

PROCESS TECHNICAL BASIS DOCUMENTATION DIAGRAM FOR A SOLID-WASTE PROCESSING FACILITY

C.J. Benar and C.A. Petersen
Westinghouse Hanford Company
Richland, WA

ABSTRACT

The Process Technical Basis Documentation Diagram is for a solid-waste processing facility that could be designed to treat, package, and certify contact-handled mixed low-level waste for permanent disposal. The treatment processes include stabilization using cementitious materials and immobilization using a polymer material. The Diagram identifies several engineering/demonstration activities that would confirm the process selection and process design.

An independent peer review was conducted at the request of Westinghouse Hanford Company to determine the technical adequacy of the technical approach for waste form development. The peer review panel provided comments and identified documents that it felt were needed in the Diagram as precedence for Title I design.

The Diagram is a visual tool to identify traceable documentation of key activities, including those documents suggested by the peer review, and to show how they relate to each other. The Diagram is divided into three sections: 1) the Facility section, which contains documents pertaining to the facility design, 2) the Process Demonstration section, which contains documents pertaining to the process engineering/demonstration work, and 3) the Regulatory section, which contains documents describing the compliance strategy for each acceptance requirement for each feed type, and how this strategy will be implemented.

INTRODUCTION

The Waste Receiving and Processing (WRAP) Module 2A is a solid-waste processing facility designed to treat, package, and certify contact-handled mixed low-level waste for permanent disposal. The treatment processes selected for use in WRAP 2A consist of stabilization using cementitious materials and immobilization using polymers. The Process Technical Basis Documentation Diagram (Diagram) (Fig. 1) was created as a visual tool to identify key documents that needed to be included for the WRAP 2A project to proceed to Title I design.

A peer review was conducted February 9-11, 1993, at the request of Westinghouse Hanford Company (WHC) to examine the process technical basis. The peer review panel provided comments and identified additional documents that it felt needed to be in place for the WRAP 2A project to proceed into Title I design.

The WRAP 2A Diagram contains several numbered documents, including those suggested by the reviewers. The diagram is divided into three sections. The top section is the Facility section, which contains documents pertaining to the facility design. The middle section is the Process Demonstration section, which contains documents pertaining to the process selection/confirmation work. The third section is the Regulatory section, which contains documents describing the compliance strategy for each acceptance requirement for each feed type and describes how this strategy will be implemented.

WRAP 2A PROCESS TECHNICAL BASIS DOCUMENTATION

This section discusses each document and explains its specific development role for the WRAP 2A project.

WRAP 2A Process Confirmation Plan

The WRAP 2A Project requires a documented, auditable technical basis for the process. The technical basis must support regulatory interaction. A strategy was developed to provide several documents, each containing information that

would serve a specific purpose for the WRAP 2A project. The *WRAP 2A Process Confirmation Plan* (1) identifies the documents and explains their purposes and relationships. The strategy of providing individual documents that pertain to a specific area of the project is to eliminate or minimize overlap in content, which will facilitate maintenance.

WRAP 2A Feed Specification

WRAP 2A will process many different feed types possessing various physical characteristics, chemical constituents, regulatory waste codes, and disposal requirements. In order to proceed with the selection of suitable treatment processes, it is necessary to completely document the feed characterization. This document includes the following items for each feed type:

- Physical description
- Chemical composition
- Hazardous constituents
- *Resource Conservation and Recovery Act of 1976*/U.S. Environmental Protection Agency and Washington State codes of hazardous constituents
- Radionuclide distribution
- Quantity
- Package description
- Source of information.

The feed specification document will define every stream characteristic important to the selection and design of the process, and will represent these parameters in terms of values and envelopes, forming a complete basis for the process design.

WRAP 2A Product Specification

The feed types identified in the feed specification document will enter the WRAP 2A facility to be processed into compliant waste forms for permanent disposal. To ensure the acceptability of each waste form, it is necessary to identify

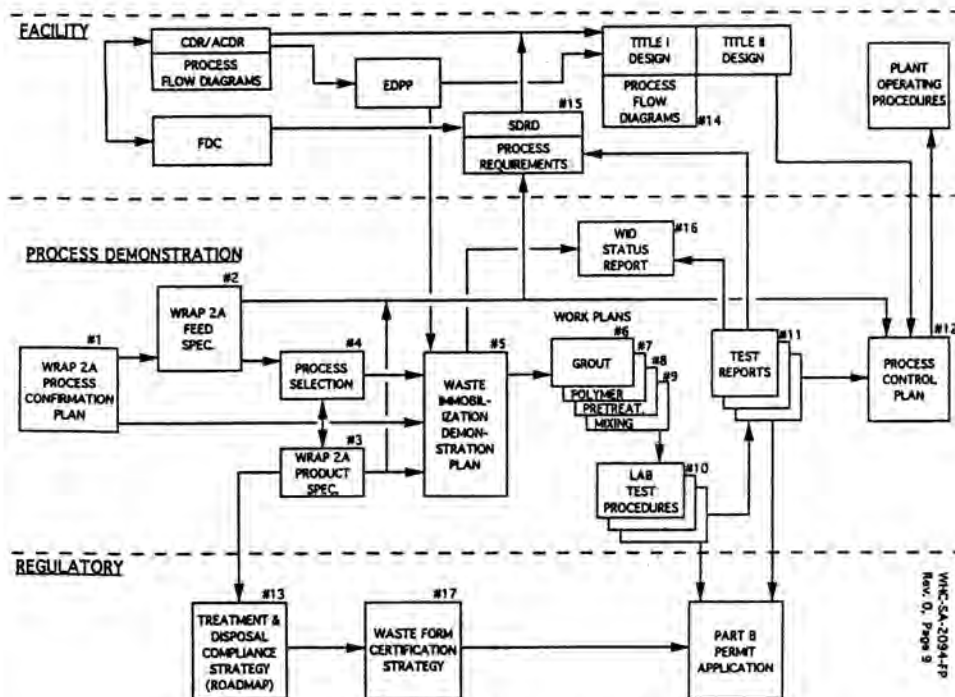


Fig. 1. WRAP 2A process technical basis documentation.

specifications that each waste must meet for disposal. The specification requirements fall into two categories:

- Regulatory [i.e., toxic characteristic leach procedure (TCLP)]
- non-regulatory (i.e., compressive strength).

The WRAP 2A product specification document will identify and describe all performance specifications that each final waste form must meet. This document also identifies the regulatory or non-regulatory requirements from which each specification was derived and explains how test criteria and limits were determined.

WRAP 2A Process Selection

This document summarizes the technical basis for the major processes selected for WRAP 2A, including the following items.

- WRAP 2A feed descriptions
- Treatment standards
- Selection of Stabilization Processes
- Validation of Process Selection.

Waste Immobilization Demonstration Plan

Before proceeding with Title I design of WRAP 2A, the technical basis for the process selection must be confirmed by demonstrating the treatment processes selected in the laboratory. Data also need to be gathered to confirm facility design, support regulatory permitting efforts, and develop baseline process control parameters and operating procedures. This will be accomplished by performing various demonstration and testing activities. The waste immobilization demonstration (WID) plan describes the approach that will be taken to complete these activities. This approach is similar to the one described in *Chemical Fixation and Solidification of Hazardous Wastes* (2).

The WID plan describes the specific demonstration and testing activities required to confirm the process selection and process design and to provide input to the process technical manual. The manual will serve as the technical baseline for all process-related engineering, demonstration, and test work that will be performed in support of WRAP 2A. The following are included in the WID plan:

- Formulation development
- Mixing process development
- Hot demonstration
- Special process demonstration.

Individual work plans corresponding to specific work activities will be written. The laboratories will prepare test procedures for each work activity specified in the work plans. Test reports containing results, analysis, and conclusions also will be written by the laboratories. The WID plan provides input to Title I & II design, the process technical manual, the process flow diagrams, and the process parameters section of the supplemental design requirements document (SDRD).

Cementitious Waste Form Work Plan

Each feed type identified in the WRAP 2A feed specification is subject to a regulatory road map, which is defined in the treatment and disposal compliance strategy document. Feed types that are selected for stabilization using cementitious materials will be subject to WID plan activities described in a cementitious waste form work plan.

The cementitious waste-form testing activities have two objectives. The first is to confirm the WRAP 2A Facility cementitious stabilization process design by producing acceptable cementitious waste forms. These waste forms are deemed acceptable if they meet the non-regulatory product specifications, such as compressive strength, identified in the *WRAP 2A Product Specification* document. The second is to demonstrate the ability to produce waste forms that meet the

regulatory specifications, such as TCLP, which are also identified in the WRAP 2A product specification.

The cementitious waste-form work-plan activities include surrogate preparation, bench-scale surrogate testing, bench-scale waste testing, and drum-scale verification of formulations. The testers will prepare a series of reports to document the results of these tests.

Polymer Waste Form Work Plan

Each feed type identified in the WRAP 2A feed specification is subject to a regulatory road map, which will be defined in a treatment and disposal compliance strategy document. A feed type selected for polymer encapsulation will be subject to the WID plan activities described in the polymer waste form test plan.

The polymer waste-form testing activities have two objectives. The first is to confirm the WRAP 2A facility polymer immobilization process design by producing acceptable polymer waste forms. These waste forms are deemed acceptable if they meet the non-regulatory product specifications identified in the WRAP 2A product specification. The second is to demonstrate the ability to produce waste forms that meet the regulatory requirements, which also will be identified in the WRAP 2A product specification.

The polymer waste-form work plan activities include surrogate preparation, bench-scale surrogate testing, bench-scale waste testing, and drum-scale verification of formulations. The results of these tests will be documented in the test reports.

Pretreatment Equipment Work Plans

WRAP 2A feed types possess a wide variety of physical characteristics resulting in the need for some kind of pretreatment, such as unpackaging, sorting, size reduction, homogenization, and dewatering. This pretreatment will ensure that the physical parameters fall within acceptable ranges for successful processing. Acceptable ranges of each key physical parameter of the feed will be determined during the WID mixing activities.

Work Plans will be written to describe demonstration/engineering activities that will provide sufficient information to select suitable pretreatment equipment. The pretreatment equipment selected should be flexible enough to ensure that the facility designed will be able to process waste with a wide range of physical characteristics. The demonstration must show that the individual pieces of equipment can meet all requirements and can function together to form an efficient operating system. An additional objective is to develop baseline process control parameters and operating procedures.

Mixing Equipment Work Plans

Once the feed types have entered the WRAP 2A Facility, they will pass through the pretreatment equipment, then enter the processing enclosure for binder (cementitious or polymer materials) addition and subsequent mixing. Because the mixing process can have a significant effect on the properties of the final waste form, it is necessary to perform mixing demonstrations. The WID plan activities for the mixing equipment are described in a mixing equipment work plan.

The first objective of the WID plan mixing activities is to confirm the WRAP 2A facility mixing equipment selection. This will be accomplished by producing a full-scale (55-gal) cementitious waste form that meets all applicable product specifications. The second is to gather data to develop base-

line process control parameters and operating procedures. This will involve developing equipment operating ranges and determining key physical parameters of the feed and binder mixture and their ranges.

Laboratory Test Procedures

The work plans will provide the laboratory personnel with the work objectives and descriptions of the specific WID plan activities that must be performed. The laboratories will write detailed test procedures for each work activity.

Test Reports

These are reports prepared by the laboratories to document test results, analyses of results, conclusions, and recommendations.

Process Technical Manual

The process technical manual, to be finalized before hot operation, will be the definitive engineering document describing the plant feed types, process chemistry, process control parameters, process development activities, and process equipment design features.

Treatment and Disposal Compliance Strategy

The treatment and disposal compliance strategy identifies a regulatory road map for each feed type to ensure its permanent disposal.

This document will include the following:

- A list of all waste codes of each feed type and their disposal requirements.
- A list of actions to be taken to determine the most suitable treatment method for each feed type. (This may include sampling the waste for analysis or performing tests to support a treatment variance or treatability studies to evaluate treatment processes.)
- A description of the treatment processes considered for each feed type.
- A description of the final waste form for each feed type, including the regulatory specifications that must be met by each.
- A summary of the test information that verifies the treatment process(s) selected for each feed type.
- An identification of the treatment process selected for each feed type.

Process Flow Diagrams

Data gathered from the WID plan activities will support design efforts by providing input to the process flow diagrams. The flow diagrams will be prepared to develop the process descriptions, features, and parameters needed to provide a complete basis for the design. These flow diagrams will include process flow diagrams (PFDs), process and instrumentation drawings (P&IDs), and mechanical flow diagrams (MFDs), and will be prepared by the architect/engineer.

Process Parameters Section of the Supplemental Design Requirements Document (SDRD)

The Supplemental Design Requirements Document (SDRD) communicates the plant design information from WHC to the U.S. Department of Energy and the cognizant architect/engineer. It is prepared after a project conceptual design report (CDR) is completed and before a definitive

design is initiated. The SDRD provides information for two purposes: to convey design requirements that are too detailed for inclusion in a functional design criteria report and to provide change control for design commitments in the CDR.

Process information obtained during the WID Plan activities will be incorporated into the design efforts by providing input to the SDRD. The Process Parameters Section of the SDRD will provide all requirements and data necessary for the architect/engineer to prepare a complete set of flow diagrams.

WID Status Report

During conceptual design of the WRAP 2A facility, screening tests to confirm the initial baseline waste form selection were performed using two matrices for waste solidification: cementitious materials and polymers. Eight different feed types were tested, which represented about 80 percent of the projected feed to WRAP 2A. Waste surrogates containing major chemical constituents of each feed type were tested to measure the gross compatibility with the immobilization media. Based on the test results, the selection of cementitious materials and polymers as principal processes was confirmed.

The project background, feedstreams overview, and the conceptual design baseline approach are discussed in this report, in addition to the test work and test results. Appendices include various documents containing feed type information, literature search results, review of solidification technologies, and test plans.

Waste Form Certification Strategy

A treatment and disposal compliance strategy document identifies a regulatory road map by which each feed type will be processed into a compliant waste form. To ensure that each waste form produced meets the applicable regulatory specifi-

cations, a certification strategy will be in place for each waste form. The main objective of the waste form certification strategy is to identify what is to be controlled, sampled, and monitored during the process to ensure that each waste form meets the regulatory requirements.

This document identifies the key process operating parameters that must be controlled to produce compliant waste forms. Process parameters and their optimum ranges will be developed during the WID Plan activities, and will be documented in the process technical manual. The Waste Form Certification Strategy also will identify the method of monitoring the key process control parameters. This may include sampling process streams for laboratory analysis, in-line monitoring, or a combination of the two.

REFERENCES

1. *WRAP 2A Process Confirmation Plan*.
2. JESSE R. CONNER, *Chemical Fixation and Solidification of Hazardous Wastes*, Van Nostrand Reinhold, 1990.

LIST OF TERMS

ACDR	advanced conceptual design report
CDR	conceptual design report
EDPP	Engineering Development Program Plan
EPA	U.S. Environmental Protection Agency
MFD	mechanical flow diagram
PFD	process flow diagram
P&ID	process and instrumentation drawing
RCRA	Resource Conservation and Recovery Act of 1976
SDRD	supplemental design requirements document
WIDP	Waste Immobilization Demonstration Plan
WRAP	Waste Receiving and Processing