitated by making it and the training course part of a standard engineering handbook and available on a local area computer network.

## FUTURE PLANS

Current and future plans to prevent pollution during the design of new facilities consist of improving and implementing the tools developed during this project. The Hanford Site, Idaho National Engineering Laboratory (INEL), and Argonne National Laboratory (ANL) are working together to assist the DOE in this endeavor.

One of the key activities being funded is the development of a user-friendly electronic version of the design guideline that utilizes multi-media and graphical interfaces. Key features of this software program are hypertext design that will provide easy access to information; integration of illustrations, diagrams, and photos as needed to enhance the information presented; and the incorporation of worksheets to evaluate technical and economic applicability of pollution prevention opportunities. The electronic guideline will allow searching by key word, subject matter, or phase in the design process.

Another activity being funded is the creation of a process, similar to the EPA's Pollution Prevention Opportunity Assessments, that will enable engineers to effectively design for pollution prevention. This process would be oriented toward standardizing pollution prevention into the DOE design process during the different phases of design, construction, operation, and decontamination and decommissioning of a facility. This process includes the identification of intended facility processes, anticipated waste streams generated, projected use of hazardous substances, and the recyclability of wastes generated at the proposed facility. As with the EPA's process, this will involve a mass balance of projected materials entering and exiting the facility during each phase of the facility's life.

Modifications or improvements to pollution prevention opportunities contained in the guideline are also being investigated. For each of the opportunities identified, information may be added to identify the phase of the design process that the opportunity should be considered, provide supplemental reference and case study information to assist the designer in evaluating the opportunity, and include rough cost estimate information associated with the implementation of the opportunity.

1995 goals involve the development of a complete training program for design and project engineers that includes the creation of a multi-media training course using the electronic guideline, providing workshops or seminars on specific topics in design with presentations from subject matter experts, providing pollution prevention design information in an engineering services technical bulletin, and identifying avenues for making the electronic guideline available for commercial use. One such media identified is the DOE's Energy Pollution Prevention Clearinghouse; an electronic bulletin board system directly linked to the EPA's pollution prevention bulletin board.

The overall benefits to the DOE-complex from these projects will be the development of a systematic approach to incorporating and implementing pollution prevention into the design of facilities. The final products will be directly transferrable and available to other sites, ready for their use, and centers of expertise for designing for the environment will be developed at ANL, INEL, and Hanford.

## CONCLUSION

The initial effort to push pollution prevention upstream into the DOE design process focused on development of the design guideline. However, it quickly became apparent that this tool would not be utilized unless engineers were trained in the concepts of pollution prevention as well as on how to use the guideline in their everyday work practices. Furthermore, a top-down approach was needed to clearly relay pollution prevention policies, plans, and procedures (specific to design) from DOE headquarters, to the DOE field offices, and finally to the site contractors actually designing new facilities and modifications to existing facilities.

Ongoing efforts to facilitate pollution prevention during design will enhance each of these three areas: (1) the design guideline, (2) training, and (3) integration into the design process. Design guideline enhancements will emphasize improving the usability and availability of the guideline by transferring it to a hypertext design software package available to users via network. Training enhancements will emphasize expanding training tools to other media, including a computer-based training course, working seminars with subject matter experts, and written articles in contractor engineering bulletins. Integration into the design process will be enhanced by continued review of DOE policies and procedures with recommended modifications, as well as development of a mass-balanced approach to evaluating future facility waste streams during design. This approach will be analogous to the EPA's waste minimization opportunity assessment guidance for existing waste streams. By continuing to enhance these three efforts, the hope is to affect not only the knowledge base of design engineers, but their behavioral response to the tools and training as well.

An observation from development of this guideline is that designing for pollution prevention is inherently tied to optimization design, ALARA, "good engineering practice", and designing for D&D. Because DOE design engineers are familiar with these design practices, designing for pollution prevention, once given the tools and training, should be a natural progression.

## ACKNOWLEDGEMENTS

The financial support of the Department of Energy, Waste Minimization Division (EM-352), is gratefully acknowledged. Mr. David Encke, Westinghouse Hanford Company, is credited with the original idea of developing a pollution prevention design guideline formatted after DOE Order 6430.1A.

## REFERENCES

1. Waste Minimization Pollution Prevention Crosscut Plan, predecisional draft - rev. 2, United States Department of Energy - Office of the Secretary, October 1993.
2. General Design Criteria, DOE Order 6430.1A, Department of Energy, Washington, D.C., 1989.

3. Pollution Prevention Act of 1990, United States Code 6601-6610, Public Law 101-508, 1990.
4. M. Boylan, "Pollution Prevention Awareness at the Idaho National Engineering Laboratory", in Proceedings from the Waste Minimization/Pollution Prevention Conference IX, Department of Energy, San Francisco, California, 1993.
5. Chemical Manufacturing - Pollution Prevention Opportunities Checklist, County Sanitation Districts of Los Angeles County, Industrial Waste Section, P.O. Box 4998, Whittier, California 90607; Phone (213)699-7411.
6. Clean Washington Center Recycled Product Directory, Clean Washington Center, Division of the Department of Trade and Economic Development, February, 1992.
7. Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Plants, American National Standards Institute, N300-1975, 1975.
8. Hanford Site Pollution Prevention Plan, DOE/RL-92-62 rev. 0, United States Department of Energy - Richland Operations, Richland, Washington, 1992.
9. L.J. Durney (ed.), Electroplating Engineering Handbook, 4th ed., Van Nostrand Reinhold, New York, 1984.
10. Environmental Life Cycle Assessment - Part 2: Life Cycle Assessment Guideline, Z760.2, draft #7, Canadian Standards Association, 1993.
11. EPA Guide to Pollution Prevention, The Fabricated Metal Products Industry.
12. Facility Pollution Prevention Guide, EPA/600/R-92/088, US EPA, Office of Research and Development, Washington, DC, 1992.
13. R.A. Fredrickson, "Navy Hazardous Waste Minimization Overview", in Proceedings of the National Conference on Minimization and Recycling of Industrial and Hazardous Waste, Hazardous Materials Control Resources Institute, Arlington, Virginia, 1992, p. 219.
14. H.M. Freeman, Hazardous Waste Minimization, McGraw-Hill Publishing, New York, 1990.
15. C.H. Fromm, S. Budaraju, and S.A. Cordery, "Minimization of Process Equipment Cleaning Waste", in Conference proceedings of HAZTECH International, Denver, Colorado, 1986, pp. 291-307.
16. Green Products by Design - Summary, US EPA Office of Technology Assessment, September, 1992.
17. T.E. Higgins, Hazardous Waste Minimization Handbook, Lewis Publishers, Michigan, 1989.
18. J.P. Kusz, "The Role of Product Design in the New Reality", from Design for Environmentally Responsible Products, Executive Enterprises Seminar, Washington DC, 1991.
19. League of Women Voters, The Household Recycling Center: A Design Handbook for Architects, Designers, Homebuilders, and Do-It-Yourselfers, Washington Department of Ecology: Waste Reduction, Recycling and Litter Control Program, 1987.

20. W.R. Lewis, "In-Plant Spill Prevention", in Proceedings of the National Conference on Minimization and Recycling of Industrial and Hazardous Waste, Hazardous Materials Control Resources Institute, Arlington, Virginia, 1992, p. 59.
21. Life Cycle Design Guidance Manual, EPA600/R-92/226, US EPA, Office of Research and Development, Cincinnati, Ohio, January, 1993.
22. D. Petrich, "In Praise of Composting Toilets", EcoBuilding Times, vol. 1, no. 1, Fall 1993, p. 7.
23. Petroleum Refining and Petroleum Distribution Systems Fact Sheet, Wyoming Department of Environmental Quality, Solid and Hazardous Waste Division, Cheyenne, Wyoming, 82002.
24. N. Riikonen, Industrial Wastewater Source Control - An Inspection Guide, City of San Diego, Technomic Publishing Co., Lancaster, Pennsylvania.
25. D. Scher and J. Munn, "Waste Minimization in the Gravure Printing Industry", in Proceedings of the National Conference on Minimization and Recycling of Industrial and Hazardous Waste, Arlington, Virginia, 1992, p. 25.
26. Volume Reduction of Low-Level Radioactive Waste or Mixed Waste, ANSI/ANS-40.35-1991, American Nuclear Society, 1991.
27. W.E. McFarland and M.P. Stangl, "Waste Minimization Program for a Large Petroleum Distributor", in Proceedings of the National Conference on Minimization and Recycling of Industrial and Hazardous Waste, Hazardous Materials Control Resources Institute, Arlington, Virginia, 1992, p. 62.
28. Waste Reduction Makes Good Business Sense for Photofinishers, Alaska Health Project.
29. Water and Chemicals Reduction For Cooling Towers, Pollution Prevention Program, North Carolina Department of Environment, Health, and Natural Resources, May, 1987.
30. R. Westlund, "Builders Weigh Advantages of a Recycled Home," Resource Recycling, Vol.12, No.3, 1993.
31. Radioactive Waste Management, DOE Order 5820.2A, Department of Energy, Washington, D.C., 1988.
32. Hanford Site Waste Minimization and Pollution Prevention Program Plan, DOE/RL-91-31, Department of Energy - Richland Operations Office, May 1991.

## TABLES

Table 1. Excerpts from the Design Guideline Table.

Division 1: General Requirements Pollution Prevention Design Opportunity (A. Source Reduction, B. Reuse/Recycle, C. Treatment, D. Disposal)	For More Information	Will Consider	Remarks
1.A.34 Are storage areas adequately illuminated to avoid accidents resulting in leaks and to spot leaks sooner?	(Freeman, 1990)		
1.A.35 Are spring-loaded/automatic shut-off valves used on faucets and at rinse stations and cleaning areas?	(Freeman, 1990, p. 121)		
1.A.44 Is spill and overflow protection provided on tanks?	40 CFR 280.20		
1.B.4 Is priority given to use of recycled materials or products containing recycled materials (For example - building insulation products, paper, cement containing fly ash, retread tires, etc.)?	RCRA 6002(i)		
1.B.5 Do designs incorporate energy recycling to the maximum extent practicable?eg use lighting for heat source, steam condensate for heating/pre-heating, used oil for energy recovery, cogeneration, etc.	DOE 6430.1A, 1620-1, 1589-3		
1.B.17 Can surplus government property be used instead of buying new materials? Has a review of the Excess Surplus Property database been conducted to identify useful materials?	Hanford Local Area Network (HLAN), Soft Reporting System, report no. ESP530R "Excess/Surplus Property"		
9.A.3 Can two (or more) paint booths be provided in order to keep hazardous and non-hazardous paint wastes segregated?	(Fredrickson, 1992), (Fromm, et al, 1986)		
10.A.3 Can air hand dryers be used instead of paper towels to reduce paper trash?			
10.B.1 Can shower dividers, toilet partitions, locker room benches vanities, etc. be made from recycled plastics/materials?			
11.A.7 Is it possible to design equipment for disassembly by using like materials to avoid segregation during demolition?	(Kusz, 1991)		
11.A.11 Are solvent tanks located away from heat sources in order to minimize evaporative losses?	(Freeman, 1990, p. 117)		
12.A.4 Can carpet "tiles" be used so that individual tiles can be replaced rather than requiring recarpeting entire offices or hallways?	Boylan, 1993		
13.A.32 Can countercurrent rinsing systems be used to increase rinsing efficiency and therefore decrease the volume of rinsing solution needed?	(Freeman, 1990, p. 114)		
13.D.4 Is space provided in the facility to segregate hazardous and non-hazardous wastes?	(Scher and Munn, 1992)		
15.A.23 Are reusable filters utilized wherever feasible to prevent secondary solid waste generation from filter disposal?	(EPA/WMACs)		

**DATE  
FILMED**

*6 / 27 / 94*

**END**

